SET-1

Series HFG1E/1

प्रश्न-पत्र कोड
Q.P. Code **56/1/1**

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे *अधिकतम अंक : 70*

Time allowed : 3 hours *Maximum Marks : 70*

- कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **19** हैं ।
- प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
- कृपया जाँच कर लें कि इस प्रश्न-पत्र में **35** प्रश्न हैं ।
- **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**
- इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।
- Please check that this question paper contains **19** printed pages.
- Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains **35** questions.
- **Please write down the serial number of the question in the answer-book before attempting it.**
- 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

*

General Instructions :

Read the following instructions carefully and strictly follow them :

(i) *This question paper contains **35** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

(iii) *In **Section A** – Questions no. **1** to **18** are multiple choice (MCQ) type questions, carrying **1** mark each.*

(iv) *In **Section B** – Questions no. **19** to **25** very short answer (VSA) type questions, carrying **2** marks each.*

(v) *In **Section C** – Questions no. **26** to **30** are short answer (SA) type questions, carrying **3** marks each.*

(vi) *In **Section D** – Questions no. **31** and **32** are case-based questions carrying **4** marks each.*

(vii) *In **Section E** – Questions no. **33** to **35** are long answer (LA) type questions carrying **5** marks each.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 2 questions in Section E.*

(ix) *Use of calculators is **not** allowed.*

SECTION A

*Questions no. **1** to **18** are Multiple Choice (MCQ) type Questions, carrying **1** mark each.* *18×1=18*

1. The colligative property used for the determination of molar mass of polymers and proteins is :

(a) Osmotic pressure

(b) Depression in freezing point

(c) Relative lowering in vapour pressure

(d) Elevation is boiling point

2. Low concentration of oxygen in the blood and tissues of people living at high altitude is due to :

(a) high atmospheric pressure

(b) low temperature

(c) low atmospheric pressure

(d) both low temperature and high atmospheric pressure

---

3. The correct cell to represent the following reaction is :

$$Zn + 2Ag^+ \longrightarrow Zn^{2+} + 2Ag$$

(a) $2Ag \mid Ag^+ \parallel Zn \mid Zn^{2+}$

(b) $Ag^+ \mid Ag \parallel Zn^{2+} \mid Zn$

(c) $Ag \mid Ag^+ \parallel Zn \mid Zn^{2+}$

(d) $Zn \mid Zn^{2+} \parallel Ag^+ \mid Ag$

4. ΔG and E°_{cell} for a spontaneous reaction will be :

(a) positive, negative (b) negative, negative

(c) negative, positive (d) positive, positive

5. Which of the following is affected by catalyst ?

(a) ΔH (b) ΔG

(c) E_a (d) ΔS

6. The order of the reaction

$$H_2 (g) + Cl_2 (g) \xrightarrow{h\nu} 2HCl (g) \text{ is :}$$

(a) 2 (b) 1

(c) 0 (d) 3

7. The most common and stable oxidation state of a Lanthanoid is :

(a) + 2 (b) + 3

(c) + 4 (d) + 6

8. The compounds $[Co(SO_4) (NH_3)_5] Br$ and $[Co(Br) (NH_3)_5] SO_4$ represent :

(a) optical isomerism (b) linkage isomerism

(c) ionisation isomerism (d) coordination isomerism

9. The synthesis of alkyl fluoride is best obtained from :

(a) Free radicals (b) Swartz reaction

(c) Sandmeyer reaction (d) Finkelstein reaction

10. In the reaction $R - OH + HCl \xrightarrow{ZnCl_2} RCl + H_2O$, what is the correct order of reactivity of alcohol ?

(a) $1^\circ < 2^\circ < 3^\circ$ (b) $1^\circ > 3^\circ > 2^\circ$

(c) $1^\circ > 2^\circ > 3^\circ$ (d) $3^\circ > 1^\circ > 2^\circ$

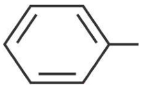
11. CH_3CONH_2 on reaction with NaOH and Br_2 in alcoholic medium gives :

(a) CH_3COONa (b) CH_3NH_2

(c) CH_3CH_2Br (d) $CH_3CH_2NH_2$

12. Which of the following is least basic ?

(a) $(CH_3)_2NH$ (b) NH_3

(c)  NH_2 (d) $(CH_3)_3N$

13. The glycosidic linkage involved in linking the glucose units in amylase part of starch is :

(a) $C_1 - C_6$ α linkage (b) $C_1 - C_6$ β linkage

(c) $C_1 - C_4$ α linkage (d) $C_1 - C_4$ β linkage

14. An α-helix is a structural feature of :

(a) Sucrose (b) Starch

(c) Polypeptides (d) Nucleotides

For Questions number 15 to 18, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

15. *Assertion (A) :* —NH_2 group is *o*- and *p*-directing in electrophilic substitution reactions.

Reason (R) : Aniline cannot undergo Friedel-Crafts reaction.

16. *Assertion (A) :* Acetylation of aniline gives a monosubstituted product.

Reason (R) : Activating effect of $-NHCOCH_3$ group is more than that of amino group.

17. *Assertion (A) :* The molecularity of the reaction $H_2 + Br_2 \longrightarrow 2HBr$ appears to be 2.

Reason (R) : Two molecules of the reactants are involved in the given elementary reaction.

18. *Assertion (A) :* Low spin tetrahedral complexes are rarely observed.

Reason (R) : Crystal field splitting energy is less than pairing energy for tetrahedral complexes.

SECTION B

19. What is Henry's law ? Give one application of it. *2*

20. (a) On diluting two electrolytes 'A' and 'B', the $\wedge_m$ of 'A' increases 25 times while that of 'B' increases by 1·5 times. Which of the two electrolytes is strong ? Justify your answer graphically. *2*

OR

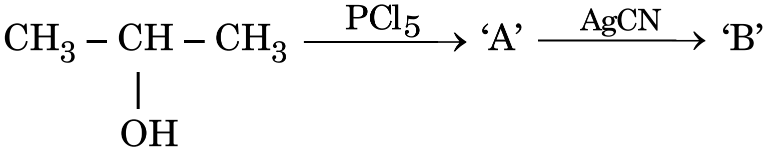
(b) The electrical resistance of a column of 0·05 mol L^{-1} NaOH solution of diameter 1 cm and length 50 cm is $5{\cdot}55 \times 10^3$ ohm. Calculate the conductivity. *2*

21. Complete the following equations : *1+1=2*

(a) $2MnO_4^- + 5NO_2^- + 6H^+ \longrightarrow$

(b) $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow$

22. (a)



$$CH_3-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow{PCl_5} \text{'A'} \xrightarrow{AgCN} \text{'B'}$$

(b) $CH_3CH_2CH_2Cl + KOH \xrightarrow{\text{ethanol}} \text{'A'} \xrightarrow{HBr} \text{'B'}$

Identify 'A' and 'B' in the above reactions. *1+1=2*

---

23. (a) Account for the following : *1+1=2*

(i) Phenol is a stronger acid than an alcohol.

(ii) The boiling point of alcohols decreases with increase in branching of alkyl chain.

OR

(b) (i) Write the mechanism of the following reaction :

$$CH_3CH_2OH \xrightarrow[443\ K]{H^+} CH_2 = CH_2 + H_2O$$

(ii) Write the equation involved in Reimer-Tiemann reaction. *1+1=2*

24. Explain briefly : *1+1=2*

(a) Carbylamine reaction

(b) Gabriel phthalimide synthesis

25. (a) Write chemical reaction to show that open structure of D-glucose contains the straight chain.

(b) What type of linkage is responsible for the formation of protein ? *2*

SECTION C

26. (a) Differentiate between Ideal solution and Non-ideal solution.

(b) 30 g of urea is dissolved in 846 g of water. Calculate the vapour pressure of water for this solution if vapour pressure of pure water at 298 K is 23·8 mm Hg. *3*

27. Write main product formed when : *3×1=3*

(a) Methyl chloride is treated with NaI/Acetone.

(b) 2,4,6-trinitrochlorobenzene is subjected to hydrolysis.

(c) n-Butyl chloride is treated with alcoholic KOH.

28. How do you convert the following : (Any ***three***) *3×1=3*

(a) Phenol to picric acid

(b) Propanone to 2-Methylpropan-2-ol

(c) Phenol to anisole

(d) Propene to Propan-1-ol

---

29. (a) Explain why : *3×1=3*

(i) Carboxyl group in benzoic acid is meta directing.

(ii) Sodium bisulphite is used for the purification of aldehydes and ketones.

(iii) Carboxylic acids do not give characteristic reactions of carbonyl group.

OR

(b) An organic compound 'A', having the molecular formula C_3H_8O on treatment with Cu at 573 K, gives 'B'. 'B' does not reduce Fehling's solution but gives a yellow precipitate of the compound 'C' with I_2/NaOH. Deduce the structures of A, B and C. *3*

30. (a) What are the hydrolysis products of (i) Lactose, (ii) Maltose ?

(b) Give the basic structural difference between starch and cellulose. *2+1=3*

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

31. The rate of reaction is concerned with decrease in concentration of reactants or increase in the concentration of products per unit time. It can be expressed as instantaneous rate at a particular instant of time and average rate over a large interval of time. Mathematical representation of rate of reaction is given by rate law. Rate constant and order of a reaction can be determined from rate law or its integrated rate equation.

(i) What is average rate of reaction ? *1*

(ii) Write two factors that affect the rate of reaction. *1*

(iii) (1) What happens to rate of reaction for zero order reaction ?

(2) What is the unit of k for zero order reaction ? *2×1=2*

OR

(iii) (1) For a reaction $P + 2Q \longrightarrow$ Products
Rate = $k[P]^{1/2}\ [Q]^1$. What is the order of the reaction ?

(2) Define pseudo first order reaction with an example. *2×1=2*

32. In coordination compounds, metals show two types of linkages, primary and secondary. Primary valencies are ionisable and are satisfied by negatively charged ions. Secondary valencies are non-ionisable and are satisfied by neutral or negative ions having lone pair of electrons. Primary valencies are non-directional while secondary valencies decide the shape of the complexes.

(i) If $PtCl_2 \cdot 2NH_3$ does not react with $AgNO_3$, what will be its formula ? *1*

(ii) What is the secondary valency of $[Co(en)_3]^{3+}$? *1*

(iii) (1) Write the formula of Iron(III)hexacyanidoferrate(II).

(2) Write the IUPAC name of $[Co(NH_3)_5Cl]\ Cl_2$. *2×1=2*

OR

(iii) Write the hybridization and magnetic behaviour of $[Ni(CN)_4]^{2-}$. *2*
[Atomic number : Ni = 28]

SECTION E

33. (a) (i) State Kohlrausch's law of independent migration of ions. Write an expression for the limiting molar conductivity of acetic acid according to Kohlrausch's law.

(ii) Calculate the maximum work and log K_c for the given reaction at 298 K :

$$\text{Ni (s)} + 2\text{Ag}^+ \text{(aq)} \rightleftharpoons \text{Ni}^{2+} \text{(aq)} + 2\text{Ag (s)}$$

Given : $E^\circ_{Ni^{2+}/Ni} = -0{\cdot}25$ V, $E^\circ_{Ag^+/Ag} = +0{\cdot}80$ V

$1\ F = 96500\ C\ mol^{-1}$ *2+3=5*

OR

(b) (i) State Faraday's first law of electrolysis. How much charge, in terms of Faraday, is required for the reduction of 1 mol Cu^{2+} to Cu ?

(ii) Calculate emf of the following cell at 298 K for

$Mg (s) \mid Mg^{2+} (0{\cdot}1\ M) \parallel Cu^{2+} (0{\cdot}01\ M) \mid Cu (s)$

$[E^\circ_{cell} = +2{\cdot}71\ V,\ \ 1\ F = 96500\ C\ mol^{-1},\ \ \log 10 = 1]$ *2+3=5*

34. Assign reason for each of the following : *5×1=5*

(i) Manganese exhibits the highest oxidation state of +7 among the 3d series of transition elements.

(ii) Transition metals and their compounds are generally found to be good catalysts in chemical reactions.

(iii) Cr^{2+} is reducing in nature while with the same d-orbital configuration (d^4) Mn^{3+} is an oxidising agent.

(iv) Zn has lowest enthalpy of atomization.

(v) Cu^+ is unstable in an aqueous solution.

35. (a) (i) Carry out the following conversions :

(1) Ethanal to But-2-en-1-al

(2) Propanoic acid to 2-chloropropanoic acid

(ii) An alkene with molecular formula C_5H_{10} on ozonolysis gives a mixture of two compounds 'B' and 'C'. Compound 'B' gives positive Fehling test and also reacts with iodine and NaOH solution. Compound 'C' does not give Fehling solution test but forms iodoform. Identify the compounds 'A', 'B' and 'C'. *2+3=5*

OR

(b) (i) Distinguish with a suitable chemical test :

(1) $CH_3COCH_2CH_3$ and $CH_3CH_2CH_2CHO$

(2) Ethanal and Ethanoic acid

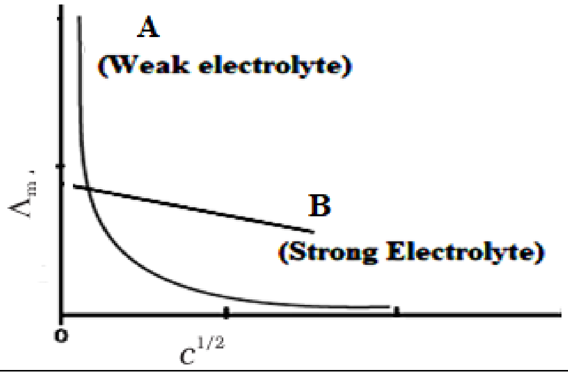
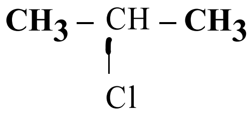
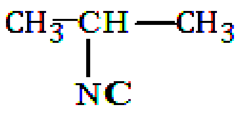
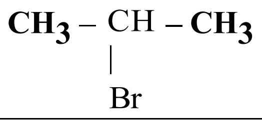
(ii) Write the structure of oxime of acetone.

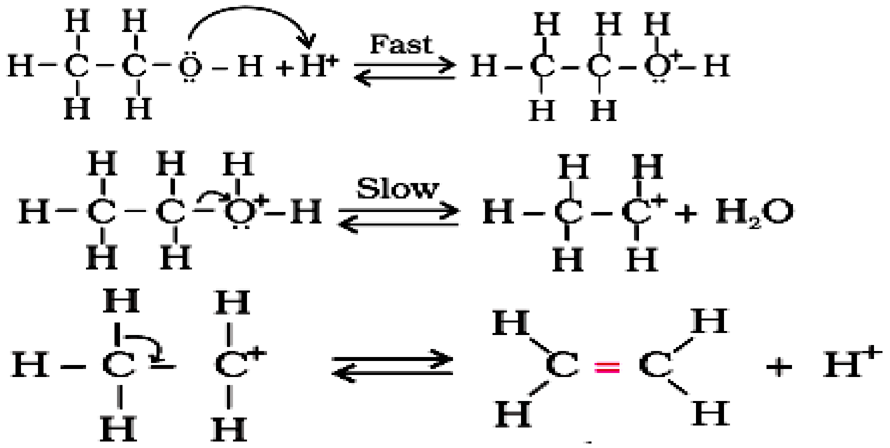
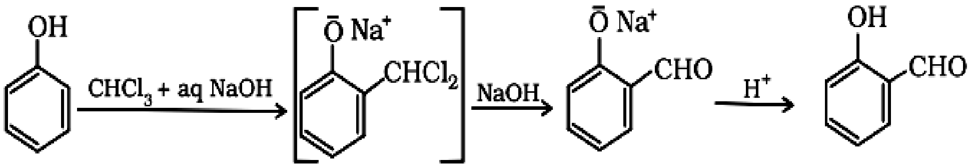
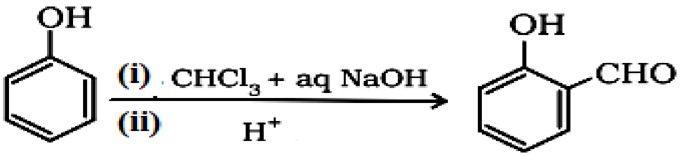
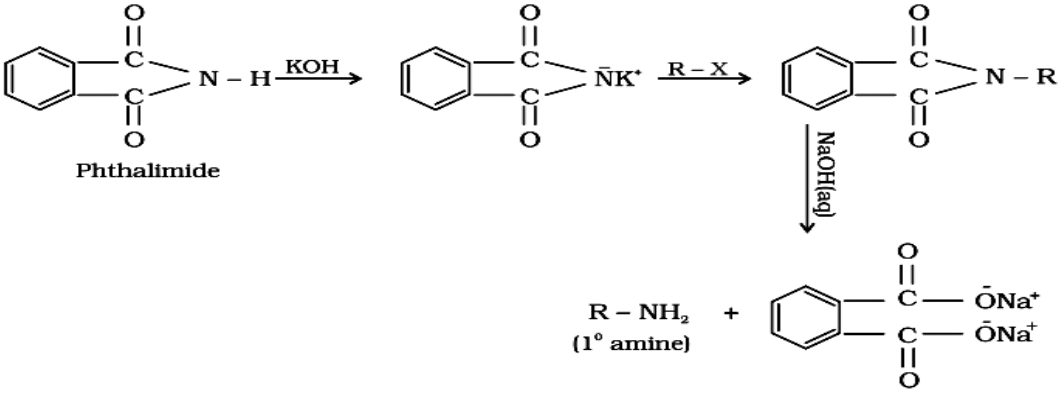
(iii) Identify A to D. *2+1+2=5*

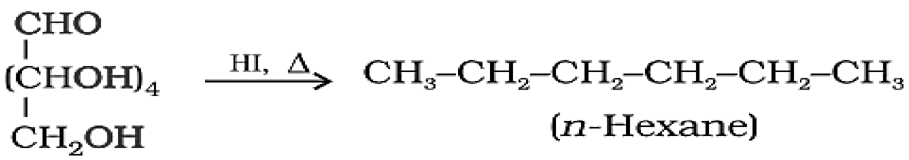
$$\begin{tikzcd}
CH_3COOH \arrow[r, "PCl_5"] & A \arrow[r, "H_2/Pd-BaSO_4"] & B \arrow[r, "(i)\,CH_3/MgBr", "(ii)\,H_3O^+"'] \arrow[d, "LiAlH_4"] & C \\
& & D &
\end{tikzcd}$$

MARKING SCHEME
Senior Secondary School Examination, 2023
CHEMISTRY (Subject Code–043)
[Paper Code: 56/1/1]

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION-A	
1.	(a)	1
2.	(c)	1
3.	(d)	1
4.	(c)	1
5.	(c)	1
6.	(c) / Full mark to be awarded for any option	1
7.	(b)	1
8.	(c)	1
9.	(b)	1
10.	(a)	1
11.	(b)	1
12.	(c)	1
13.	(c) / Award full mark if attempted (Printing error)	1
14.	(c)	1
15.	(b)	1
16.	(c)	1
17.	(a)	1
18.	(a)	1
	SECTION- B	
19.	Henry's law states that the partial vapour pressure of a gas is directly proportional to the mole fraction of the gas in the solution / $p = K_H x$ where p = partial pressure of gas, x = mole fraction in solution, and k_H is Henry's constant. **Application**: To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure / to minimize the painful effects accompanying the	1

<table>
<tr><td></td><td>decompression of deep-sea divers (bends). Oxygen diluted with less soluble helium gas is used for breathing / At higher altitudes, low blood oxygen causes climbers to become weak and unable to think clearly (anoxia). (Any one)
(or any other correct application)</td><td>1</td></tr>
<tr><td>20.</td><td>‘B’ is a strong electrolyte.

</td><td>1
1</td></tr>
<tr><td></td><td>OR
$A = \pi r^2 = 3{\cdot}14 \times (0{\cdot}5)^2 = 0{\cdot}785\ cm^2\ ,\ \ \ell = 50\ cm$
$k = \frac{\ell}{R \times A}$
$= \frac{50}{0{\cdot}785\ X\ (5.55\ X\ 10^3)}$
$= \mathbf{11{\cdot}47\ X\ 10^{-3}}\ S\ cm^{-1}$
(or by any other correct method)</td><td>½
1
½</td></tr>
<tr><td>21.</td><td>(a) $2\,MnO_4^- + 5\,NO_2^- + 6\,H^+ \longrightarrow 2\,Mn^{2+} + 5\,NO_3^- + 3\,H_2O$
(b) $Cr_2O_7^{2-} + 14\,H^+ + 6\,e^- \longrightarrow 2\,Cr^{3+} + 7\,H_2O$</td><td>1
1</td></tr>
<tr><td>22.</td><td>(a) A =  $CH_3-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_3$ / 2-Chloropropane
B =  $CH_3-\underset{\displaystyle NC}{\underset{|}{CH}}-CH_3$ / Isopropyl isocyanide / Propan-2-isonitrile
(b) A = $CH_3-CH=CH_2$ / Propene
B =  $CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3$ / 2-Bromopropane</td><td>½ x 4</td></tr>
<tr><td>23.</td><td>(a)
(i) Because phenoxide ion is more stable due to resonance than alkoxide ion.
(or any other correct explanation)
(ii) Because branching decreases the surface area / the van der Waals force decreases with a decrease in surface area.</td><td>1
1</td></tr>
<tr><td></td><td>OR</td><td></td></tr>
</table>

	(b) (i)  (For any two correct steps)	½ + ½
	(ii)  / 	1
24.	(a) Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamines which are foul-smelling substances. / $R{-}NH_2 + CHCl_3 + 3KOH \xrightarrow{Heat} R{-}NC + 3KCl + 3H_2O$ Isocyanide with an offensive smell is formed. (Explanation or reaction)	1
	(b) Phthalimide on treatment with ethanolic potassium hydroxide forms potassium salt of phthalimide which on heating with alkyl halide followed by alkaline hydrolysis produces the corresponding primary amine /  (Explanation or reaction)	1

<table>
<tr><td>25.</td><td>(a)


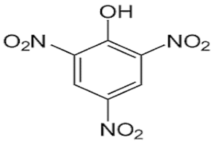
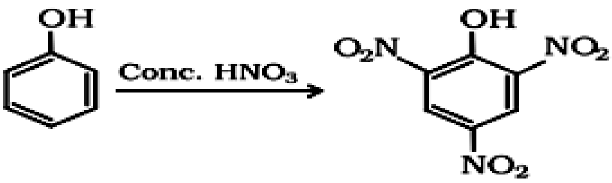
$$\begin{matrix} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{matrix} \xrightarrow{HI,\ \Delta} CH_3{-}CH_2{-}CH_2{-}CH_2{-}CH_2{-}CH_3$$

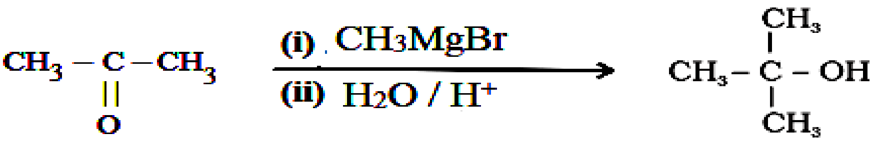
(*n*-Hexane)
(b) Peptide linkage</td><td>1
1</td></tr>
<tr><td></td><td>SECTION-C</td><td></td></tr>
<tr><td>26.</td><td>(a)
<table>
<tr><th>Ideal Solution</th><th>Non-ideal solution</th></tr>
<tr><td>The solution obeys Raoult’s law at all concentrations.</td><td>The solution does not obey Raoult’s law.</td></tr>
<tr><td>$\Delta V_{mixing} = 0$ and $\Delta H_{mixing} = 0$</td><td>$\Delta V_{mixing} \neq 0$ and $\Delta H_{mixing} \neq 0$.
(Any one)</td></tr>
</table>
(or any other correct difference)

(b) $$\frac{P_A^o - P_A}{P_A^o} = \frac{\frac{W_B}{M_B}}{\frac{W_B}{M_B} + \frac{W_A}{M_A}}$$

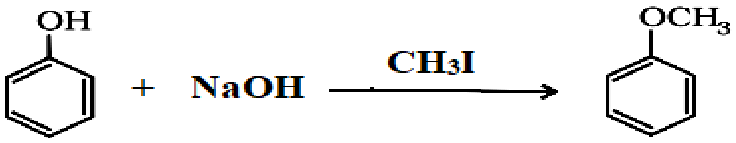
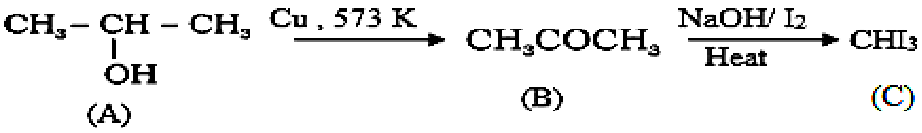
$$1 - \frac{P_A}{23{\cdot}8} = \frac{\frac{30}{60}}{\frac{846}{18}} \quad \text{or} \quad 1 - \frac{P_A}{23{\cdot}8} = \frac{\frac{30}{60}}{\frac{846}{18} + \frac{30}{60}}$$

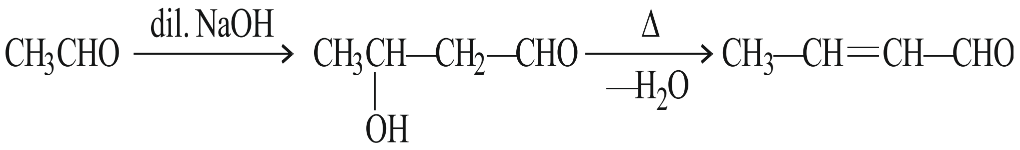
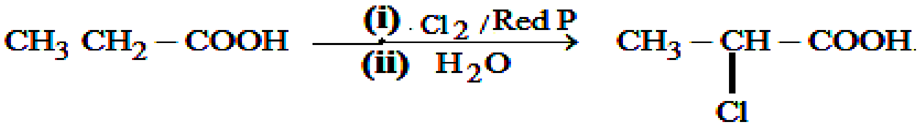
$$P_A = \frac{46.5}{47} \times 23{\cdot}8 = 23{\cdot}5 \text{ mm Hg} \quad \text{or} \quad P_A = \frac{47}{47.5} \times 23{\cdot}8 = 23{\cdot}5 \text{ mm Hg}$$

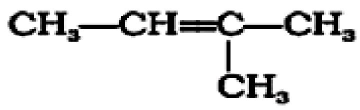
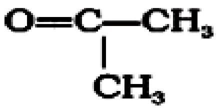
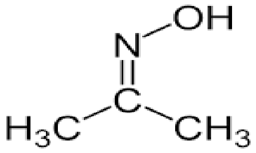
(Full marks may be awarded if the student substitutes M_B for molar mass as the molar mass of urea is not given in the question).</td><td>1
½
1
½</td></tr>
<tr><td>27.</td><td>(a) CH_3I / Iodomethane / Methyl iodide
(b)

/ Picric acid / 2,4,6-Trinitrophenol / 2,4,6-Trinitrobenzenol
(c) $CH_3CH_2CH{=}CH_2$ / But-1-ene</td><td>1 x 3</td></tr>
<tr><td>28.</td><td>(a)


(b)


$$CH_3-\underset{\underset{O}{||}}{C}-CH_3 \xrightarrow[\text{(ii) } H_2O\ /\ H^+]{\text{(i) } CH_3MgBr} CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-OH$$</td><td>1 x 3</td></tr>
</table>

	(c)  (d) $CH_3-CH=CH_2 \xrightarrow[(ii)\ NaOH\text{-}H_2O_2]{(i)\ (H-BH_2)_2} CH_3-CH_2-CH_2-OH$ (or by any other correct method)	
29.	(a) (i) Because it is an electron-withdrawing group / deactivating group / -R effect , electrophilic substitution takes place at the m-position. (ii) Because aldehydes & ketones form addition compound with $NaHSO_3$ which on hydrolysis forms pure aldehydes & ketones. (iii) Due to resonance, carboxylic carbon becomes less electrophilic.	1 x 3
	OR (b)  (or explanation with correct structures of A, B, and C)	1 x 3
30.	(a) (i) Glucose and Galactose (ii) Glucose and Glucose (b) Starch is a polymer of α-glucose while cellulose is a polymer of β-glucose (or any other correct structural difference)	1+1 1
	SECTION-D	
31.	(i) Change in the concentration of a reactant or product per unit time. (ii) Concentration of reactants, Surface area, catalyst and temperature (any two). (iii) (1) rate is independent of the concentration of reactant(s) /rate remains constant / rate = k (2) mol L^{-1} s^{-1} **OR** (iii) (1) 3/2 / 1.5 (2) A reaction that appears to be of higher order but follows first-order kinetics. Example: Hydrolysis of an ester (or any other correct example)	1 1 1+1 1 ½ , ½
32.	(i) $[Pt(NH_3)_2Cl_2]$ (ii) 6 (iii) (1) $Fe_4[Fe(CN)_6]_3$ (2) Pentamminechloridocobalt(III) chloride. **OR** (iii) dsp^2, diamagnetic	1 1 1,1 1,1
	SECTION-E	
33.	(a) (i) Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte. $\Lambda^{\circ}_m\ (CH_3COOH) = \lambda^{\circ}_{CH_3COO^-} + \lambda^{\circ}_{H^+}$	1 1

	(ii) $\Delta_r G^\circ = -\,nF\,E^\circ_{cell}$	
	Maximum work $= -\,\Delta_r G^\circ = nF\,E^\circ_{cell}$	½
	$= 2 \times 96500\ C\ mol^{-1} \times (0{\cdot}80 + 0{\cdot}25)\ V$	½
	$= 2 \times 96500 \times 1{\cdot}05\ J\ mol^{-1}$ $= 202{,}650\ J\ mol^{-1}$ or $202{\cdot}65\ kJ\ mol^{-1}$	1
	$\log K_c = \dfrac{nE^\circ_{cell}}{0{\cdot}059}$	½
	$= \dfrac{2 \times 1{\cdot}05}{0{\cdot}059} = 35{\cdot}6$	½
	OR	
	(b) (i) It states that the mass of a substance deposited /liberated at the electrodes is directly proportional to the charge/quantity of electricity passed through the electrolyte.	1
	2F charge is required.	1
	(ii) $E_{cell} = E^\circ_{cell} - \dfrac{0{\cdot}0591}{2} \log \dfrac{[Mg^{2+}]}{[Cu^{2+}]}$	1
	$= 2{\cdot}71\ V - \dfrac{0{\cdot}0591}{2} \log \dfrac{0{\cdot}1}{0{\cdot}01}$ $= 2{\cdot}71\ V - \dfrac{0{\cdot}0591}{2} \log 10$	1
	$= 2{\cdot}71\ V - 0{\cdot}0295$ $= 2{\cdot}68\ V.$ (Deduct ½ mark for no or incorrect unit)	1
34.	(i) Due to the participation of all 3d and 4s electrons in bond formation /due to the presence of maximum number of unpaired electrons.	1
	(ii) Due to variable oxidation state / due to the ability to adopt multiple oxidation states / due to the large surface area / due to complex formation.	1
	(iii) Cr^{2+} changes from d^4 to stable half-filled t_{2g}^3 configuration while Mn^{3+} changes to stable half-filled d^5 configuration.	1
	(iv) Due to the absence of unpaired electrons and weak interatomic interactions.	1
	(v) Cu^+ ion (aq.) undergoes disproportionation to Cu^{2+} (aq.) and Cu / $2\,Cu^+\,(aq.) \longrightarrow Cu^{2+}\,(aq.) + Cu\,(s)$	1
35.	(a) (i) (1)  $CH_3CHO \xrightarrow{\text{dil. NaOH}} CH_3\underset{\underset{\displaystyle OH}{\vert}}{CH}-CH_2-CHO \xrightarrow[-H_2O]{\Delta} CH_3-CH{=}CH-CHO$	1
	(2)  $CH_3\,CH_2-COOH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } Cl_2\,/\text{Red P}} CH_3-\underset{\underset{\displaystyle Cl}{\vert}}{CH}-COOH$	1

	(ii) **A** =  $CH_3-CH=C(CH_3)-CH_3$ / **2-Methylbut-2-ene** **B** = H_3C-CHO / **Ethanal** / **Acetaldehyde** **C** =  $O=C(CH_3)-CH_3$ / **Propanone** / **Acetone**	1 x 3
	OR	
	(b) (i) (1) Add Iodine (I_2), NaOH, and heat both the test tubes containing the given organic compounds. Butanone gives yellow precipitate (CHI_3) while butanal will not give the positive iodoform test.	1
	(2) Add $NaHCO_3$ in both the test tube containing the given organic compounds. Ethanoic acid will give brisk effervescence of CO_2 and ethanal will not. (or any other suitable chemical test)	1
	(ii) 	1
	(iii) A = **CH_3COCl**, B = **CH_3CHO**, C = **$(CH_3)_2CH(OH)$**, D = **CH_3CH_2OH**	½ x 4

* * *

SET-1

Series HFG1E/2

प्रश्न-पत्र कोड
Q.P. Code 56/2/1

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

रसायन विज्ञान (सैद्धांतिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे *अधिकतम अंक : 70*
Time allowed : 3 hours *Maximum Marks : 70*

- कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।
- प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
- कृपया जाँच कर लें कि इस प्रश्न-पत्र में **35** प्रश्न हैं ।
- **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**
- इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

- Please check that this question paper contains **23** printed pages.
- Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains **35** questions.
- **Please write down the serial number of the question in the answer-book before attempting it.**
- 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

General Instructions :

Read the following instructions very carefully and follow them :

(i) *This Question Paper contains* ***35*** *questions.* ***All*** *questions are compulsory.*

(ii) *Question Paper is divided into* ***FIVE*** *sections – Section* ***A, B, C, D*** *and* ***E****.*

(iii) ***In section A*** *– question number* ***1*** *to* ***18*** *are Multiple Choice (MCQ) type questions carrying* ***1*** *mark each.*

(iv) ***In section B*** *– question number* ***19*** *to* ***25*** *are Very Short Answer (VSA) type questions carrying* ***2*** *marks each.*

(v) ***In section C*** *– question number* ***26*** *to* ***30*** *are Short Answer (SA) type questions carrying* ***3*** *marks each.*

(vi) ***In section D*** *– question number* ***31*** *&* ***32*** *are case-based questions carrying* ***4*** *marks each.*

(vii) ***In section E*** *– question number* ***33*** *to* ***35*** *are Long Answer (LA) questions carrying* ***5*** *marks each.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section* ***B****, 2 questions in Section* ***C****, 2 questions in Section* ***D*** *and 2 questions in Section* ***E****.*

(ix) *Use of calculator is NOT allowed.*

SECTION – A

1. The conversion of an alkyl halide into an alkene by alcoholic KOH is classified as **1**

(a) a substitution reaction

(b) an addition reaction

(c) a dehydrohalogenation reaction

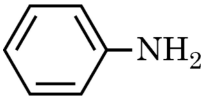
(d) a dehydration reaction

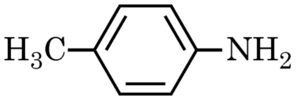
2. The oxidation state of Fe in $[Fe(CO)_5]$ is **1**

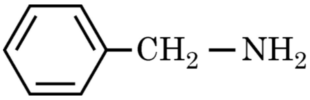
(a) + 2 (b) 0

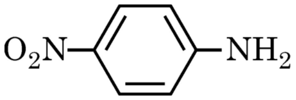
(c) + 3 (d) + 5

3. Among the following, which is the strongest base ? **1**

(a) 

(b) 

(c) 

(d) 

4. The slope in the plot of $ln[R]$ vs. time for a first order reaction is **1**

(a) $\frac{+k}{2.303}$ (b) $-k$

(c) $\frac{-k}{2.303}$ (d) $+k$

5. An α-helix is a structural feature of **1**

(a) Sucrose (b) Polypeptides

(c) Nucleotides (d) Starch

6. Racemisation occurs in **1**

(a) S_N1 reaction

(b) S_N2 reaction

(c) Neither S_N1 nor S_N2 reaction

(d) S_N2 reaction as well as S_N1 reaction

7. Value of Henry's constant K_H : **1**

(a) increases with decrease in temperature.

(b) decreases with increase in temperature.

(c) increases with increase in temperature.

(d) remains constant.

8. Which of the following solutions of KCl will have the highest value of molar conductivity ? **1**

(a) 0.01 M	(b) 1 M
(c) 0.5 M	(d) 0.1 M

9. Which of the following reactions are feasible ? **1**

(a) $CH_3CH_2Br + Na^+ \, O^-C(CH_3)_3 \rightarrow CH_3CH_2\text{–}O - C\,(CH_3)_3$

(b) $(CH_3)_3\,C - Cl + Na^+ \, O^- \, CH_2CH_3 \rightarrow CH_3CH_2 - O - C(CH_3)_3$

(c) Both (a) and (b)

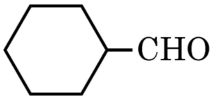
(d) Neither (a) nor (b)

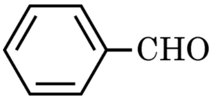
10. Which of the following is most reactive in nucleophilic addition reactions ? **1**

(a) HCHO	(b) CH_3CHO
(c) CH_3COCH_3	(d) $CH_3COC_2H_5$

11. Which of the following does not give aldol condensation reaction ? **1**

(a) $CH_3–CHO$

(b) 

(c) 

(d) CH_3COCH_3

12. For the reaction 3A → 2B, rate of reaction $+\frac{d[B]}{dt}$ is equal to **1**

(a) $\frac{-3}{2}\frac{d[A]}{dt}$

(b) $\frac{-2}{3}\frac{d[A]}{dt}$

(c) $\frac{-1}{3}\frac{d[A]}{dt}$

(d) $+\frac{2d[A]}{dt}$

13. Which of the following characteristics of transition metals is associated with their catalytic activity ? **1**

(a) Paramagnetic nature

(b) Colour of hydrated ions

(c) High enthalpy of atomisation

(d) Variable oxidation states

14. The formula of the complex dichloridobis (ethane –1, 2-diamine) platinum (IV) nitrate is **1**

(a) $[Pt\ Cl_2(en)_2\ (NO_3)_2]$

(b) $[Pt\ Cl_2(en)_2]\ (NO_3)_2$

(c) $[Pt\ Cl_2(en)_2\ (NO_3)]NO_3$

(d) $[Pt\ (en)_2\ (NO_3)_2]Cl_2$

Given below are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below :

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

(c) (A) is true, but (R) is false.

(d) (A) is false, but (R) is true.

15. **Assertion (A) :** Osmotic pressure is a colligative property.

Reason (R) : Osmotic pressure is proportional to the molality. **1**

16. **Assertion (A) :** Conductivity decreases with decrease in concentration of electrolyte. **1**

Reason (R) : Number of ions per unit volume that carry the current in a solution decreases on dilution.

17. **Assertion (A) :** Copper is a non-transition element. **1**

Reason (R) : Copper has completely filled d-orbitals in its ground state.

18. **Assertion (A) :** Nucleophilic substitution of iodoethane is easier than chloroethane. **1**

Reason (R) : Bond enthalpy of C-I bond is less than that of C-C*l* bond.

SECTION – B

19. The vapour pressure of pure liquid X and pure liquid Y at 25 °C are 120 mm Hg and 160 mm Hg respectively. If equal moles of X and Y are mixed to form an ideal solution, calculate the vapour pressure of the solution. **2**

20. (a) Give reasons : **2 × 1**

(i) Mercury cell delivers a constant potential during its life time.

(ii) In the experimental determination of electrolytic conductance, Direct Current (DC) is not used.

OR

(b) Define fuel cell with an example. What advantages do the fuel cells have over primary and secondary batteries ? **2**

21. (a) The conversion of molecule A to B followed second order kinetics. If concentration of A increased to three times, how will it affect the rate of formation of B ? **2 × 1**

(b) Define Pseudo first order reaction with an example.

22. (a) Write the IUPAC names of the following : **2 × 1**

(i) $[Co(NH_3)_5(ONO)]^{2+}$

(ii) $K_2[NiCl_4]$

OR

(b) (i) What is a chelate complex ? Give one example.

(ii) What are heteroleptic complexes ? Give one example. **2 × 1**

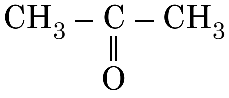
23. Write the chemical equation involved in the following reactions : **2 × 1**

(a) Reimer-Tiemann reaction

(b) Acetylation of Salicylic acid

24. Do the following conversions in not more than two steps : **2 × 1**

(a) CH_3CN to



$CH_3-\underset{\underset{O}{\|}}{C}-CH_3$

(b)

25. Write two differences between DNA and RNA. **1 × 2**

SECTION – C

26\. (a) (i) Write the mechanism of the following reaction : **2 + 1**

$$2CH_3CH_2OH \xrightarrow[413\ K]{H^+} CH_3 - CH_2 - O - CH_2 - CH_3 + H_2O$$

(ii) Why ortho-nitrophenol is steam volatile while para-nitrophenol is not ?

OR

(b) What happens when

(i) Anisole is treated with CH_3Cl/anhydrous $AlCl_3$? **3 × 1**

(ii) Phenol is oxidised with $Na_2Cr_2O_7/H^+$?

(iii) $(CH_3)_3\ C - OH$ is heated with Cu/573 K ?

Write chemical equation in support of your answer.

27\. Answer any **3** of the following : **3 × 1**

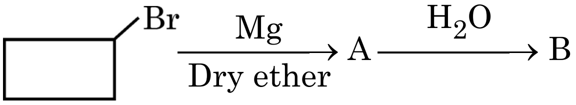
(a) Which isomer of C_5H_{10} gives a single monochloro compound C_5H_9Cl in bright sunlight ?

(b) Arrange the following compounds in increasing order of reactivity towards S_N2 reaction :

2-Bromopentane, 1-Bromopentane, 2-Bromo-2-methylbutane

(c) Why p-dichlorobenzene has higher melting point than those of ortho- and meta-isomers ?

(d) Identify A and B in the following :



28\. A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy (E_a) for the reaction. [$R = 8.314\ J\ K^{-1}\ mol^{-1}$] **3**

[Given : log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021]

29. When 19.5 g of $F - CH_2 - COOH$ (Molar mass = 78 g mol^{-1}), is dissolved in 500 g of water, the depression in freezing point is observed to be 1°C. Calculate the degree of dissociation of $F - CH_2 - COOH$.

[Given : K_f for water = 1.86 K kg mol^{-1}] **3**

30. (a) Draw the geometrical isomers of $[Co(en)_2Cl_2]^{2+}$. Which geometrical isomer of $[Co(en)_2Cl_2]^{2+}$ is not optically active and why ? **2 + 1**

(b) Write the hybridisation and magnetic behaviour of $[CoF_6]^{3-}$.

[Given : Atomic number of Co = 27]

SECTION – D

The following questions are case based questions. Read the passage carefully and answer the questions that follow :

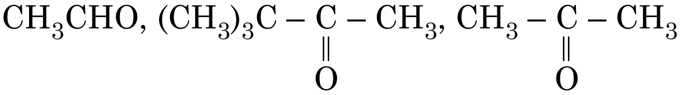
31. The carbon – oxygen double bond is polarised in aldehydes and ketones due to higher electronegativity of oxygen relative to carbon. Therefore they undergo nucleophilic addition reactions with a number of nucleophiles such as HCN, $NaHSO_3$, alcohols, ammonia derivatives and Grignard reagents. Aldehydes are easily oxidised by mild oxidising agents as compared to ketones. The carbonyl group of carboxylic acid does not give reactions of aldehydes and ketones. Carboxylic acids are considerably more acidic than alcohols and most of simple phenols.

Answer the following :

(a) Write the name of the product when an aldehyde reacts with excess alcohol in presence of dry HCl. **1**

(b) Why carboxylic acid is a stronger acid than phenol ? **1**

(c) (i) Arrange the following compounds in increasing order of their reactivity towards CH_3MgBr :

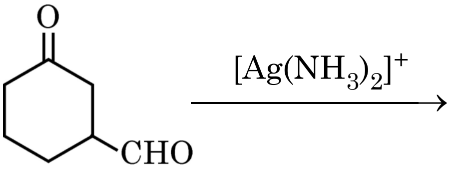


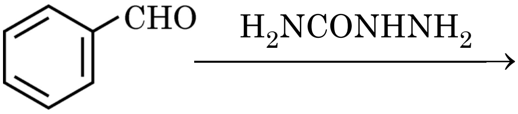
CH_3CHO, $(CH_3)_3C-\underset{\underset{O}{\|}}{C}-CH_3$, $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$

(ii) Write a chemical test to distinguish between propanal and propanone. **2 × 1**

OR

(c) Write the main product in the following :

(i) 

(ii) 

2 × 1

32. Carbohydrates are optically active polyhydroxy aldehydes and ketones. They are also called saccharides. All those carbohydrates which reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars. Glucose, the most important source of energy for mammals, is obtained by the hydrolysis of starch. Vitamins are accessory food factors required in the diet. Proteins are the polymers of α-amino acids and perform various structural and dynamic functions in the organisms. Deficiency of vitamins leads to many diseases.

Answer the following :

(a) The penta-acetate of glucose does not react with Hydroxylamine. What does it indicate ? **1**

(b) Why cannot vitamin C be stored in our body ? **1**

(c) Define the following as related to proteins :

(i) Peptide linkage

(ii) Denaturation **2 × 1**

OR

(c) Define the following as related to carbohydrates :

(i) Anomers

(ii) Glycosidic linkage **2 × 1**

SECTION – E

33. (a) (I) Account for the following : **3 + 2**

(i) E° value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+}.

(ii) Sc^{3+} is colourless whereas Ti^{3+} is coloured in an aqueous solution.

(iii) Actinoids show wide range of oxidation states.

(II) Write the chemical equations for the preparation of $KMnO_4$ from MnO_2.

OR

(b) (I) Account for the following : **2 + 2 + 1**

(i) Transition metals form alloys.

(ii) Ce^{4+} is a strong oxidising agent.

(II) Write one similarity and one difference between chemistry of Lanthanoids and Actinoids.

(III) Complete the following ionic equation :

$Cr_2O_7^{2-} + 2OH^- \longrightarrow$

34. (a) (I) Give reasons : **3 + 2**

(i) Aniline on nitration gives good amount of m-nitroaniline, though – NH_2 group is o/p directing in electrophilic substitution reactions.

(ii) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.

(iii) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

(II) Write the reaction involved in the following :

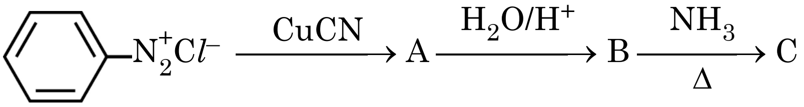
(i) Carbyl amine test

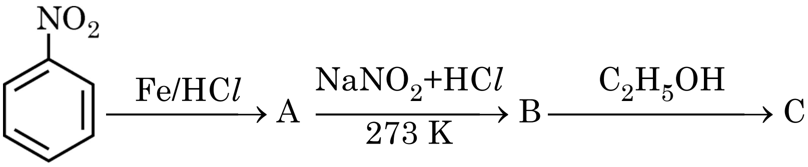
(ii) Gabriel phthalimide synthesis

OR

(b) (I) Write the structures of A, B and C in the following reactions :

3 + 1 + 1

(i) 

(ii) 

(II) Why aniline does not undergo Friedal-Crafts reaction ?

(III) Arrange the following in increasing order of their boiling point :

C_2H_5OH, $C_2H_5NH_2$, $(C_2H_5)_3N$

35. (a) Conductivity of 2×10^{-3} M methanoic acid is 8×10^{-5} S cm^{-1}. Calculate its molar conductivity and degree of dissociation if $\wedge_m^o$ for methanoic acid is 404 S $cm^2 mol^{-1}$. **3 + 2**

(b) Calculate the $\Delta_r G^\circ$ and log K_c for the given reaction at 298 K :

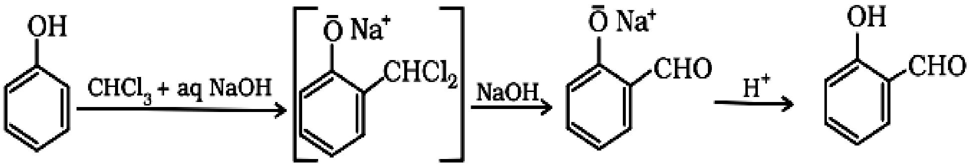
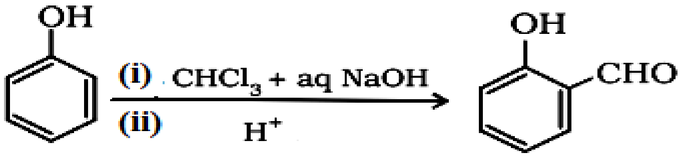
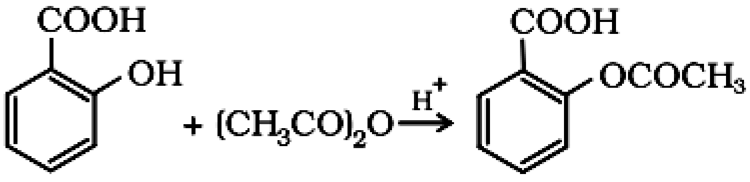
$$Ni_{(s)} + 2Ag^+_{(aq)} \rightleftharpoons Ni^{2+}_{(aq)} + 2Ag_{(s)}$$

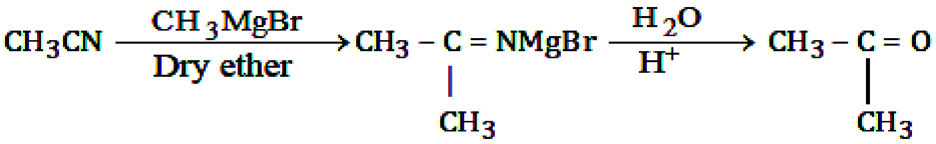
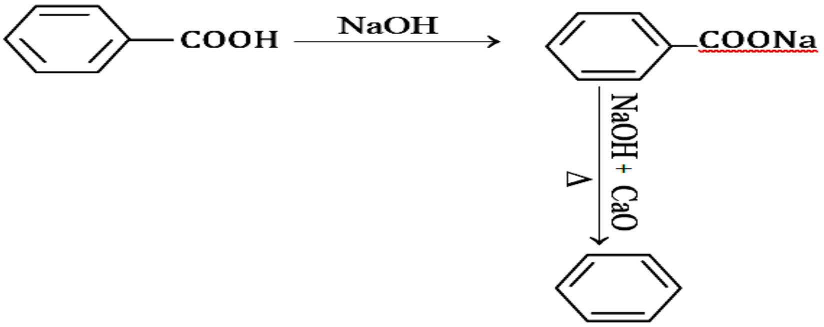
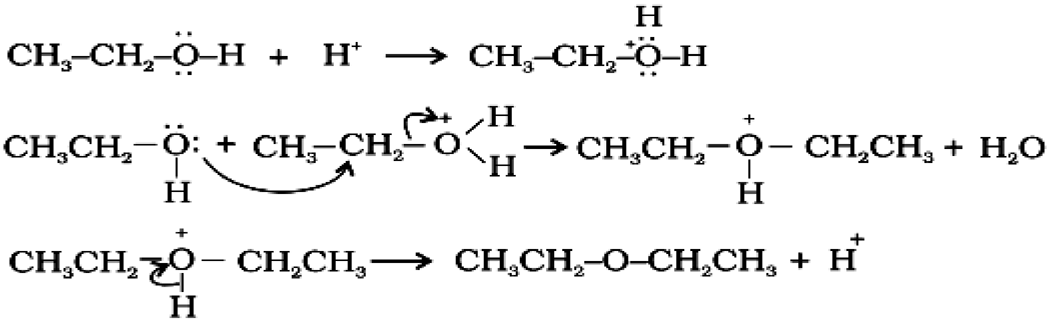
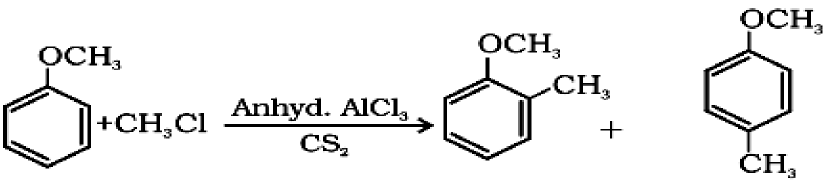
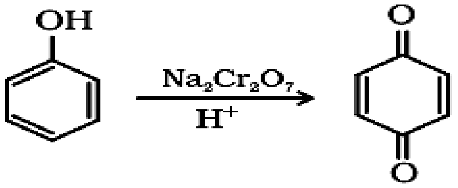
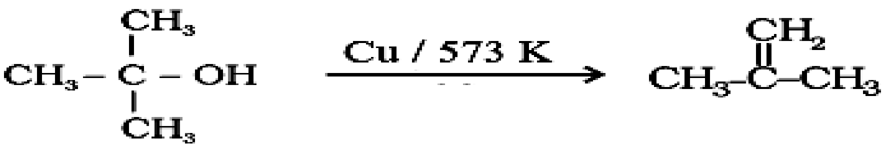
Given : $E^\circ_{Ni^{2+}/Ni} = -0.25$ V, $E^o_{Ag^+/Ag} = +0.80$ V

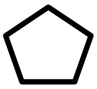
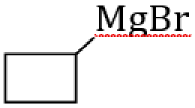
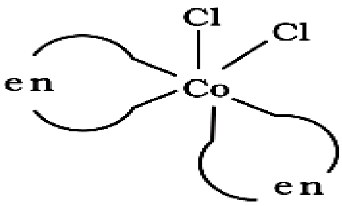
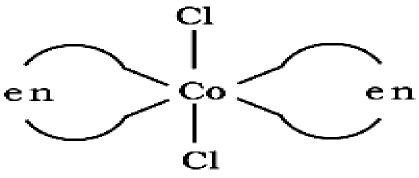
1F = 96500 C mol^{-1}.

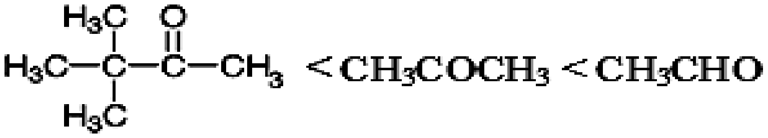
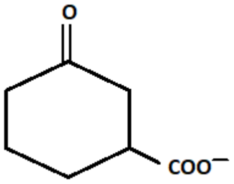
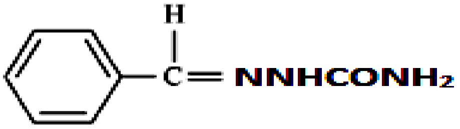
MARKING SCHEME
Senior Secondary School Examination, 2023
CHEMISTRY (Subject Code–043)
[Paper Code: 56/2/1]

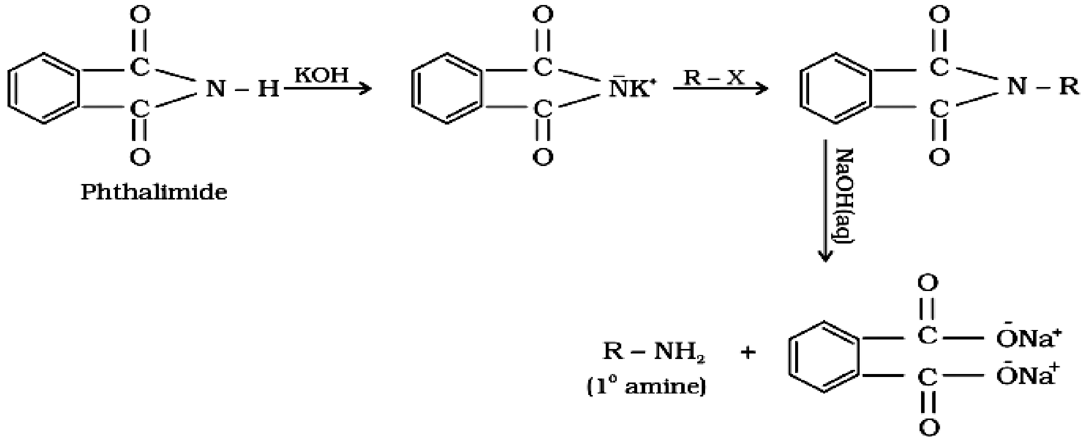
Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION-A	
1.	(c)	1
2.	(b)	1
3.	(c)	1
4.	(b)	1
5.	(b)	1
6.	(a)	1
7.	(c)	1
8.	(a)	1
9.	(a)	1
10.	(a)	1
11.	(c)	1
12.	(b)	1
13.	(d)	1
14.	(b)	1
15.	(c)	1
16.	(a)	1
17.	(d)	1
18.	(a)	1
	SECTION- B	
19.	$p_{Total} = p^{\circ}_{X}\,\chi_X + p^{\circ}_{Y}\,\chi_B$ $\chi_X = \chi_B = 0.5$	½

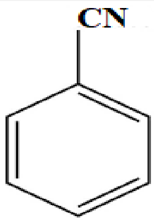
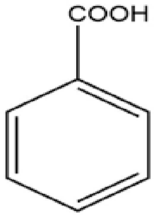
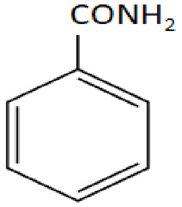
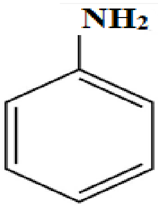
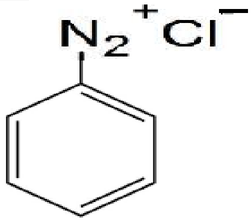
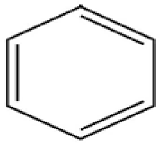
	p_{Total} = (120 x 0.5) + (160 x 0.5) = 140 mm Hg	1 ½
20.	(a) (i) Because the overall reaction does not involve any ion in the solution whose concentration can change. (ii) Because DC changes the composition of the electrolytic solution.	1 1
	OR	
	(b) • A Galvanic cell used to convert the energy of combustion of fuel directly into electrical energy. For example, H_2-O_2 fuel cell (or any other correct example) • **Advantages**: High efficiency, and pollution free (or any other correct advantage)	½ x 4
21.	(a) 9 times (b) A reaction that appears to be of higher order but follows first-order kinetics. Example: Hydrolysis of an ester (or any other correct example)	1 ½, ½
22.	(a) (i) Pentaamminenitrito-O-cobalt(III) ion (ii) Potassium tetrachloridonickelate(II)	1 x 2
	OR	
	(b) (i) • A complex formed by a didentate or a polydentate ligand. • $[Co(ox)_3]^{3-}$ (or any other suitable example) (ii) • Complexes in which a metal is bound to more than one kind of donor groups or ligands. • $[Co(NH_3)_4Cl_2]^+$ (or any other suitable example)	½, ½ ½, ½
23.	(a)  /  (b) 	1 1

24.	(a)  $CH_3CN \xrightarrow[\text{Dry ether}]{CH_3MgBr} CH_3-\underset{CH_3}{\underset{\vert}{C}}=NMgBr \xrightarrow[H^+]{H_2O} CH_3-\underset{CH_3}{\underset{\vert}{C}}=O$ (b)  	1 1
25.	Sr. No. DNA RNA 1. Double stranded Single stranded 2. Thymine base is present Uracil base is present (Any other correct differences)	1 x 2
26.	(a) (i)  (ii) Due to intramolecular H-bonding in o-nitrophenol while p-nitrophenol has intermolecular H-bonding.	½ 1 ½ **1**
	OR	
	(b) (i)  (ii)  (iii)  	**1 x 3**

27.	(a) Cyclopentane /  (b) 2-Bromo-2-methylbutane < 2-Bromopentane < 1-Bromopentane (c) Because para isomer fits well into the crystal lattice due to symmetry. (d) A =  B = 	1 x 3
28.	$k = \frac{0\cdot693}{t_{1/2}}$ $k_1 = \frac{0\cdot693}{30}\ \text{min}^{-1}$ $k_2 = \frac{0\cdot693}{10}\ \text{min}^{-1}$ $\log\frac{k_2}{k_1} = \frac{Ea}{2\cdot303\ R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$ $\log 3 = \frac{Ea}{2.303 \times 8.314}\left[\frac{1}{300}-\frac{1}{320}\right]$ $Ea = \frac{0\cdot4771 \times 19\cdot147 \times 300 \times 320}{20}$ **Ea = 43848 J mol^{-1} or 43.848 KJ mol^{-1} or 43·85 k J mol^{-1}** **(Deduct ½ mark for incorrect or no unit)**	½ ½ 1 1
29.	$\Delta T_f = i\, K_f.m$ $= i\, K_f \frac{W_B}{M_B} \times \frac{1000}{W_A}$ $1 = i \times 1\cdot86 \times \frac{19\cdot5}{78} \times \frac{1000}{500}$ $i = 1\cdot075$ $\alpha = \frac{i-1}{n-1}$ $= \frac{1\cdot075-1}{2-1} = 0\cdot075$	½ 1 ½ ½ ½
30.	(a)  Cis  Trans	1

	The trans isomer is not optically active because its mirror image is superimposable. (If the student writes charge (+2 / +1) over the isomers, award full marks). (b) sp^3d^2 , paramagnetic.	1 ½ , ½
	SECTION D	
31.	(a) Acetal (b) Because the carboxylate ion is more resonance stabilized than the phenoxide ion. (c) (i)  $(CH_3)_3C-CO-CH_3 < CH_3COCH_3 < CH_3CHO$ (ii) (1) Add Iodine (I_2), NaOH, and heat both the test tubes containing the given organic compounds. Propanone gives yellow precipitate (CHI_3) while propanal will not give yellow precipitate. (or any other suitable chemical test)	1 1 1 1
	OR	
	(c) (i)  (ii) 	1 x 2
32.	(a) Absence of free – CHO group. (b) Because being water soluble it is excreted through urine. (c) (i) -CONH- linkage between two amino acids. (ii) Loss of biological activity when protein is subjected to change in temperature, pH, etc.	1 1 1 x 2
	OR	
	(c) (i) The isomers (carbohydrates) having a change in configuration at C-1(for aldoses) or C-2 (for ketoses). (ii) A linkage joining two monosaccharides through oxygen atom.	1 x 2
	SECTION-E	
33.	(a) (I) (i) Cr^{2+} changes from d^4 to stable half-filled t_{2g}^3 configuration while Mn^{3+} changes to stable half-filled d^5 configuration.	1

	(ii) Because of no unpaired electron in the d-orbital of Sc^{3+} whereas there is one unpaired electron in Ti^{3+} / Ti^{3+} to show d-d transition.	1
	(iii) Because of comparable energies of 5f, 6d and 7s orbitals.	1
	(II) $2\,MnO_2 + 4\,KOH + O_2 \longrightarrow 2\,K_2MnO_4 + 2\,H_2O$	1
	$3\,MnO_4^{2-} + 4\,H^+ \longrightarrow 2\,MnO_4^- + MnO_2 + 2\,H_2O$	1
	(or any other suitable chemical equations of preparation)	
	OR	
	(b) (I)	
	(i) Because of almost identical atomic radii.	1
	(ii) Because Ce^{4+} changes to the common + 3 oxidation state.	1
	(II)	
	• **Similarity:** Both Lanthanoids and Actinoids show contraction / stable in + 3 oxidation state.	1
	• **Difference**: Lanthanoids are mainly non-radioactive whereas Actinoids are radioactive.	1
	(or any other suitable similarity and difference)	
	(III) $Cr_2O_7^{2-} + 2\,OH^- \longrightarrow 2\,CrO_4^{2-} + H_2O$	1
34.	(a) (I)	
	(i) Aniline gets protonated and is deactivated / Aniline on protonation forms anilinium ion which is meta-directing.	1
	(ii) Combination of inductive effect and solvation effect.	1
	(iii) Because it forms a mixture of amines that is difficult to separate.	1
	(II)	
	(i) $R-NH_2 + CHCl_3 + NaOH \longrightarrow RNC + 3NaCl + H_2O$	1
	(ii)  	1
	OR	

	(b) (I) (i) A =  B =  C = 	½ x 3
	(ii) A =  B =  C = 	½ x 3
	(II) Because of the formation of salt with Lewis acid anhydrous $AlCl_3$.	1
	(III) $(C_2H_5)_3N < C_2H_5NH_2 < C_2H_5OH$	1
35.	(a) $\Lambda_m = \frac{k}{c}$ x 1000 S cm^2 mol^{-1}	½
	$= \frac{8 \times 10^{-5}}{2 \times 10^{-3}}$ x 1000 S cm^2 mol^{-1}	½
	$= 40$ S cm^2 mol^{-1}	1
	$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$ $= \frac{40}{404}$	½
	$= 0{\cdot}099$	½
	(b) $\Delta_r G^\circ = -\ nF E^\circ_{cell}$ $= -2 \times 96500\ C\ mol^{-1} \times (0{\cdot}80 + 0{\cdot}25)\ V$ $= -2 \times 96500 \times 1{\cdot}05\ J\ mol^{-1}$	½
	$= -202{,}650\ J\ mol^{-1}$ or $-202{\cdot}65\ kJ\ mol^{-1}$	½
	$\log K_c = \frac{nE^\circ_{cell}}{0{\cdot}059}$	½
	$= \frac{2 \times 1{\cdot}05}{0{\cdot}059} = 35{\cdot}6$	½

* * *

SET-1

Series HFG1E/3

प्रश्न-पत्र कोड
Q.P. Code **56/3/1**

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे *अधिकतम अंक : 70*

Time allowed : 3 hours *Maximum Marks : 70*

- कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।
- प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
- कृपया जाँच कर लें कि इस प्रश्न-पत्र में **35** प्रश्न हैं ।
- **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**
- इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।
- Please check that this question paper contains **23** printed pages.
- Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains **35** questions.
- **Please write down the serial number of the question in the answer-book before attempting it.**
- 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

*

General Instructions :

Read the following instructions carefully and strictly follow them :

*(i) This question paper contains **35** questions. **All** questions are **compulsory**.*

*(ii) This question paper is divided into **five** Sections – **A, B, C, D** and **E**.*

*(iii) In **Section A** – Questions no. **1** to **18** are multiple choice (MCQ) type questions, carrying **1** mark each.*

*(iv) In **Section B** – Questions no. **19** to **25** very short answer (VSA) type questions, carrying **2** marks each.*

*(v) In **Section C** – Questions no. **26** to **30** are short answer (SA) type questions, carrying **3** marks each.*

*(vi) In **Section D** – Questions no. **31** and **32** are case-based questions carrying **4** marks each.*

*(vii) In **Section E** – Questions no. **33** to **35** are long answer (LA) type questions carrying **5** marks each.*

(viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 2 questions in Section E.

*(ix) Use of calculators is **not** allowed.*

SECTION A

*Questions no. **1** to **18** are Multiple Choice (MCQ) type Questions, carrying **1** mark each.* *18×1=18*

1. Which of the following is ***not*** true about enantiomers ?

(a) They have the same density.

(b) They have the same melting or boiling point.

(c) They have the same specific rotation.

(d) They have the same chemical reactivity.

2. Aspirin is obtained by the acetylation of which of the following compounds ?

(a) Salicylaldehyde

(b) Salicylic acid

(c) Acetyl salicylic acid

(d) Phenol

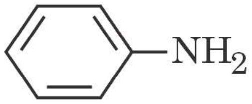
3. The reactivities of the carbonyl compounds HCHO (I), CH_3CHO (II) and CH_3COCH_3 (III) towards nucleophilic addition reaction decreases in the order :

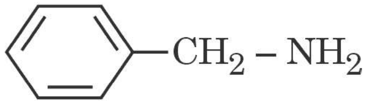
(a) III > II > I
(b) I > II > III
(c) II > III > I
(d) I > III > II

4. Among the following, which is the strongest base ?

(a)


(b)


(c)


(d)


5. On hydrolysis, which of the following carbohydrates gives only glucose ?

(a) Starch
(b) Fructose
(c) Lactose
(d) Sucrose

6. Which of the following vitamins is water soluble ?

(a) Vitamin A
(b) Vitamin D
(c) Vitamin E
(d) Vitamin C

7. The unit of the rate of reaction is the same as that of the rate constant for a :

(a) first order reaction
(b) second order reaction
(c) zero order reaction
(d) it cannot be same

8. Kohlrausch gave the following relation for strong electrolyte :

$$\Lambda = \Lambda_o - A\sqrt{C}$$

Which of the following equality holds true ?

(a) $\Lambda = \Lambda_o$ as $C \longrightarrow \sqrt{A}$
(b) $\Lambda = \Lambda_o$ as $C \longrightarrow 0$
(c) $\Lambda = \Lambda_o$ as $C \longrightarrow \infty$
(d) $\Lambda = \Lambda_o$ as $C \longrightarrow 1$

9. An azeotropic mixture of two liquids has a boiling point higher than either of the two liquids when it :

(a) shows large negative deviation from Raoult's law.

(b) shows no deviation from Raoult's law.

(c) shows large positive deviation from Raoult's law.

(d) obeys Raoult's law.

10. Which of the following colligative property is used to find the molar mass of proteins ?

(a) Osmotic pressure

(b) Elevation in boiling point

(c) Depression in freezing point

(d) Relative lowering of vapour pressure

11. Among the following outermost configurations of transition metals which one shows the highest oxidation state ?

(a) $3d^3 4s^2$ (b) $3d^5 4s^1$

(c) $3d^5 4s^2$ (d) $3d^6 4s^2$

12. How many ions are produced in the solution from the complex $[Ni(NH_3)_6]Cl_2$?

(a) 4 (b) 3

(c) 2 (d) 5

13. Which of the following species is ***not*** expected to be a ligand ?

(a) CO (b) NH_4^+

(c) NH_3 (d) H_2O

14. Which of the following is the most stable complex species ?

(a) $[Fe(C_2O_4)_3]^{3-}$

(b) $[Fe(CN)_6]^{3-}$

(c) $[Fe(CO)_5]$

(d) $[Fe(H_2O)_6]^{3+}$

For Questions number 15 to 18, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

15. *Assertion (A) :* Order and molecularity of a reaction are always same.

Reason (R) : Complex reactions involve a sequence of elementary reactions and the slowest step is rate determining.

16. *Assertion (A) :* Electrolysis of aqueous solution of NaCl gives chlorine gas at anode instead of oxygen gas.

Reason (R) : Formation of oxygen gas at anode requires overpotential.

17. *Assertion (A) :* Nucleophilic substitution of iodoethane is easier than chloroethane.

Reason (R): Bond energy of C – Cl bond is less than C – I bond.

18. *Assertion (A):* Zinc is not regarded as a transition element.

Reason (R): In zinc, 3d orbitals are completely filled in its ground state as well as in its oxidised state.

SECTION B

19. Write the structures and IUPAC names of the products expected from the following reactions : *2*

(a) Reaction of methanal with $(CH_3)_2CHMgBr$ followed by hydrolysis.

(b) Reaction of phenol with conc. HNO_3 .

20. A chemical reaction

$$2N_2O_5\,(g) \longrightarrow 4NO_2\,(g) + O_2\,(g)$$

in gas phase was carried out in a closed vessel. The concentration of NO_2 was found to increase by 5×10^{-3} mol L^{-1} in 10 seconds. Calculate : *2*

(a) the rate of formation of NO_2, and

(b) the rate of consumption of N_2O_5 .

21. (a) Define fuel cell and write its two advantages. *2*

OR

(b) Using E° values of X and Y given below, predict which is better for coating the surface of Iron to prevent corrosion and why ? *2*

Given : $E^\circ_{X^{2+}/X} = -\,2{\cdot}36$ V

$E^\circ_{Y^{2+}/Y} = -\,0{\cdot}14$ V

$E^\circ_{Fe^{2+}/Fe} = -\,0{\cdot}44$ V

22. (a) (i) How are carbohydrates stored in animal body ? Mention any one organ where they are present.

(ii) What is the basic structural difference between starch and cellulose ? *2*

OR

(b) Differentiate between : *2*

(i) Peptide linkage and Glycosidic linkage

(ii) Nucleoside and Nucleotide

23. Give reasons for the following : *2*

(a) Carboxylic carbon is less electrophilic than Carbonyl carbon of aldehydes and ketones.

(b) Propanal is more reactive than Propanone towards addition of HCN.

24. Write the chemical equation involved in the following reactions : *2*

(a) Carbylamine reaction

(b) Gabriel phthalimide synthesis

25. Give reasons for the following : *2*

(a) Aquatic animals are more comfortable in cold water in comparison to warm water.

(b) Sprinkling of salt helps in clearing the snow-covered roads in hilly areas.

SECTION C

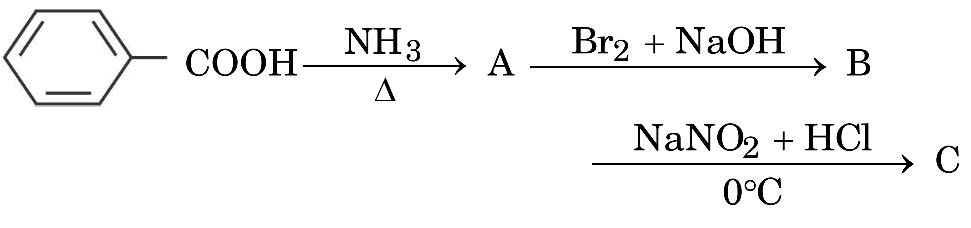
26. (a) Write the mechanism of the following reaction :

$$CH_3 - CH_2 - OH \xrightarrow[443\ K]{H^+} CH_2 = CH_2 + H_2O$$

(b) Write the equation of the reaction for the preparation of phenol from cumene. *3*

27. (a) Write the structures of A, B and C in the following reactions : $2 \times 1\frac{1}{2} = 3$

(i)



(ii) $CH_3CH_2Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[0°C]{HNO_2} C$

OR

(b) How will you convert the following : $3 \times 1 = 3$

(i) Aniline to p-bromoaniline

(ii) Ethanoic acid to methanamine

(iii) Butanenitrile to 1-aminobutane

---

28. 0·3 g of acetic acid ($M = 60\ g\ mol^{-1}$) dissolved in 30 g of benzene shows a depression in freezing point equal to 0·45°C. Calculate the percentage association of acid if it forms a dimer in the solution. *3*

(Given : K_f for benzene = $5{\cdot}12\ K\ kg\ mol^{-1}$)

29. The rate of a reaction doubles when temperature changes from 27°C to 37°C. Calculate energy of activation for the reaction.
($R = 8{\cdot}314\ J\ K^{-1}\ mol^{-1}$) *3*
(Given : log 2 = 0·3010, log 3 = 0·4771, log 4 = 0·6021)

30. Write the structure of product when D-Glucose reacts with the following : (any ***three***) *3×1=3*

(a) HI

(b) Conc. HNO_3

(c) Br_2 water

(d) HCN

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

31. The polarity of C – X bond of alkyl halides is responsible for their nucleophilic substitution, elimination and their reaction with metal atoms to form organometallic compounds. Alkyl halides are prepared by the free radical halogenation of alkanes, addition of halogen acids to alkenes, replacement of – OH group of alcohols with halogens using phosphorus halides, thionyl chloride or halogen acids. Aryl halides are prepared by electrophilic substitution of arenes. Nucleophilic substitution reactions are categorised into S_N1 and S_N2 on the basis of their kinetic properties. Chirality has a profound role in understanding the S_N1 and S_N2 mechanism.

Answer the following questions :

(i) What happens when bromobenzene is treated with Mg in the presence of dry ether ? *1*

(ii) Which compound in each of the following pairs will react faster in S_N1 reaction with $\overline{OH}$? *1*

(1) $CH_2 = CH - CH_2 - Cl$ or $CH_3 - CH_2 - CH_2 - Cl$

(2) $(CH_3)_3C - Cl$ or CH_3Cl

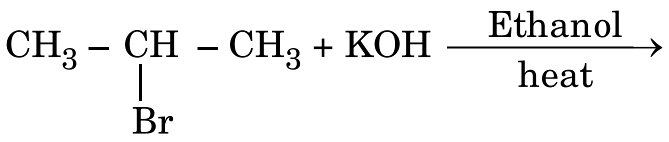
(iii) Write the equations for the preparation of 1-iodobutane from

(1) 1-chlorobutane

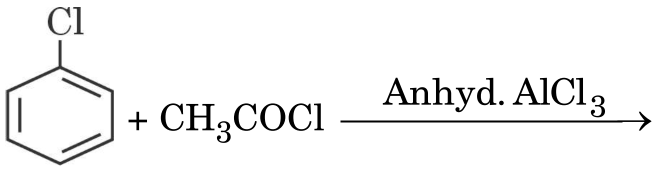
(2) but-1-ene. *2 ×1=2*

OR

(iii) Write the structure of the major products in each of the following reactions : *2 ×1=2*

(1) 

$$CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3 + KOH \xrightarrow[\text{heat}]{\text{Ethanol}}$$

(2) 

32. Coordination compounds are widely present in the minerals, plant and animal worlds and are known to play many important functions in the area of analytical chemistry, metallurgy, biological systems and medicine. Alfred Werner's theory postulated the use of two types of linkages (primary and secondary), by a metal atom/ion in a coordination compound. He predicted the geometrical shapes of a large number of coordination entities using the property of isomerism. The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometrical shapes of coordination compounds. It, however, fails to describe the optical properties of these compounds. The Crystal Field Theory (CFT) explains the effect of different crystal fields (provided by the ligands taken as point charges) on the degeneracy of d-orbital energies of the central metal atom/ion.

Answer the following questions :

(i) When a coordination compound $NiCl_2 \cdot 6H_2O$ is mixed with $AgNO_3$ solution, 2 moles of AgCl are precipitated per mole of the compound. Write the structural formula of the complex and secondary valency for Nickel ion. *1*

(ii) Write the IUPAC name of the ionisation isomer of $[Co(NH_3)_5(SO_4)]Cl$. *1*

(iii) Using Valence Bond Theory, predict the geometry and magnetic nature of :

(1) $[Ni(CO)_4]$

(2) $[Fe(CN)_6]^{3-}$

[Atomic number : Ni = 28, Fe = 26] *2 ×1=2*

OR

(iii) Give reasons : *2 ×1=2*

(1) Low spin tetrahedral complexes are not formed.

(2) $[Co(NH_3)_6]^{3+}$ is an inner orbital complex whereas $[Ni(NH_3)_6]^{2+}$ is an outer orbital complex.

[Atomic number : Co = 27, Ni = 28]

SECTION E

33. (a) (i) Account for the following :

(1) Transition metals form complex compounds.

(2) The $E^{\circ}_{Mn^{2+}/Mn}$ value for manganese is highly negative whereas $E^{\circ}_{Mn^{3+}/Mn^{2+}}$ is highly positive.

(3) Cu^+ ion is unstable in aqueous solution.

(ii) Write the equations involved in the preparation of $KMnO_4$ from Pyrolusite ore (MnO_2). *3+2=5*

OR

(b) (i) Identify the following :

(1) Transition metal of 3d series that exhibits only one oxidation state.

(2) Transition metal of 3d series that acts as a strong reducing agent in +2 oxidation state in aqueous solution.

(ii) Complete and balance the following equations :

(1) $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \longrightarrow$

(2) $KMnO_4 \xrightarrow{heat}$

(iii) What is Misch metal ? Write its one use. *2+2+1=5*

34. (a) (i) An organic compound (X) having molecular formula $C_5H_{10}O$ can show various properties depending on its structures. Draw each of the structures if it

(1) gives positive iodoform test.

(2) shows Cannizzaro's reaction.

(3) reduces Tollens' reagent and has a chiral carbon.

(ii) Write the reaction involved in the following :

(1) Wolff-Kishner reduction

(2) Hell-Volhard-Zelinsky reaction *3+2=5*

OR

(b) (i) How can you convert each of the following compounds to Benzoic acid ?

(1) Acetophenone
(2) Ethylbenzene
(3) Bromobenzene

(ii) Arrange the following compounds in increasing order of their property as indicated :

(1) O_2N-CH_2-COOH, $F-CH_2-COOH$, $CN-CH_2COOH$
(Acidic character)

(2) Ethanal, Propanal, Butanone, Propanone
(Reactivity in nucleophilic addition reactions) *3+2=5*

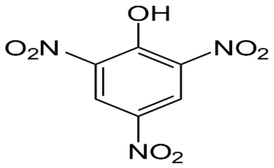
35. (a) Calculate the emf of the following cell at 25°C :

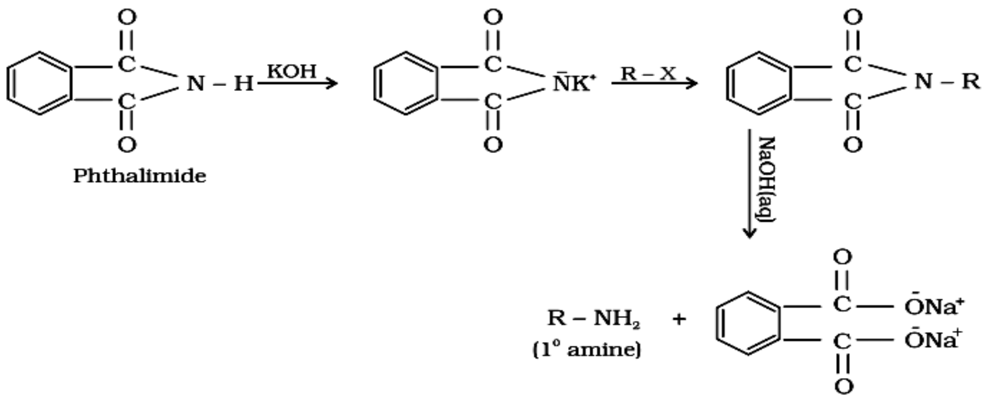
$$\mathrm{Zn\,(s)\,|\,Zn^{2+}\,(0{\cdot}1\,M)\,||\,H^{+}\,(0{\cdot}01\,M)\,|\,H_2\,(g)\,(1\,bar),\,Pt\,(s)}$$

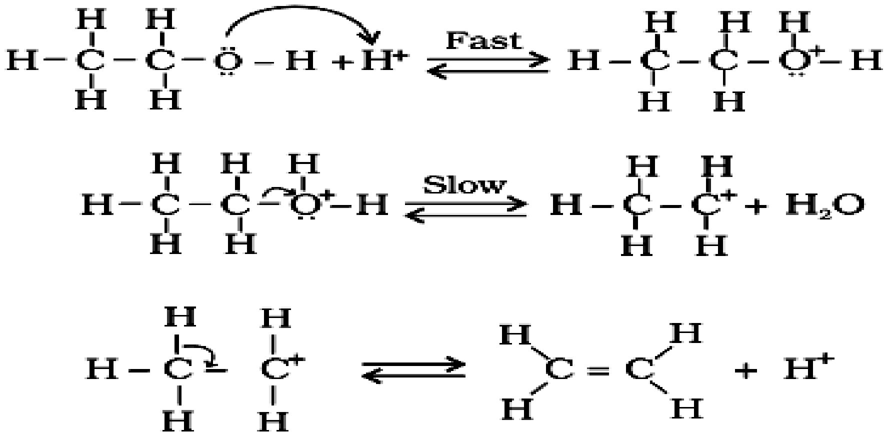
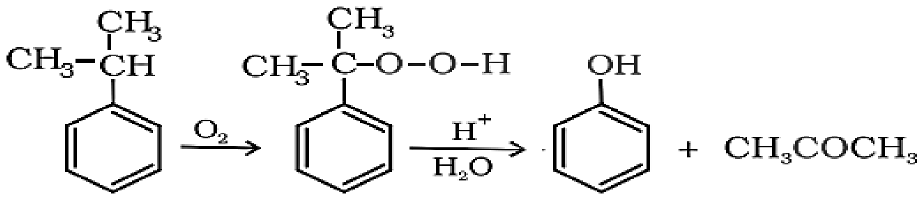
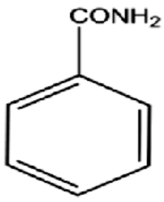
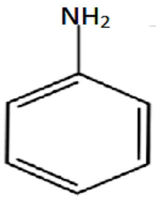
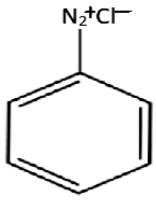
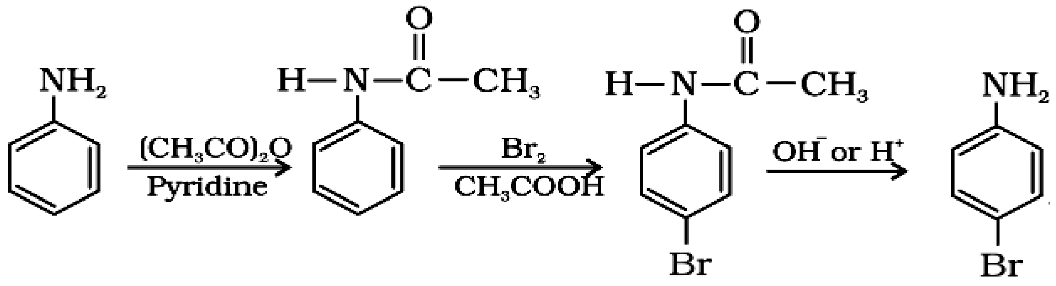
$$[\text{Given : } E^{\circ}_{Zn^{2+}/Zn} = -0{\cdot}76\ \mathrm{V},\ E^{\circ}_{H^{+}/H_2} = 0{\cdot}00\ \mathrm{V},\ \log 10 = 1]$$

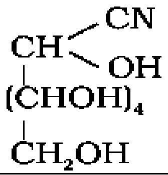
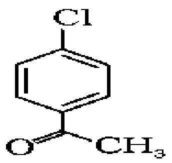
(b) State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution ? *3+2=5*

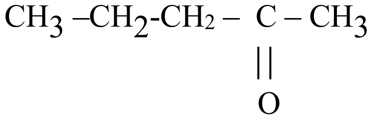
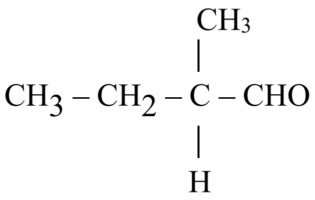
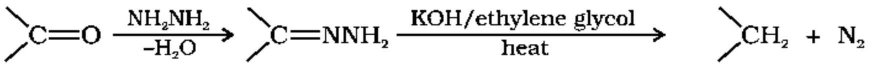
MARKING SCHEME
Senior Secondary School Examination, 2023
CHEMISTRY (Subject Code–043)
[Paper Code: 56/3/1]

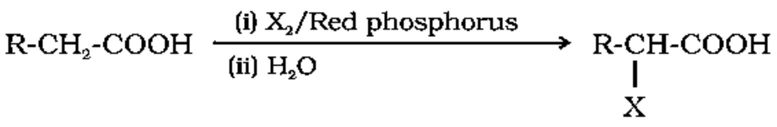
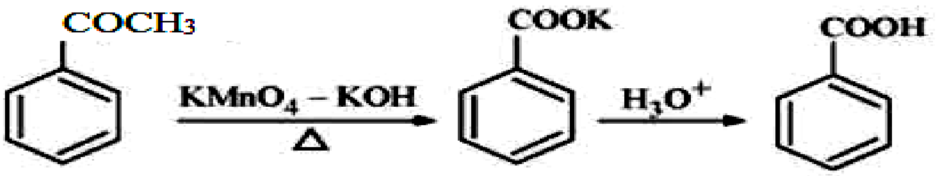
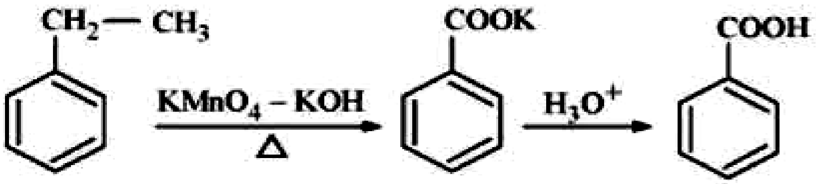
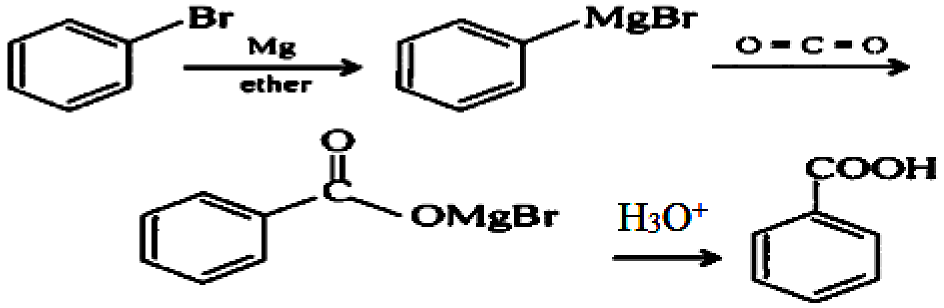
Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION-A	
1.	(c)	1
2.	(b)	1
3.	(b)	1
4.	(d)	1
5.	(a)	1
6.	(d)	1
7.	(c)	1
8.	(b)	1
9.	(a)	1
10.	(a)	1
11.	(c)	1
12.	(b)	1
13.	(b)	1
14.	(a)	1
15.	(d)	1
16.	(a)	1
17.	(c)	1
18.	(a)	1
	SECTION-B	
19.	(a) $(CH_3)_2\ CH - CH_2OH$, 2-Methylpropanol (b)  , 2,4,6-Trinitrophenol / 2,4,6-Trinitrobenzenol	½ , ½ ½ , ½

20.	$-\frac{1}{2}\frac{\Delta(N_2O_5)}{\Delta t} = +\frac{1}{4}\frac{\Delta[NO_2]}{\Delta t} = +\frac{\Delta[O_2]}{\Delta t}$ (a) Rate of formation of $NO_2 = \frac{1}{4}\frac{\Delta[NO_2]}{\Delta t}$ $= \frac{1}{4} \times \frac{5 \times 10^{-3}}{10}$ mol L^{-1} = $1{\cdot}25 \times 10^{-4}$ mol L^{-1} s^{-1} (b) $-\frac{\Delta[N_2O_5]}{\Delta t} = \frac{2}{4}\frac{\Delta[NO_2]}{\Delta t}$ = $0.5 \times 1{\cdot}25 \times 10^{-4}$ mol L^{-1} s^{-1} = $0{\cdot}625 \times 10^{-4}$ mol L^{-1} s^{-1} OR 6.25×10^{-5} mol L^{-1} s^{-1}	½ ½ ½ ½
21.	(a) A Galvanic cell that converts the energy of combustion of fuel directly to electrical energy. **Advantages**: (1) More efficient. (2) Pollution free. (or any other suitable advantage)	1 ½+ ½
	OR (b) • X is better. • Due to higher standard reduction potential of iron than X, iron will not get oxidised.	1 1
22.	(a) (i) Glycogen liver/muscles/brain (Any one) (ii) Starch is a polymer of α-Glucose whereas Cellulose is a polymer of β-Glucose.	½ ½ *1*
	OR (b) (i) **Peptide linkage** : A linkage formed when two amino acids are joined through – CONH – bond. **Glycosidic linkage** : When two monosaccharides are joined through oxygen atom. (ii) **Nucleoside** : Base + Sugar **Nucleotide** : Base + Sugar + Phosphate (or any other correct difference)	1 1
23.	(a) Due to resonance of carboxyl carbon with – OH group / explanation through resonating structures. (b) Due to the steric effect and electronic reasons.	1 1
24.	(a) $R-NH_2 + CHCl_3 + 3\ KOH\ (alc.) \longrightarrow R-NC + 3KCl + 3\ H_2O$ (b)  	1 1

25.	(a) Due to more solubility of oxygen in cold water than in warm water. (b) Sprinkling of salt causes depression in freezing point and snow easily melts.	1 x 2
	SECTION-C	
26.	(a)  (b) 	½ 1 ½ 1
27.	(a) (i) A=  B=  C=  (ii) **A = CH_3CH_2CN** **B = $CH_3CH_2CH_2NH_2$** **C = $CH_3CH_2CH_2OH$**	½ X 3 ½ x 3
	OR (b) (i)  (ii) $CH_3COOH \xrightarrow[\Delta]{NH_3} CH_3CONH_2 \xrightarrow{Br_2/KOH} CH_3NH_2$ (iii) $CH_3CH_2CH_2CN \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2NH_2$ (or any other correct method of conversion)	1 1 1

28.	$\Delta T_f = i\, K_f \frac{W_B}{M_B} \text{ x } \frac{1000}{W_A}$ $0{\cdot}45 = i \text{ x } 5{\cdot}12 \text{ K kg mol}^{-1} \text{ x } \frac{0{\cdot}3 \text{ g}}{60 \text{ g mol}^{-1}} \text{ x } \frac{1000}{30 \text{ kg}}$ $i = 0{\cdot}527$ $\alpha = \frac{1 - i}{1 - \frac{1}{n}}$ $\alpha = \frac{1 - 0{\cdot}527}{1 - \frac{1}{2}} = 0{\cdot}946$ or $94{\cdot}6\%$	½ 1 ½ ½ ½
29.	$\log \frac{k_2}{k_1} = \frac{Ea}{2{\cdot}303\ R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$ $\log \frac{2k_1}{k_1} = \frac{Ea}{2{\cdot}303 \times 8{\cdot}314 \text{ J K}^{-1} \text{ mol}^{-1}}\left[\frac{1}{300} - \frac{1}{310}\right]$ $E_a = \frac{0{\cdot}3010 \times 19{\cdot}147 \text{ J mol}^{-1} \times 300 \times 310}{10}$ $E_a = 53598.2 \text{ J mol}^{-1}$ or $53{\cdot}598 \text{ kJ mol}^{-1}$ or 53.6 kJ mol^{-1} (Deduct ½ mark for no or incorrect unit)	1 1 1
30.	(a) $CH_3(CH_2)_4 - CH_3$ (b) $HOOC - (CHOH)_4 - COOH$ (c) $HOCH_2 - (CHOH)_4 - COOH$ (d)  $CH(CN)(OH) - (CHOH)_4 - CH_2OH$	1 x 3
	SECTION- D	
31.	(i) C_6H_5MgBr / Phenyl magnesium bromide is formed. (ii) (1) $CH_2 = CH - CH_2 - Cl$ (2) $(CH_3)_3C - Cl$ (iii)(1) $CH_3CH_2CH_2CH_2 - Cl \xrightarrow[\text{acetone}]{\text{NaI}} CH_3CH_2CH_2CH_2 - I$ **(2)** $\mathbf{CH_3CH_2CH = CH_2 \xrightarrow[\text{peroxide}]{\text{HBr}} CH_3CH_2CH_2CH_2\text{-}Br \xrightarrow[\text{acetone}]{\text{NaI}} CH_3CH_2CH_2CH_2 - I}$ **OR** **(iii) (1)** $\mathbf{CH_3 - CH = CH_2}$ **(2)** 	1 ½ ½ 1 1 1 1

32.	(i) $[Ni(H_2O)_6]Cl_2$, 6 (ii) Pentaamminechloridocobalt(III)sulphate (iii) (1) $[Ni(CO)_4]$ – tetrahedral, diamagnetic (2) $[Fe(CN)_6]^{3-}$ - octahedral, paramagnetic OR (iii) (1) Because Δ_t is not sufficient for the pairing of electrons / Crystal field splitting energy (CFSE) is not sufficient for pairing of electrons. (2) NH_3 being a strong field ligand can pair up the electrons to form d^2sp^3 but cannot pair up in Ni^{2+} as two vacant d-orbitals are not available. ∴ sp^3d^2 is formed.	½ ,½ 1 ½, ½ ½ , ½ 1 1
	SECTION-E	
33.	(a) (i) (1) Because of small size, high ionic charge and availability of d-orbital. (2) Because of stable half-filled $3d^5$ configuration in Mn^{2+}. (3) Cu^+ ion (aq.) undergoes disproportionation to Cu^{2+} (aq.) and Cu / $2\,Cu^+ (aq.) \longrightarrow Cu^{2+} (aq.) + Cu$. (ii) $\mathbf{2\,MnO_2 + 4\,KOH + O_2 \longrightarrow 2\,K_2MnO_4 + 2\,H_2O}$ $\mathbf{3}\,MnO_4^{2-} \mathbf{+ 4\,H^+ \longrightarrow 2}\,MnO_4^- \mathbf{+ MnO_2 + 2\,H_2O}$ (or any other suitable method of preparation)	1 1 1 1 1
	OR (b) (i) (1) Sc (2) Cr / Fe (ii) (1) $Cr_2O_7^{2-}$ $\mathbf{+ 14\,H^+ + 6\,Fe^{2+} \longrightarrow 2\,Cr^{3+} + 6\,Fe^{3+} + 7\,H_2O}$ (2) $\mathbf{2\,KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2}$ (iii) An alloy of Lanthanoide (95% lanthanoid + 5% Fe) is Mischmetal. It is used in bullets, flints etc.	1 1 1 1 ½ , ½
34.	(a) (i) (1)  $CH_3-CH_2-CH_2-\underset{\underset{O}{\vert\vert}}{C}-CH_3$ (2) $(CH_3)_3C-CHO$ (3)  $CH_3-CH_2-\overset{\overset{CH_3}{\vert}}{\underset{\underset{H}{\vert}}{C}}-CHO$ (ii) (1) 	1 1 1 1

	(2)  $\mathrm{R{-}CH_2{-}COOH} \xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) X}_2\text{/Red phosphorus}} \mathrm{R{-}\underset{\underset{X}{\vert}}{C}H{-}COOH}$ X = Cl, Br	1
	OR (b) (i) (1).  (2).  (3).  (or any other suitable method of conversion). (ii) (1) $NC{-}CH_2-COOH < F{-}CH_2-COOH < NO_2-CH_2COOH$ / $F{-}CH_2-COOH < CN{-}CH_2-COOH < NO_2-CH_2COOH$ (2) Butanone < Propanone < Propanal < Ethanal	1 x 3 1 1
35.	**(a)** $E_{cell} = E^{\circ}_{cell} - \frac{0{\cdot}059}{2}\log\frac{[Zn^{2+}]}{[H^+]^2}$ $= 0{\cdot}76\text{ V} - \frac{0{\cdot}059}{2}\log\frac{[0{\cdot}1]}{[0{\cdot}01]^2}$ $= 0{\cdot}76\text{ V} - \frac{0{\cdot}059}{2}\log 10^3$ $= 0{\cdot}76\text{ V} - \frac{0{\cdot}059 \times 3}{2}$ $E_{cell} = 0{\cdot}671\text{ V}$ (Deduct ½ mark for no or incorrect unit) (b) Limiting molar conductivity of an electrolyte is equal to the sum of individual contributions of cation and anion of the electrolyte. Because no. of ions per unit volume decreases.	1 1 1 1 1

* * *

SET-1

Series HFG1E/4

प्रश्न-पत्र कोड
Q.P. Code **56/4/1**

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे *अधिकतम अंक : 70*

Time allowed : 3 hours *Maximum Marks : 70*

- कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।
- प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
- कृपया जाँच कर लें कि इस प्रश्न-पत्र में **35** प्रश्न हैं ।
- **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**
- इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।
- Please check that this question paper contains **23** printed pages.
- Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains **35** questions.
- **Please write down the serial number of the question in the answer-book before attempting it.**
- 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

*

General Instructions :

Read the following instructions carefully and strictly follow them :

(i) *This question paper contains* ***35*** *questions.* ***All*** *questions are* ***compulsory****.*

(ii) *This question paper is divided into* ***five*** *Sections –* ***A, B, C, D*** *and* ***E****.*

(iii) *In* ***Section A*** *– Questions no.* ***1*** *to* ***18*** *are multiple choice (MCQ) type questions, carrying* ***1*** *mark each.*

(iv) *In* ***Section B*** *– Questions no.* ***19*** *to* ***25*** *very short answer (VSA) type questions, carrying* ***2*** *marks each.*

(v) *In* ***Section C*** *– Questions no.* ***26*** *to* ***30*** *are short answer (SA) type questions, carrying* ***3*** *marks each.*

(vi) *In* ***Section D*** *– Questions no.* ***31*** *and* ***32*** *are case-based questions carrying* ***4*** *marks each.*

(vii) *In* ***Section E*** *– Questions no.* ***33*** *to* ***35*** *are long answer (LA) type questions carrying* ***5*** *marks each.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 2 questions in Section E.*

(ix) *Use of calculators is* ***not*** *allowed.*

SECTION A

Questions no. ***1*** *to* ***18*** *are Multiple Choice (MCQ) type Questions, carrying* ***1*** *mark each.* *18×1=18*

1. A compound undergoes complete tetramerization in a given organic solvent. The Van't Hoff factor 'i' is :

(a) 4·0 (b) 0·25

(c) 0·125 (d) 2·0

2. The half-life for a zero order reaction equals :

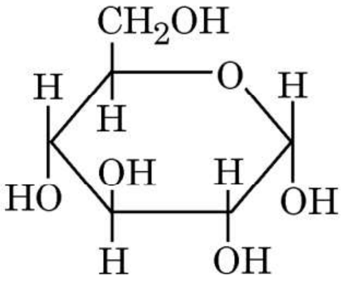
(a) $\frac{2k}{R}$ (b) $\frac{1}{2}\frac{k}{R^2}$

(c) $\frac{R^2}{2k}$ (d) $\frac{R}{2k}$

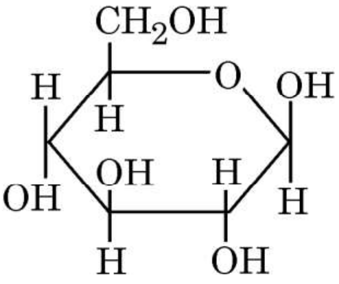
where R is the initial concentration.

3. Which of the following structures represents α-D-glucose ?

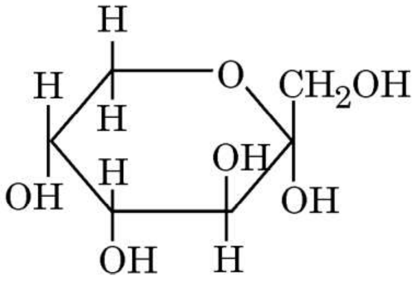
(a)



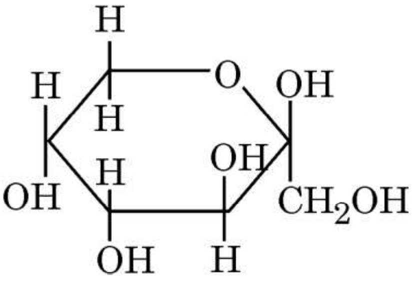
(b)



(c)



(d)



4. The ions of metals of Group 12 (Zn, Cd and Hg) have completely filled d orbitals and so they :

(a) behave like semiconductors

(b) are very high melting solids

(c) do not behave like transition metals

(d) behave like superconductors

5. $[Co(NH_3)_5NO_3]SO_4$ and $[Co(NH_3)_5SO_4]NO_3$ exhibit :

(a) linkage isomerism

(b) ionization isomerism

(c) optical isomerism

(d) coordination isomerism

6. Reaction of 1-phenyl-2-chloropropane with alcoholic KOH gives mainly :

(a) 1-phenylpropene (b) 3-phenylpropene

(c) 1-phenylpropan-3-ol (d) 1-phenylypropan-2-ol

7. When diethyl ether is heated with excess of HI, it produces :

(a) ethanol (b) iodoform

(c) methyl iodide (d) ethyl iodide

---

8. The reduction of ethanenitrile with sodium and alcohol gives :

(a) 1-aminopropane (b) 1-aminoethane

(c) Ethanoic acid (d) Ethanamide

9. How many Faradays are required to reduce 1 mol of MnO_4^- to Mn^{2+} ?

(a) 4 (b) 3

(c) 6 (d) 5

10. In a reaction, the initial concentration of the reactants increases four fold and the rate becomes sixteen times its initial value. The order of the reaction is :

(a) 2·0 (b) 3·5

(c) 1·5 (d) 2·5

11. On hydrolysis, which of the following carbohydrates gives only glucose ?

(a) Maltose (b) Sucrose

(c) Lactose (d) Galactose

12. Deficiency of which of the following vitamins causes Pernicious anaemia ?

(a) Vitamin B_1 (b) Vitamin B_2

(c) Vitamin B_6 (d) Vitamin B_{12}

13. $C_6H_5CHO + CH_3COCH_3 \xrightarrow[\Delta]{OH^-} C_6H_5CH = CH - COCH_3$

This reaction is known as :

(a) Aldol condensation

(b) Cross-Aldol condensation

(c) Cannizzaro's reaction

(d) Friedel-Crafts reaction

14. In which of the following does the central atom exhibit an oxidation state of +3 ?

(a) $K_2[Ni(CN)_4]$ (b) $K_4[Fe(CN)_6]$

(c) $[Fe(C_2O_4)_3]^{3-}$ (d) $[Cu(NH_3)_4]^{2+}$

For Questions number 15 to 18, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

15. *Assertion (A) :* When NaCl is added to water, a depression in freezing point is observed.

Reason (R) : The lowering of vapour pressure of a solution causes depression in the freezing point.

16. *Assertion (A) :* $\wedge_m$ for weak electrolytes shows a sharp decrease when the electrolytic solution is diluted.

Reason (R) : For weak electrolytes, degree of dissociation increases with dilution of solution.

17. *Assertion (A) :* Zr and Hf have almost identical radii.

Reason (R) : Both Zr and Hf exhibit similar properties.

18. *Assertion (A) :* Monobromination of aniline can be conveniently done by protecting the amino group by acetylation.

Reason (R) : Acetylation decreases the activating effect of the amino group.

SECTION B

19. An alkyl halide (A) of molecular formula $C_6H_{13}Cl$ on treatment with alcoholic KOH gives two isomeric alkenes (B) and (C) of molecular formula C_6H_{12}. Both alkenes on hydrogenation give 2,3-dimethylbutane. Write the structures of (A), (B) and (C). *2*

20. (a) What type of deviation from Raoult's law is shown by a mixture of ethanol and acetone ? Give reason. *2*

OR

(b) Define Azeotrope. What type of azeotrope is formed by negative deviation from Raoult's law ? Give an example. *2*

21. Name the cell which : $4\times\frac{1}{2}=2$

(a) was used in Apollo Space programme.

(b) is used in automobiles and inverters.

(c) is suitable for hearing aids and watches.

(d) does not give a steady potential and is used in transistors.

22. The rate constant for the first order decomposition of N_2O_5 is given by the following equation :

$$\log k = 23{\cdot}6 - \frac{2\times10^4 K}{T}$$

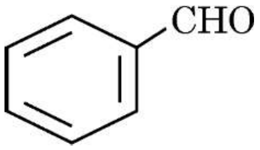
Calculate E_a for this reaction. *2*

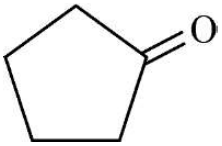
$[R = 8{\cdot}314 \text{ J K}^{-1} \text{ mol}^{-1}]$

23. Write the mechanism of the following reaction : *2*

$$CH_2 = CH_2 + H_2O \xrightarrow{H^+} CH_3CH_2OH$$

24. (a) Write the products of the following reactions : *2×1=2*

(i)  $\xrightarrow[\Delta]{\text{Conc. NaOH}}$

(ii)  $+ H_2NNH-CO-NH_2 \xrightarrow{H^+}$

OR

(b) Do the following conversions in not more than two steps : *2×1=2*

(i) Toluene to Benzoic acid

(ii) Benzaldehyde to 1-Phenylethanol

25. Write IUPAC names of the following coordination entities : *2×1=2*

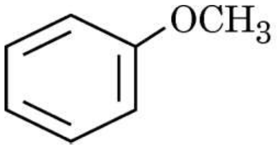
(a) $[Co(NH_3)_4Cl(NO_2)]Cl$

(b) $[PtCl_2(en)_2]^{2+}$

SECTION C

26. (a) (i) Write hydroboration-oxidation reaction with an example.

(ii) Write the products of the following reaction :

 $+ HBr \longrightarrow$

(iii) Why is p-nitrophenol more acidic than phenol ? *3×1=3*

OR

(b) (i) What happens when phenol reacts with

(1) Conc. HNO_3, and

(2) $CHCl_3$ in presence of aqueous NaOH followed by acidification ?

Write equations only.

(ii) Why does the reaction of CH_3ONa with $(CH_3)_3C-Br$ give 2-methylpropene and not $(CH_3)_3C-OCH_3$? *2+1=3*

---

27. Account for the following : *3×1=3*

(a) Benzyl chloride is highly reactive towards S_N1 reaction.

(b) (±)-Butan-2-ol is optically inactive, though it contains a chiral carbon atom.

(c) Chloroform is stored in closed dark coloured bottles.

28. Answer any ***three*** of the following questions : *3×1=3*

(a) Explain the type of hybridization in $[Fe(CN)_6]^{3-}$ on the basis of valence bond theory. (Given : Atomic number of Fe = 26)

(b) Draw the geometrical isomers of $[PtCl_2(en)_2]^{2+}$ ion.

(c) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral. Why ?

(d) Name the type of isomerism when ambidentate ligands are attached to central metal ion. Give one example of ambidentate ligand.

29. If benzoic acid ($M = 122\ g\ mol^{-1}$) is associated into a dimer when dissolved in benzene and the osmotic pressure of a solution of 6·1 g of benzoic acid in 100 mL benzene is 6·5 atm at 27°C, then what is the percentage association of benzoic acid ? *3*

(Given : $R = 0{\cdot}0821\ L\ atm\ K^{-1}\ mol^{-1}$)

30. The following data were obtained during the first order thermal decomposition of C_2H_5Cl at a constant volume :

$$C_2H_5Cl\ (g) \longrightarrow C_2H_4\ (g) + HCl\ (g)$$

Experiment	Time (s^{-1})	Total pressure (atm)
1	0	0·4
2	100	0·6

Calculate the rate constant. *3*

(Given : log 2 = 0·3010, log 3 = 0·4771, log 4 = 0·6021)

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

31. Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids, etc. Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules which provide such units on hydrolysis. They are broadly classified into three groups — monosaccharides, oligosaccharides and polysaccharides. Monosaccharides are held together by glycosidic linkages to form disaccharides like sucrose, maltose or polysaccharides like starch and cellulose.

Another biomolecule : proteins are polymers of α-amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. Structure and shape of proteins can be studied at four different levels i.e. primary, secondary, tertiary and quaternary, each level being more complex than the previous one.

Answer the following questions :

(i) What is the difference between a glycosidic linkage and peptide linkage ? *1*

(ii) Which amino acids are called essential amino acids ? *1*

(iii) What are the common types of secondary structures of proteins ? Write any two forces which stabilise the secondary and tertiary structures of protein. *2*

OR

(iii) Define denaturation of protein with an example. During denaturation which structures of protein lose their biological activity ? *2*

32. Amines are usually formed from nitro compounds, halides, amides, imides, etc. They exhibit hydrogen bonding which influences their physical properties. In alkyl amines, a combination of electron releasing, steric and hydrogen bonding factors influence the stability of the substituted ammonium cations in protic polar solvents and thus affect the basic nature of amines. In aromatic amines, electron releasing and withdrawing groups, respectively increase and decrease their basic character. Influence of the number of hydrogen atoms at nitrogen atom on the type of reactions and nature of products is responsible for identification and distinction between primary, secondary and tertiary amines. Presence of amino group in aromatic ring enhances reactivity of the aromatic amines. Aryl diazonium salts provide advantageous methods for producing aryl halides, cyanides, phenols and arenes by reductive removal of the diazo group.

Answer the following questions :

(i) Arrange the following in the increasing order of their pK_b values in aqueous solution : *1*

$C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$

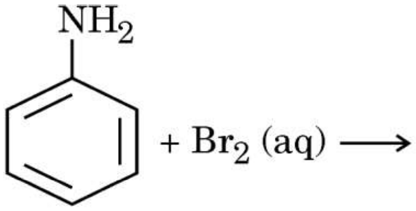
(ii) Aniline on nitration gives a substantial amount of m-nitroaniline, though amino group is o/p directing. Why ? *1*

(iii) An aromatic compound 'A' of molecular formula $C_7H_6O_2$ on treatment with aqueous ammonia and heating forms compound 'B'. Compound 'B' on heating with Br_2 and aqueous KOH gives a compound 'C' of molecular formula C_6H_7N. Write the structures of A, B and C. *2*

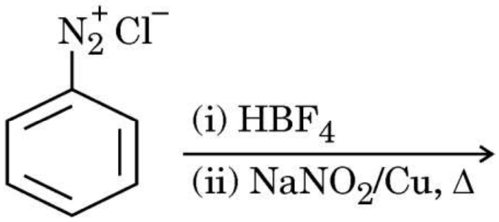
OR

(iii) Complete the following reactions giving main products : *2×1=2*

(1)



(2)



SECTION E

33. (a) (i) Calculate the emf of the following cell at 298 K :

$\text{Al (s)} \mid \text{Al}^{3+} \text{(0·001 M)} \parallel \text{Ni}^{2+} \text{(0·1 M)} \mid \text{Ni (s)}$

[Given : $E^\circ_{Al^{3+}/Al} = -1{\cdot}66$ V, $E^\circ_{Ni^{2+}/Ni} = -0{\cdot}25$ V, log 10 = 1]

(ii) With the help of a graph explain why it is not possible to determine Λ°_m for a weak electrolyte by extrapolating the molar conductivity (Λ_m) versus $C^{1/2}$ curve as for strong electrolyte. *3+2=5*

OR

(b) (i) The molar conductivities of NH_4^+ and Cl^- ion are 73·8 S cm^2 mol^{-1} and 76·2 S cm^2 mol^{-1} respectively. The conductivity of 0·1 M NH_4Cl is $1{\cdot}29 \times 10^{-2}$ S cm^{-1}. Calculate its molar conductivity and degree of dissociation.

(ii) Calculate the half-cell potential at 298 K for the reaction

$$Zn^{2+} + 2e^- \longrightarrow Zn$$

if $[Zn^{2+}] = 0{\cdot}1$ M and $E^\circ_{Zn^{2+}/Zn} = -0{\cdot}76$ V. *3+2=5*

34. (a) (i) Account for the following :

(1) Zn^{2+} salts are colourless while Ni^{2+} salts are coloured.

(2) Cr^{2+} is a strong reducing agent.

(3) Transition metals and their compounds show catalytic activities.

(ii) Write the ionic equations for the oxidizing action of MnO_4^- in acidic medium with

(1) I^- ion, and

(2) Fe^{2+} ion. *3+2=5*

OR

(b) (i) Name two oxometal anions of the 3d series of the transition metals in which the metal exhibits the oxidation state equal to its group number.

(ii) What is the effect of increasing pH on a solution of $K_2Cr_2O_7$?

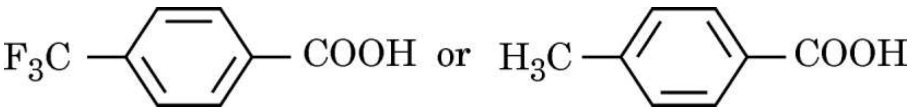
(iii) Why is Cu^+ not stable in aqueous solution ?

(iv) Name a member of Lanthanoid series which is well-known to exhibit +4 oxidation state.

(v) Name two elements of 3d series which show anomalous electronic configuration. *5×1=5*

35. (a) Draw structure of the 2,4-dinitrophenylhydrazone of benzaldehyde.

(b) Which acid of the following pair is a stronger acid ?

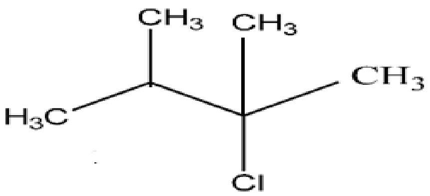


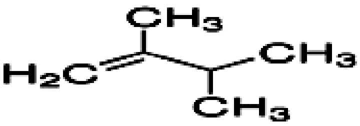
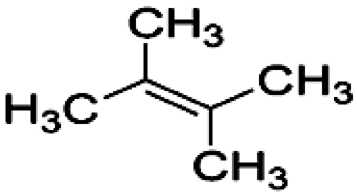
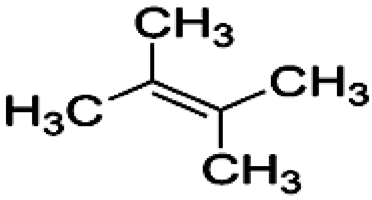
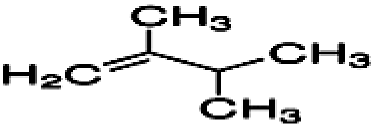
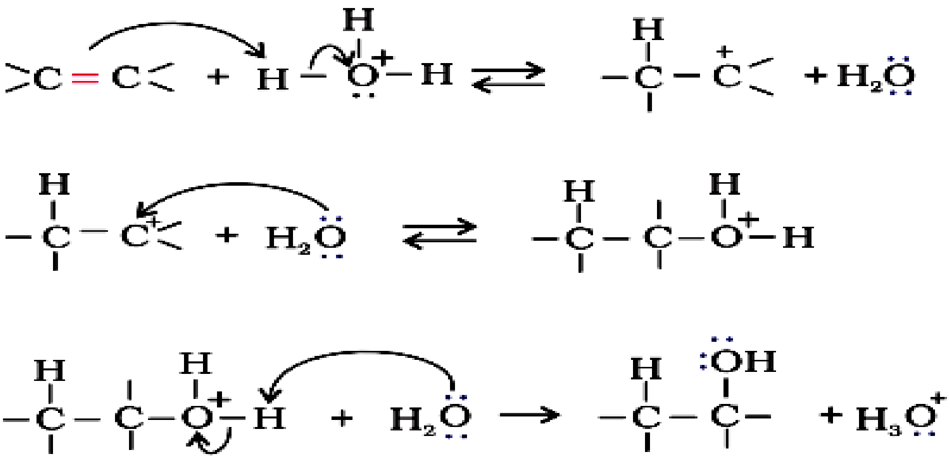
(c) Write the chemical equation involved in Rosenmund's reduction.

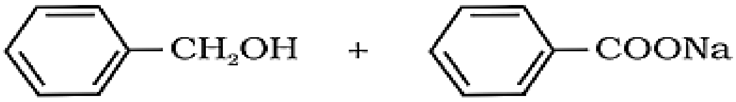
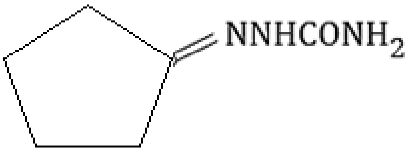
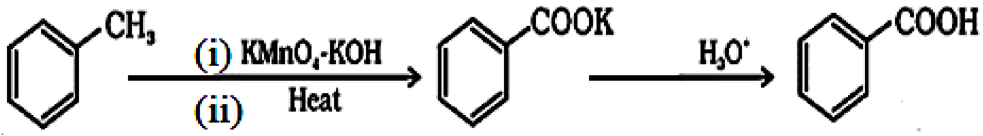
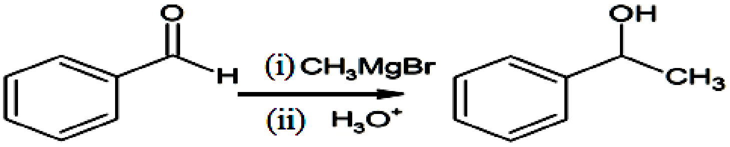
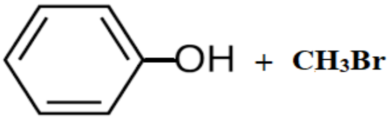
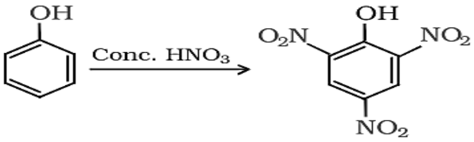
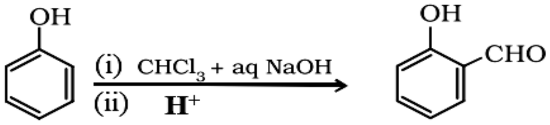
(d) Why are α-hydrogen atoms of aldehydes and ketones acidic in nature ?

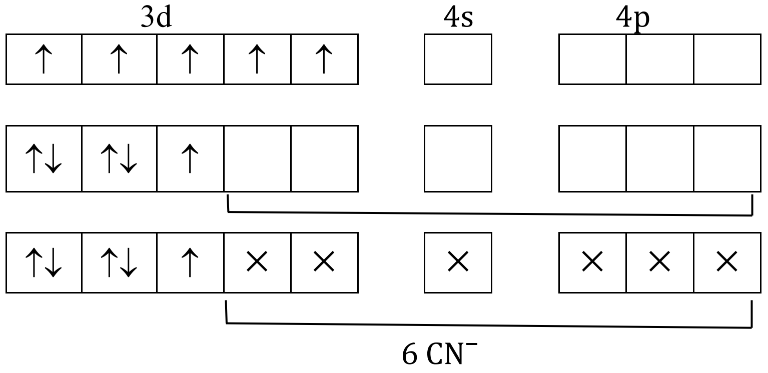
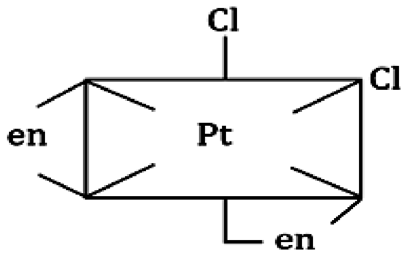
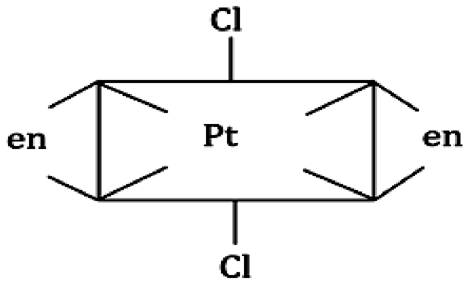
(e) Write a chemical test to distinguish between Benzaldehyde and Benzoic acid. *5×1=5*

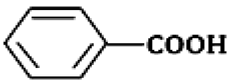
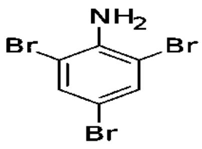
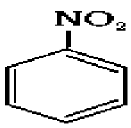
MARKING SCHEME
Senior Secondary School Examination, 2023
CHEMISTRY (Subject Code–043)
[Paper Code: 56/4/1]

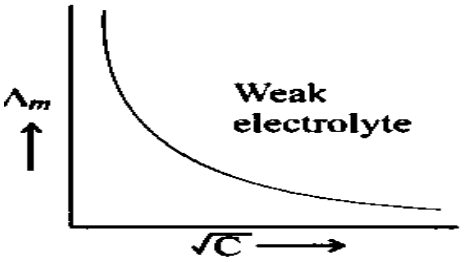
Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION-A	
1.	(b)	1
2.	(d)	1
3.	(a)	1
4.	(c)	1
5.	(b)	1
6.	(a)	1
7.	(d)	1
8.	(b)	1
9	(d)	1
10.	(a)	1
11.	(a)	1
12.	(d)	1
13.	(b)	1
14.	(c)	1
15.	(a)	1
16.	(d)	1
17.	(b)	1
18.	(a)	1
	SECTION-B	
19.	A = 	1

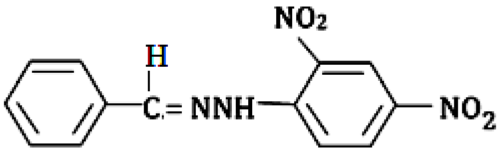
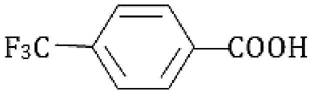
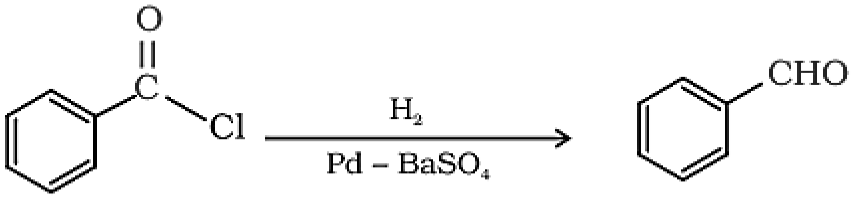
	B=  OR  C=  OR 	½ ½
20.	(a) • Positive deviation, • On adding acetone, some of the hydrogen bonds of ethanol are broken down causing an increase in vapour pressure / the ethanol-acetone shows weaker interactions than pure ethanol-ethanol and acetone-acetone interactions.	1 1
	OR (b) A liquid binary mixture that distills at constant temperature without undergoing a change in composition. Maximum boiling azeotrope 68% HNO_3+ 32% H_2O	1 ½ ½
21.	(a) Fuel cell (b) Lead storage (c) Mercury cell (d) Dry cell	½ x 4
22.	$\log k = \log A - \frac{Ea}{2{\cdot}303\ RT}$ $-\frac{Ea}{2{\cdot}303\ R} = -2 \times 10^4\ K$ $E_a = 2{\cdot}303 \times 8{\cdot}314\ J\ K^{-1}\ mol^{-1}$ x $2 \times 10^4\ K$ $E_a = 3.830 \times 10^5\ J\ mol^{-1}$	½ ½ ½ ½
23.	$H_2O + H^+ \rightarrow H_3O^+$ 	½ 1 ½

24.	(a) (i)  (ii) 	1 1
	OR (b) (i)  (ii)  (or any other correct method of conversion in not more than two steps)	1 1
25.	(a) Tetraamminechloridonitrito-N-cobalt(III) chloride (b) Dichloridobis(ethane-1,2-diamine)platinum(IV) ion	1 1
	SECTION -C	
26.	(a) (i) $3\,CH_3-CH=CH_2 \xrightarrow{B_2H_6} (CH_3-CH_2-CH_2)_3B \xrightarrow{H_2O_2/OH^-} 3\,CH_3-CH_2-CH_2OH + B(OH)_3$ (ii)  (iii) Because of electron-withdrawing nature or -I effect of – NO_2 group / p-nitrophenoxide ion is more stable than phenoxide ion / due to more effective delocalization of negative charge in p-nitrophenoxide ion.	1 1 1
	OR (b) (i) (1)  (2) 	1 1
	(ii) Because CH_3ONa acts as a strong base which leads to elimination reactions.	1

27.	(a) Due to the resonance stabilisation of benzyl carbocation. (b) Because it is a racemic mixture / it contains an equimolar mixture of the two enantiomers of Butan-2-ol. (c) Because it forms a poisonous gas phosgene in presence of air and light.	1 1 1
28.	(a) Fe = $3d^6 4s^2$ Fe^{3+} = Fe^{3+} = in presence of CN^- $[Fe[CN_6]^{3-}$ =  Hence hybridization is d^2sp^3 (b)  cis  trans (c) Cl^- being a weak field ligand does not cause pairing of electrons and hence $[NiCl_4]^{2-}$ is paramagnetic while CO being a strong field ligand causes pairing of electrons therefore $[Ni(CO)_4]$ is diamagnetic. (d) Linkage isomerism. Example, CN^- / NO_2^- / SCN^-	1 x 3
29.	$\pi = i\frac{n_B}{V}RT$ $6\cdot5 = i \times \frac{W_B}{M_B} \times \frac{1000}{V} \times 0\cdot0821$ $6\cdot5 = i \times \frac{6\cdot1}{122} \times \frac{1000}{100\ L} \times 0\cdot0821 \times 300\ K$ $i = \frac{6\cdot5 \times 122}{6\cdot1 \times 0\cdot0821 \times 300 \times 10} = 0\cdot528$ $\alpha = \frac{1-i}{1-\frac{1}{n}} = \frac{1-0\cdot528}{1-\frac{1}{2}} = 0\cdot944 \text{ or } 94\cdot4\%$	½ 1 ½ 1

30.	$k = \frac{2.303}{t} \log \frac{p_i}{(2p_i - p_t)}$ $k = \frac{2\cdot303}{100} \log \frac{0\cdot4}{0\cdot8 - 0\cdot6}$ $= \frac{2\cdot303}{100} \log 2$ $= \frac{2\cdot303 \times 0\cdot3010}{100}$ $= 0\cdot0069\ s^{-1}$ or $0\cdot007\ s^{-1}$ (Deduct ½ mark for no or incorrect unit)	½ 1 ½ 1
	SECTION-D	
31.	(i) **Peptide linkage** : A linkage formed when two amino acids are joined through – CONH – bond. **Glycosidic linkage**: When two monosaccharides are joined through oxygen atom. (or any other correct difference) (ii) Those which are not synthesised in the body and must be obtained through diet. (iii) α-helix and β-pleated sheet. Hydrogen bond, van der Waals forces, disulphide linkages, electrostatic force of attraction. (any two)	1 1 1 ½ , ½
	OR (iii) Loss of biological activity when native form of protein is subjected to change in temperature, pH, etc. Example, curdling of milk (or any other suitable example) Secondary and tertiary structure lose their biological activity.	1 1
32.	(i) $(C_2H_5)_2NH < (C_2H_5)_3N < C_2H_5NH_2$ (ii) Due to the protonation of aniline to form anilinium ion which makes it deactivating and meta-directing. (iii) A =  B =  C = 	1 1 1 ½ ½
	OR (1)  (2) 	1 x 2

	SECTION-E	
33.	(a) (i)	
	$E_{cell} = E^\circ_{cell} - \frac{0.059}{6} \log \frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$	1
	$E_{cell} = [-0.25 + 1.66] - \frac{0.059}{6} \log \frac{[0.001]^2}{[0.1]^3}$	
	$= 1.41 - \frac{0.059}{6} \log 10^{-6+3}$	1
	$= 1.41 + \frac{0.059}{6} \times 3$	
	$= 1.41 + 0.0295$	
	$= 1.4395\ V$	1
	(Deduct ½ mark for no or incorrect unit)	
	(b) (i)	
		1
	(ii) As seen from the curve, it runs parallel to the y-axis. So, even on extrapolation, it will not intercept, hence Λ°_m cannot be obtained.	1
	OR	
	(b) (i)	
	$\Lambda^\circ_m (NH_4Cl) = 73.8 + 76.2 = 150.0\ S\ cm^2\ mol^{-1}$	½
	$\Lambda_m = \frac{k}{c} \times 1000\ S\ cm^2\ mol^{-1}$	½
	$\Lambda_m = \frac{1.29 \times 10^{-2}}{0.1} \times 1000\ S\ cm^2\ mol^{-1}$	½
	$\Lambda_m = 1.29 \times 10^2 = 129\ S\ cm^2\ mol^{-1}$	½
	$\alpha = \frac{\Lambda_m}{\Lambda^\circ_m}$	½
	$\alpha = \frac{129}{150} = 0.86$	½
	(ii)	
	$E_{Zn^{2+}\|Zn} = E^\circ_{Zn^{2+}/Zn} - \frac{0.059}{2} \log \frac{1}{[Zn^{2+}]}$	½
	$E_{Zn^{2+}\|Zn} = -0.76\ V - \frac{0.059}{2} \log \frac{1}{0.1}$	½
	$E_{Zn^{2+}\|Zn} = -0.76\ V - 0.0295$	
	$= -0.7895\ V$	1

34.	(a) (i) (1) Because of no unpaired electron in d-orbitals in Zn^{2+} whereas, Ni^{2+} has 2 unpaired electrons in d-orbitals / Ni^{2+} shows d-d transition while Zn^{2+} does not. (2) Because Cr is more stable in + 3 oxidation state due to stable t_{2g}^3 configuration. (3) Because of their ability to show multiple or variable oxidation states / ability to form complex / provide larger surface area for the reactants. (ii) (1) $2\,MnO_4^- + 10\,I^- + 16\,H^+ \longrightarrow 2\,Mn^{2+} + 5\,I_2 + 8\,H_2O$ (2) $\mathbf{MnO_4^- + 5\,Fe^{2+} + 8\,H^+ \longrightarrow Mn^{2+} + 5\,Fe^{3+} + 4\,H_2O}$	1 1 1 1 1
	OR (b) (i) Dichromate ion/ Chromate ion / Permanganate ion (any two) (ii) Changes to CrO_4^{2-} / K_2CrO_4 (iii) Cu^+ ion (aq.) undergoes disproportionation to Cu^{2+} (aq.) and Cu / $2\,Cu^+ (aq.) \longrightarrow Cu^{2+} (aq.) + Cu (s)$ (iv) Cerium /Terbium (**v**) Chromium, Copper	1 x 5
35.	(a)  (b)  (c)  (or any other correct chemical equation) (d) Due to resonance stabilization of conjugate base enolate ion. (e) On adding $NaHCO_3$ solution, Benzoic acid gives effervescence of CO_2 whereas Benzaldehyde does not. (or any other suitable chemical test)	1 1 1 1 1

* * *

SET-1

Series HFG1E/5

प्रश्न-पत्र कोड
Q.P. Code 56/5/1

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

रसायन विज्ञान (सैद्धांतिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे — *अधिकतम अंक : 70*

Time allowed : 3 hours — *Maximum Marks : 70*

- कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।
- प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
- कृपया जाँच कर लें कि इस प्रश्न-पत्र में **35** प्रश्न हैं ।
- **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**
- इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

- Please check that this question paper contains **23** printed pages.
- Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains **35** questions.
- **Please write down the serial number of the question in the answer-book before attempting it.**
- 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

^

General Instructions :

Read the following instructions very carefully and follow them :

- *(i) This question paper contains **35** questions. **All** questions are compulsory.*
- *(ii) Question paper is divided into **FIVE** sections – Section **A, B, C, D** and **E**.*
- *(iii) **In section – A :** Question Numbers **1** to **18** are Multiple Choice (MCQ) type Questions carrying **1** mark each.*
- *(iv) **In section – B :** Question Numbers **19** to **25** are Very Short Answer (VSA) type questions carrying **2** marks each.*
- *(v) **In section – C :** Question Numbers **26** to **30** are Short Answer (SA) type questions carrying **3** marks each.*
- *(vi) **In section – D :** Question Numbers **31** and **32** are case based questions carrying **4** marks each.*
- *(vii) **In section – E :** Question Numbers **33** to **35** are Long Answer (LA) type questions carrying **5** marks each.*
- *(viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section – B, 2 questions in Section – C, 2 questions in Section – D and 2 questions in Section – E.*
- *(ix) Use of calculators is NOT allowed.*

SECTION – A

1. Which of the following molecules has a chiral centre correctly labelled with an asterisk (*) ? **1**

(a) $CH_3C^*HBrCH_3$ (b) $CH_3C^*HClCH_2Br$

(c) $HOCH_2C^*H(OH)CH_2OH$ (d) $CH_3C^*Br_2CH_3$

2. Which of the following alcohols will not undergo oxidation ? **1**

(a) Butanol (b) Butan-2-ol

(c) 2-Methylbutan-2-ol (d) 3-Methylbutan-2-ol

3. A voltaic cell is made by connecting two half cells represented by half equations below : **1**

$Sn^{2+}_{(aq)} + 2e^- \rightarrow Sn_{(s)}$ $E^\circ = -0.14$ V

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$ $E^\circ = +0.77$ V

Which statement is correct about this voltaic cell ?

(a) Fe^{2+} is oxidised and the voltage of the cell is –0.91 V

(b) Sn is oxidised and the voltage of the cell is 0.91 V

(c) Fe^{2+} is oxidised and the voltage of the cell is 0.91 V

(d) Sn is oxidised and the voltage of the cell is 0.63 V

4. Four half reactions I to IV are shown below : **1**

I. $2Cl^- \rightarrow Cl_2 + 2e^-$

II. $4OH^- \rightarrow O_2 + 2H_2O + 2e^-$

III. $Na^+ + e^- \rightarrow Na$

IV. $2H^+ + 2e^- \rightarrow H_2$

Which two of these reactions are most likely to occur when concentrated brine is electrolysed ?

(a)	I and III	(b)	I and IV
(c)	II and III	(d)	II and IV

5. Which property of transition metals enables them to behave as catalysts ? **1**

(a)	High melting point	(b)	High ionisation enthalpy
(c)	Alloy formation	(d)	Variable oxidation states

6. In the two tetrahedral structures of dichromate ion **1**

(a) 4 Cr – O bonds are equivalent in length.

(b) 6 Cr – O bonds are equivalent in length.

(c) All Cr – O bonds are equivalent in length.

(d) All Cr – O bonds are non-equivalent.

7. 1 mole of liquid A and 2 moles of liquid B make a solution having a total vapour pressure 40 torr. The vapour pressure of pure A and pure B are 45 torr and 30 torr respectively. The above solution **1**

(a) is an ideal solution.

(b) shows positive deviation.

(c) shows negative deviation.

(d) is a maximum boiling azeotrope.

8. Which of the following would not be a good choice for reducing nitrobenzene to aniline ? **1**

(a) $LiAlH_4$

(b) H_2/Ni

(c) Fe and HCl

(d) Sn and HCl

9. If molality of a dilute solution is doubled, the value of the molal elevation constant (K_b) will be **1**

(a) halved

(b) doubled

(c) tripled

(d) unchanged

10. Hydrolysis of sucrose is called **1**

(a) inversion

(b) hydration

(c) esterification

(d) saponification

11. Which one of the following has lowest pK_a value ? **1**

(a) $CH_3 - COOH$

(b) $O_2N - CH_2 - COOH$

(c) $Cl - CH_2 - COOH$

(d) $HCOOH$

12. Which of the following cell was used in Apollo space programme ? **1**

(a) Mercury cell

(b) Daniel cell

(c) H_2–O_2 Fuel cell

(d) Dry cell

13. The following experimental rate data were obtained for a reaction carried out at 25 °C : **1**

$A_{(g)} + B_{(g)} \rightarrow C_{(g)} + D_{(g)}$

Initial $[A_{(g)}]$/mol dm^{-3}	Initial $[B_{(g)}]$/mol dm^{-3}	Initial rate/mol dm^{-3}s^{-1}
3.0×10^{-2}	2.0×10^{-2}	1.89×10^{-4}
3.0×10^{-2}	4.0×10^{-2}	1.89×10^{-4}
6.0×10^{-2}	4.0×10^{-2}	7.56×10^{-4}

What are the orders with respect to $A_{(g)}$ and $B_{(g)}$?

	Order with respect to $A_{(g)}$	Order with respect to $B_{(g)}$
(a)	Zero	Second
(b)	First	Zero
(c)	Second	Zero
(d)	Second	First

14. The magnetic moment of $[NiCl_4]^{2-}$ **1**

(a) 1.82 BM (b) 2.82 BM

(c) 4.42 BM (d) 5.46 BM

[Atomic number : Ni = 28]

For questions number **15** to **18**, two statements are given – one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below :

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

15. **Assertion (A) :** Proteins are polymers of α-amino acids connected by a peptide bond. **1**

Reason (R) : A tetrapeptide contains 4 amino acids linked by 4 peptide bonds.

16. **Assertion (A) :** For a zero order reaction the unit of rate constant and rate of reaction are same. **1**

Reason (R) : Rate of reaction for zero order reaction is independent of concentration of reactant.

17. **Assertion (A) :** Acetic acid but not formic acid can be halogenated in presence of red P and Cl_2. **1**

Reason (R) : Acetic acid is a weaker acid than formic acid.

18. **Assertion (A) :** Trans $[Cr\,Cl_2(ox)_2]^{3-}$ shows optical isomerism. **1**

Reason (R) : Optical isomerism is common in octahedral complexes involving didentate ligands.

SECTION – B

19. (a) (i) What should be the signs (positive/negative) for $E°_{Cell}$ and $\Delta G°$ for a spontaneous redox reaction occurring under standard conditions ? **2 × 1 = 2**

(ii) State Faraday's first law of electrolysis.

OR

(b) Calculate the emf of the following cell at 298 K :

$Fe_{(s)} \mid Fe^{2+}\,(0.01M) \| H^+_{(1M)} \mid H_{2(g)}\,(1\ bar), Pt_{(s)}$

Given $E°_{Cell} = 0.44$ V. **2**

20. What happens to the rate constant k and activation energy E_a as the temperature of a chemical reaction is increased ? Justify. **2**

21. (a) Which of the following species cannot act as a ligand ? Give reason.

OH^-, NH_4^+, CH_3NH_2, H_2O **2 × 1 = 2**

(b) The complex $[Co(NH_3)_5(NO_2)]Cl_2$ is red in colour. Give IUPAC name of its linkage isomer.

22. Why is boiling point of o-dichlorobenzene higher than p-dichlorobenzene but melting point of para isomer is higher than ortho isomer ? **2**

23. For the pair phenol and cyclohexanol, answer the following : **2 × 1 = 2**

(a) Why is phenol more acidic than cyclohexanol ?

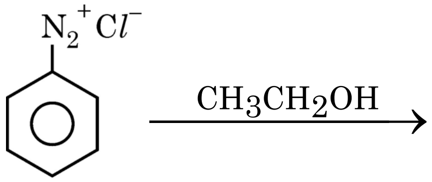
(b) Give one chemical test to distinguish between the two.

24. (a) (i) Draw the zwitter ion structure for sulphanilic acid. **2 × 1 = 2**

(ii) How can the activating effect of $-NH_2$ group in aniline be controlled ?

OR

(b) (i) Complete the reaction with the main product formed : **2 × 1 = 2**



(ii) Convert Bromoethane to Propanamine.

25. Give the reaction of glucose with hydrogen cyanide. Presence of which group is confirmed by this reaction ? **2**

SECTION – C

26. (a) For the reaction **1 + 2 = 3**

$2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$ at 318 K

calculate the rate of reaction if rate of disappearance of $N_2O_{5(g)}$ is 1.4×10^{-3} m s^{-1}.

(b) For a first order reaction derive the relationship $t_{99\%} = 2t_{90\%}$

27. (a) On the basis of crystal field theory write the electronic configuration for d^5 ion with a strong field ligand for which $\Delta_0 > P$. **1 + 2 = 3**

(b) $[Ni(CO)_4]$ has tetrahedral geometry while $[Ni(CN)_4]^{2-}$ has square planar yet both exhibit dimagnetism. Explain.

[Atomic number : Ni = 28]

28. (a) Illustrate Sandmeyer's reaction with an equation. **1 + 2 = 3**

(b) Explain, why $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in aqueous solution.

29. Give reasons for **any 3** of the following observations : **3 × 1 = 3**

(a) Penta-acetate of glucose does not react with hydroxylamine.

(b) Amino acids behave like salts.

(c) Water soluble vitamins must be taken regularly in diet.

(d) The two strands in DNA are complimentary to each other.

30. (a) (i) Why is the C – O bond length in phenols less than that in methanol ? **3 × 1 = 3**

(ii) Arrange the following in order of increasing boiling point :
Ethoxyethane, Butanal, Butanol, n-butane

(iii) How can phenol be prepared from anisole ? Give reaction.

OR

(b) (i) Give mechanism of the following reaction : **2 + 1 = 3**

$$CH_3CH_2OH \xrightarrow[413\ K]{H_2SO_4} CH_3CH_2 - O - CH_2CH_3 + H_2O$$

(ii) Illustrate hydroboration – oxidation reaction with an example.

SECTION – D

The following questions are case – based questions. Read the passage carefully and answer the questions that follow :

31. **Nucleophilic Substitution**

Nucleophilic Substitution reaction of haloalkane can be conducted according to both S_N1 and S_N2 mechanisms. S_N1 is a two step reaction while S_N2 is a single step reaction. For any haloalkane which mechanism is followed depends on factors such as structure of haloalkane, properties of leaving group, nucleophilic reagent and solvent.

Influences of solvent polarity : In S_N1 reaction, the polarity of the system increases from the reactant to the transition state, because a polar solvent has a greater effect on the transition state than the reactant, thereby reducing activation energy and accelerating the reaction. In S_N2 reaction, the polarity of the system generally does not change from the reactant to the transition state and only charge dispersion occurs. At this time, polar solvent has a great stabilizing effect on Nu than the transition state, thereby increasing activation energy and slow down the reaction rate. For example, the decomposition rate (S_N1) of tertiary chlorobutane at 25 °C in water (dielectric constant 79) is 300000 times faster than in ethanol (dielectric constant 24). The reaction rate (S_N2) of 2-Bromopropane and NaOH in ethanol containing 40% water is twice slower than in absolute ethanol. Hence the level of solvent polarity has influence on both S_N1 and S_N2 reaction, but with different results. Generally speaking weak polar solvent is favourable for S_N2 reaction, while strong polar solvent is favourable for S_N1. Generally speaking the substitution reaction of tertiary haloalkane is based on S_N1 mechanism in solvents with a strong polarity (for example ethanol containing water).

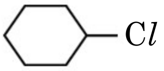
Answer the following questions :

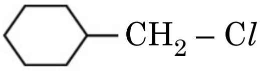
(a) Why racemisation occurs in S_N1 ? **1**

(b) Why is ethanol less polar than water ? **1**

(c) Which one of the following in each pair is more reactive towards S_N2 reaction ?

(i) $CH_3 - CH_2 - I$ or $CH_3CH_2 - Cl$

(ii) 

or 

2 × 1

OR

(c) Arrange the following in the increasing order of their reactivity towards S_N1 reactions :

(i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane

(ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 2-Bromo-3-methylbutane **2 × 1**

32. Rahul set-up an experiment to find resistance of aqueous KC*l* solution for different concentrations at 298 K using a conductivity cell connected to a Wheatstone bridge. He fed the Wheatstone bridge with a.c. power in the audio frequency range 550 to 5000 cycles per second. Once the resistance was calculated from null point he also calculated the conductivity K and molar conductivity $\wedge_m$ and recorded his readings in tabular form.

S.No.	**Conc.(M)**	**k S cm^{-1}**	**$\wedge_m$ S cm^2 mol^{-1}**
1.	1.00	111.3×10^{-3}	111.3
2.	0.10	12.9×10^{-3}	129.0
3.	0.01	1.41×10^{-3}	141.0

Answer the following questions :

(a) Why does conductivity decrease with dilution ? **1**

(b) If $\wedge_m^o$ of KC*l* is 150.0 S cm^2 mol^{-1}, calculate the degree of dissociation of 0.01 M KC*l*. **1**

(c) If Rahul had used HC*l* instead to KC*l* then would you expect the $\wedge_m$ values to be more or less than those per KC*l* for a given concentration. Justify. **2 × 1**

OR

(c) Amit, a classmate of Rahul repeated the same experiment with CH_3COOH solution instead of KCl solution. Give one point that would be similar and one that would be different in his observations as compared to Rahul. **2 × 1**

SECTION – E

33. (a) (i) Why is boiling point of 1M NaCl solution more than that of 1M glucose solution ? **1 + 2 + 2 = 5**

(ii) A non-volatile solute 'X' (molar mass = 50 g mol^{-1}) when dissolved in 78g of benzene reduced its vapour pressure to 90%. Calculate the mass of X dissolved in the solution.

(iii) Calculate the boiling point elevation for a solution prepared by adding 10g of $MgCl_2$ to 200g of water assuming $MgCl_2$ is completely dissociated.

(K_b for Water = 0.512 K kg mol^{-1}, Molar mass $MgCl_2$ = 95g mol^{-1})

OR

(b) (i) Why is the value of Van't Hoff factor for ethanoic acid in benzene close to 0.5 ? **1 + 2 + 2 = 5**

(ii) Determine the osmotic pressure of a solution prepared by dissolving 2.32×10^{-2}g of K_2SO_4 in 2L of solution at 25 °C, assuming that K_2SO_4 is completely dissociated.

(R = 0.082 L atm K^{-1} mol^{-1}, Molar mass K_2SO_4 = 174g mol^{-1})

(iii) When 25.6g of Sulphur was dissolved in 1000g of benzene, the freezing point lowered by 0.512 K. Calculate the formula of Sulphur (S_x).

(K_f for benzene = 5.12 K kg mol^{-1}, Atomic mass of Sulphur = 32g mol^{-1})

34. (a) (i) Write the reaction involved in Cannizaro's reaction. **1 + 1 + 3 = 5**

(ii) Why are the boiling point of aldehydes and ketones lower than that of corresponding carboxylic acids ?

(iii) An organic compound 'A' with molecular formula $C_5H_8O_2$ is reduced to n-pentane with hydrazine followed by heating with NaOH and Glycol. 'A' forms a dioxime with hydroxylamine and gives a positive Iodoform and Tollen's test. Identify 'A' and give its reaction for Iodoform and Tollen's test.

OR

(b) (i) Give a chemical test to distinguish between ethanal acid and ethanoic acid. **1 + 1 + 3 = 5**

(ii) Why is the α-hydrogens of aldehydes and ketones are acidic in nature ?

(iii) An organic compound 'A' with molecular formula $C_4H_8O_2$ undergoes acid hydrolysis to form two compounds 'B' and 'C'. Oxidation of 'C' with acidified potassium permanganate also produces 'B'. Sodium salt of 'B' on heating with soda lime gives methane.

(1) Identify 'A', 'B' and 'C'.

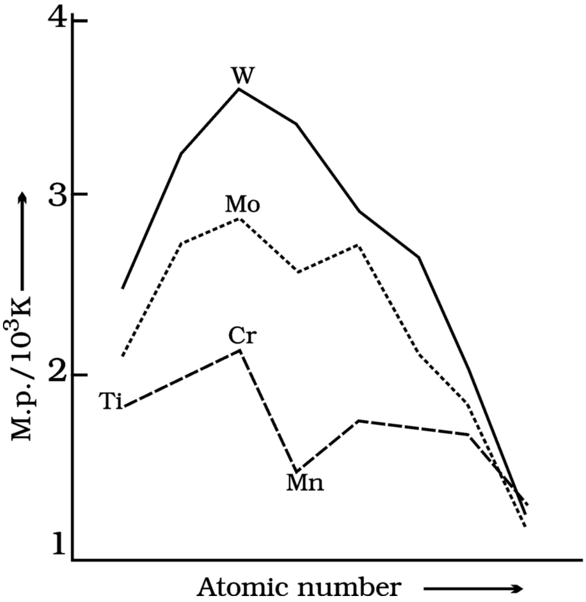
(2) Out of 'B' and 'C', which will have higher boiling point ? Give reason.

35. (a) Why is chemistry of actinoids complicated as compared to lanthanoids ? **1 + 2 + 2 = 5**

(b) Complete the following reaction and justify that it is a disproportionation reaction :

$3\ MnO_4^{2-} + 4H^+ \rightarrow$ _____ + _____ $+ 2\ H_2O$.

(c) The given graph shows the trends in melting points of transition metals :



Explain the reason why Cr has highest melting point and manganese (Mn) a lower melting point.

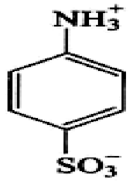
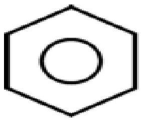
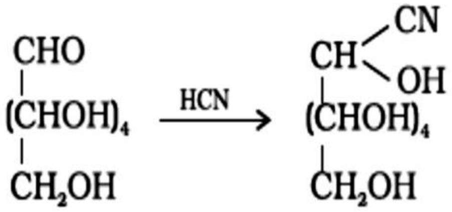
MARKING SCHEME

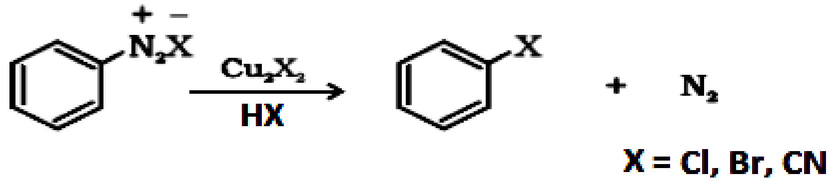
Senior Secondary School Examination, 2023

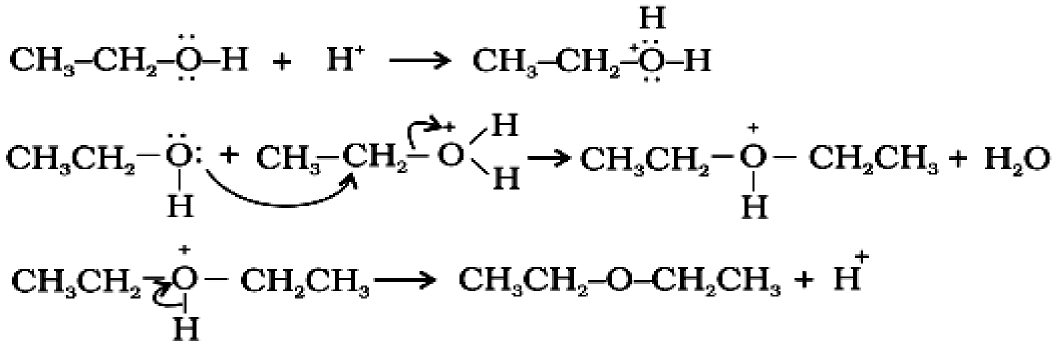
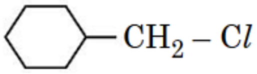
CHEMISTRY (Subject Code–043)

[Paper Code: 56/5/1]

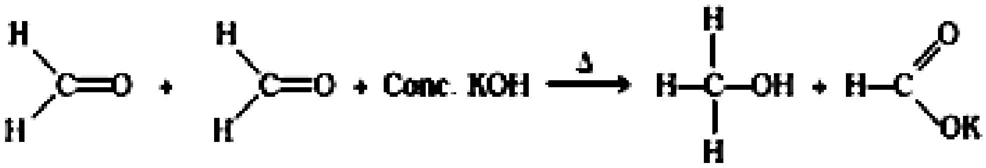
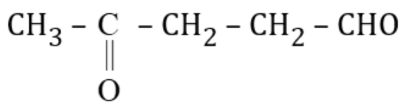
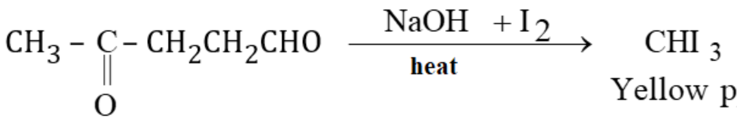
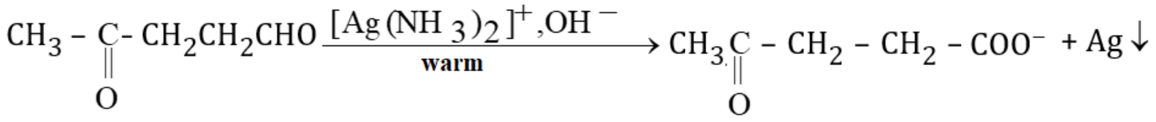
Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks
	SECTION A	
1.	(b)	1
2.	(c)	1
3.	(b)	1
4.	(b)	1
5.	(d)	1
6.	(b)	1
7.	(b)	1
8.	(a)	1
9.	(d)	1
10.	(a)	1
11.	(b)	1
12.	(c)	1
13.	(c)	1
14.	(b)	1
15.	(c)	1
16.	(a) / (b)	1
17.	(b)	1
18.	(d)	1
	SECTION- B	
19.	(a) (i) E^0_{cell} = + ve & ΔG^o= -ve (ii) It states that the mass of a substance deposited / liberated at the electrodes is directly proportional to the charge/quantity of electricity passed through the electrolyte.	½, ½ 1
	OR	
	(b) $E_{cell} = E^{\circ}_{cell} - \frac{0{\cdot}059}{2} \log \frac{[Fe^{2+}(aq)]}{[H^+(aq.)]^2}$ $= 0{\cdot}44 - \frac{0{\cdot}059}{2} \log \frac{(0{\cdot}01)}{(1)^2}$	½ 1

	$= 0{\cdot}44 - \frac{0{\cdot}059}{2} \log 10^{-2}$ $= 0{\cdot}499$ V	½
20.	• k increases. • **Reason**: k is proportional to the rate of the reaction / temperature of the reaction. • E_a unchanged / No effect. • **Reason**: E_a only depends on the nature of reactants / depends on the difference between the energy of activated complex and reactants.	½ ½ ½ ½
21.	(a) NH_4^+ , Due to the unavailability of lone pair of electrons / cannot act as a Lewis base. (b) Pentaamminenitrito-O-cobalt (III)chloride	½ ½ 1
22.	B.P. of o-isomer is higher as it has higher dipole moment or polarity / stronger intermolecular interactions. M.P. of p-isomer is higher as it is symmetric and fits better in the crystal lattice.	1 1
23.	(a) Because phenoxide ion is more stable due to resonance. (or any other correct explanation) (b) Add neutral $FeCl_3$ to both the compounds, phenol gives violet colour whereas cyclohexanol does not. (or any other suitable chemical test)	1 1
24.	(a) (i)  (Zwitter ion) (ii) Protecting /deactivating $-NH_2$ group by acetylation or acylation.	1 1
	OR	
	(b) (i)  (ii) $CH_3CH_2Br \xrightarrow{KCN} CH_3CH_2CN \xrightarrow[\text{or } LiAlH_4 \text{ or } Na(Hg)/C_2H_5OH]{H_2/Ni} CH_3CH_2CH_2NH_2$	1 1
25.	 Confirms the presence of aldehydic / carbonyl group.	1 1

	SECTION-C	
26.	(a) Rate of reaction $= -\frac{1}{2}\frac{\Delta[N_2O_5]}{\Delta t}$ $= \frac{1}{2} \times 1{\cdot}4 \times 10^{-3} = 0{\cdot}7 \times 10^{-3}\ M\ s^{-1}$ or $7 \times 10^{-4}\ M\ s^{-1}$ (Unit may be ignored) (b) $t = \frac{2{\cdot}303}{k}\log\frac{[R]_0}{[R]}$ $t_{99\%} = \frac{2{\cdot}303}{k}\log\frac{100}{1} = \frac{2{\cdot}303}{k}\log 100$ $t_{90\%} = \frac{2{\cdot}303}{k}\log\frac{100}{10} = \frac{2{\cdot}303}{k}\log 10$ $t_{99\%} / t_{90\%} = \frac{\log 100}{\log 10} = 2$	½ ½ ½ ½ ½ ½
27.	(a) $t_{2g}^{5}\ e_{g}^{0}$ (b) $[Ni(CO)_4]$ has sp^3 hybridisation $[Ni(CN)_4]^{2-}$ has dsp^2 hybridisation In both, all electrons are paired. (or explain using V.B. theory).	1 ½ ½ 1
28.	(a)  (b) Combination of inductive effect and solvation effect / Due to greater H-bonding with water molecules, $(CH_3)_2NH$ shows more hydration or solvation effect.	1 1+1
29.	(a) Absence of free – CHO group. (b) Due to the presence of both acidic (-COOH) and basic ($-NH_2$) groups in the same molecule / formation of Zwitter ion. (c) They are excreted in urine / cannot be stored in body. (d) Because the H-bonds are formed between specific pairs of bases / pairing between A & T and between C & G.	1 x 3
30.	(a) (i) Partial double bond character due to resonance in phenol and no resonance in methanol / sp^2 hybridisation in phenol and sp^3 hybridisation in methanol. (ii) n-Butane < Ethoxyethane < Butanal < Butanol (iii) $C_6H_5OCH_3 + HX \longrightarrow C_6H_5OH + CH_3X$	1 1 1
	OR	

	(b) (i)  (ii) $CH_3\text{–}CH{=}CH_2 \xrightarrow[\text{2. NaOH-}H_2O_2]{\text{1.}(H\text{–}BH_2)_2} CH_3\text{–}CH_2\text{–}CH_2\text{–}OH$	½ 1 ½ 1
	SECTION- D	
31.	(a) Because of the formation of planar carbocation / sp^2 hybridized carbocation. (b) Due to the +I effect / electron-releasing nature of the ethyl group in ethanol. (c) (i) CH_3CH_2I (ii) 	1 1 1 1
	OR	
	(c) (i) 1- Bromopentane < 2-Bromopentane < 2-Bromo-2-methylbutane. (ii) 1-Bromo-3-methylbutane < 2-Bromo-3-methylbutane < 2-Bromo-2-methylbutane.	1 1
32.	(a) the number of ions per unit volume decreases on dilution. (b) $\alpha = \frac{\Lambda_m}{\Lambda_m^{\circ}}$ α = 141/150 = 0.94 (c) - More - Mobility of H^+ more than K^+. (Data given in the paper does not support the answer to the above question, award full mark if attempted)	1 1 1+1
	OR	
	(c) - **Similarity**: $\wedge_m$ increases with dilution for both electrolytes. - **Difference**: For KCl the $\wedge_m$ increases gradually whereas for CH_3COOH, $\wedge_m$ increases steeply on dilution / In case of CH_3COOH, $\wedge_m^{\circ}$ cannot be obtained by extrapolation of $\wedge_m$ to zero concentration whereas for KCl it can be obtained / graphical explanation.	1,1

	SECTION-E	
33.	(a) (i) Dissociation of NaCl/more number of particles in NaCl solution / Value of ‘i' for NaCl is greater than that of glucose.	1
	(ii) $\frac{p^o - p}{p^o} = x_2$ $= \frac{n_2}{n_2 + n_1}$ $(n_1 = w_A / M_A = 78/M_A)$ $p = 0{\cdot}9\, p^o$	½
	$\frac{p^o - 0{\cdot}9\, p^o}{p^o} = \frac{w/50}{w/50 + 1}$ $\left[n_1 = \frac{78}{78} = 1 \right]$	1
	$0{\cdot}1\left(\frac{w}{50} + 1\right) = \frac{w}{50}$ $w = 5{\cdot}55$g (or 5g if dilute solution is considered)	½
	(Full marks may be awarded if the student substitutes M_A for molar mass of benzene as the molar mass of benzene is not given in the question).	
	(iii) $\Delta T_b = i K_b m$	½
	$i = 3$	½
	$\Delta T_b = 3 \times 0{\cdot}512 \times \frac{10}{95} \times \frac{1000}{200}$	½
	$\Delta T_b = 0{\cdot}81$ K or °C	½
	OR	
	(b) (i) Ethanoic acid molecules associate to form dimer so the number of particles are nearly reduced to half.	1
	(ii) $\pi = i\,CRT$	½
	$i = 3$	½
	$\pi = 3 \times \frac{2{\cdot}32 \times 10^{-2}}{174 \times 2} \times 0{\cdot}082 \times 298$	½
	$= 4{\cdot}88 \times 10^{-3}$ atm	½
	(iii) $\Delta T_b = K_f \frac{w_2}{M_2} \times \frac{1000}{w_1}$	½
	$0{\cdot}512 = 5{\cdot}12 \times \frac{25{\cdot}6}{M_2} \times \frac{1000}{1000}$	½
	$M_2 = 256$ $S \times x = 256$ $32 \times x = 256$	½
	$x = \frac{256}{32} = 8$ i.e. S_8	½

34.	(a) (i)  (or any other suitable reaction)	1
	(ii) Carboxylic acids have strong hydrogen bonding whereas aldehydes and ketones have weak dipole-dipole interactions.	1
	(iii) A =  $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-CHO$ / 4-oxopentanal	1
	 $CH_3-\underset{\underset{O}{\|}}{C}-CH_2CH_2CHO \xrightarrow[\text{heat}]{NaOH\ +I_2} CHI_3$ Yellow ppt	1
	 $CH_3-\underset{\underset{O}{\|}}{C}-CH_2CH_2CHO \xrightarrow[\text{warm}]{[Ag(NH_3)_2]^+,OH^-} CH_3\underset{\underset{O}{\|}}{C}-CH_2-CH_2-COO^- + Ag\downarrow$	1
	OR	
	(b) (i) Add $NaHCO_3$ solution to both compounds, ethanoic acid will give the brisk effervescence of CO_2 while ethanal does not (or any other suitable chemical test). (Award full marks if the question is attempted because there is a misprint in the question paper).	1
	(ii) due to resonance stabilization of the conjugate base formed / the strong electron-withdrawing effect of the carbonyl group.	1
	(iii)(1) A = $CH_3COOC_2H_5$ / Ethyl ethanoate / Ethyl acetate, B = CH_3COOH / Ethanoic acid / Acetic acid, C = CH_3CH_2OH / Ethanol / Ethyl alcohol.	1 ½ ½
	(2) B, due to the more extensive association of carboxylic acid molecules through strong hydrogen bonding.	½, ½
35.	(a) Actinoids show wide range of oxidation states / most of them are radioactive elements.	1
	(b) $3MnO_4^{2-} + 4H^+ \longrightarrow + \underline{2MnO_4^-} + \underline{MnO_2} + 2H_2O$ Oxidation state of Mn increases from +6 to + 7 (oxidation) and decreases from + 6 to + 4 (reduction) / Mn undergoes increase and decrease in oxidation state simultaneously.	1 1
	(c) Due to the presence of a greater number of unpaired electrons which leads to strong interatomic metal-metal bonding whereas Mn with a stable half-filled d^5 configuration has a weaker metallic bond.	1, 1

* * *

Series SQR1P/1 **SET-1**

प्रश्न-पत्र कोड
Q.P. Code **56/1/1**

रोल नं.
Roll No. ☐☐☐☐☐☐☐☐

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

नोट

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **27** हैं ।

(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं ।

(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

NOTE

(I) Please check that this question paper contains **27** printed pages.

(II) Please check that this question paper contains **33** questions.

(III) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(IV) **Please write down the serial number of the question in the answer-book before attempting it.**

(V) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे *अधिकतम अंक : 70*

Time allowed : 3 hours *Maximum Marks : 70*

General Instructions :

Read the following instructions carefully and follow them :

*(i) This question paper contains **33** questions. **All** questions are **compulsory**.*

*(ii) This question paper is divided into **five** sections – **Section A, B, C, D** and **E**.*

*(iii) **Section A** – questions number **1** to **16** are multiple choice type questions. Each question carries **1** mark.*

*(iv) **Section B** – questions number **17** to **21** are very short answer type questions. Each question carries **2** marks.*

*(v) **Section C** – questions number **22** to **28** are short answer type questions. Each question carries **3** marks.*

*(vi) **Section D** – questions number **29** and **30** are case-based questions. Each question carries **4** marks.*

*(vii) **Section E** – questions number **31** to **33** are long answer type questions. Each question carries **5** marks.*

(viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.

(ix) Kindly note that there is a separate question paper for Visually Impaired candidates.

*(x) Use of calculators is **not** allowed.*

SECTION A

*Questions no. **1** to **16** are Multiple Choice type Questions, carrying **1** mark each.* *16×1=16*

1. Which one of the following first row transition elements is expected to have the highest third ionization enthalpy ?

(A) Iron (Z = 26)

(B) Manganese (Z = 25)

(C) Chromium (Z = 24)

(D) Vanadium (Z = 23)

2. Which of the following compounds will give a ketone on oxidation with chromic anhydride (CrO_3) ?

(A) $(CH_3)_2CH - CH_2OH$

(B) $CH_3CH_2CH_2OH$

(C) $(CH_3)_3C - OH$

(D)

$CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

3. Two among the three components of DNA are β-D-2-deoxyribose and a heterocyclic base. The third component is :

(A) Adenine

(B) Phosphoric acid

(C) Sulphuric acid

(D) Uracil

4. For an electrolyte undergoing association in a solvent, the van't Hoff factor :

(A) is always greater than one

(B) has negative value

(C) has zero value

(D) is always less than one

5. For the reaction X + 2Y → P, the differential form equation of the rate law is :

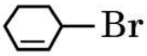
(A) $\frac{2d[P]}{dt} = \frac{-d[Y]}{dt}$

(B) $\frac{-d[P]}{dt} = \frac{-d[X]}{dt}$

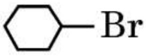
(C) $\frac{+d[X]}{dt} = \frac{-d[P]}{dt}$

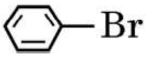
(D) $\frac{-2d[Y]}{dt} = \frac{+d[P]}{dt}$

6. The compound which undergoes S_N1 reaction most rapidly is :

(A) 

(B) 

(C) 

(D) 

7. Acetic acid reacts with PCl_5 to give :

(A) $Cl - CH_2 - COCl$

(B) $Cl - CH_2 - COOH$

(C) $CH_3 - COCl$

(D) $CCl_3 - COOH$

8. The formation of cyanohydrin from an aldehyde is an example of :

(A) nucleophilic addition

(B) electrophilic addition

(C) nucleophilic substitution

(D) electrophilic substitution

9. In the Arrhenius equation, when log k is plotted against 1/T, a straight line is obtained whose :

(A) slope is $\frac{A}{R}$ and intercept is E_a.

(B) slope is A and intercept is $\frac{-E_a}{R}$.

(C) slope is $\frac{-E_a}{RT}$ and intercept is log A.

(D) slope is $\frac{-E_a}{2{\cdot}303\ R}$ and intercept is log A.

10. The reaction of an alkyl halide with sodium alkoxide forming ether is known as :

(A) Wurtz reaction

(B) Reimer-Tiemann reaction

(C) Williamson synthesis

(D) Kolbe reaction

11. The correct order of the ease of dehydration of the following alcohols by the action of conc. H_2SO_4 is :

(A) $(CH_3)_3C - OH > (CH_3)_2CH - OH > CH_3CH_2 - OH$

(B) $(CH_3)_2CH - OH > CH_3CH_2 - OH > (CH_3)_3C - OH$

(C) $CH_3CH_2 - OH > (CH_3)_2CH - OH > (CH_3)_3C - OH$

(D) $(CH_3)_2CH - OH > (CH_3)_3C - OH > CH_3CH_2 - OH$

12. Which functional groups of glucose interact to form cyclic hemiacetal leading to pyranose structure ?

(A) Aldehyde group and hydroxyl group at C – 4

(B) Aldehyde group and hydroxyl group at C – 5

(C) Ketone group and hydroxyl group at C – 4

(D) Ketone group and hydroxyl group at C – 5

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* When NaCl is added to water a depression in freezing point is observed.

Reason (R) : NaCl undergoes dissociation in water.

14. *Assertion (A) :* Separation of Zr and Hf is difficult.

Reason (R) : Zr and Hf have similar radii due to lanthanoid contraction.

15. *Assertion (A) :* The pK_a of ethanoic acid is lower than that of $Cl - CH_2 - COOH$.

Reason (R) : Chlorine shows electron withdrawing (–I) effect which increases the acidic character of $Cl - CH_2 - COOH$.

16. *Assertion (A) :* Aniline is a stronger base than ammonia.

Reason (R) : The unshared electron pair on nitrogen atom in aniline becomes less available for protonation due to resonance.

SECTION B

17. Calculate the potential of Iron electrode in which the concentration of Fe^{2+} ion is 0·01 M.

($E^{o}_{Fe^{2+}/Fe} = -\ 0{\cdot}45$ V at 298 K)

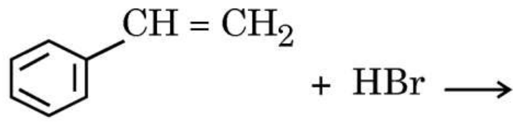
[Given : log 10 = 1] *2*

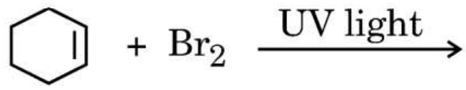
18. Define molecularity of the reaction. State any one condition in which a bimolecular reaction may be kinetically of first order. *2*

19. What happens when D-glucose is treated with the following reagents ? *1+1=2*

(a) HI (b) Conc. HNO_3

20. (a) Draw the structures of major monohalo products in each of the following reactions : *1+1=2*

(i) 

(ii) 

OR

(b) Give reasons for the following : *1+1=2*

(i) Grignard reagent should be prepared under anhydrous conditions.

(ii) Alkyl halides give alcohol with aqueous KOH whereas in the presence of alcoholic KOH, alkenes are formed.

21. Write the chemical equation when : *1+1=2*

(a) Butan-2-one is treated with Zn(Hg) and conc. HCl.

(b) Two molecules of benzaldehyde are treated with conc. NaOH.

SECTION C

22. When a certain conductivity cell was filled with 0·05 M KCl solution, it has a resistance of 100 ohm at 25°C. When the same cell was filled with 0·02 M $AgNO_3$ solution, the resistance was 90 ohm. Calculate the conductivity and molar conductivity of $AgNO_3$ solution. *3*

(Given : Conductivity of 0·05 M KCl solution = $1{\cdot}35 \times 10^{-2}$ ohm^{-1}cm^{-1})

23. The following initial rate data were obtained for the reaction :

$$2NO\,(g) + Br_2\,(g) \rightarrow 2NOBr\,(g)$$

Expt. No.	[NO]/mol L^{-1}	[Br_2]/mol L^{-1}	Initial Rate (mol L^{-1} s^{-1})
1	0·05	0·05	$1{\cdot}0 \times 10^{-3}$
2	0·05	0·15	$3{\cdot}0 \times 10^{-3}$
3	0·15	0·05	$9{\cdot}0 \times 10^{-3}$

(a) What is the order with respect to NO and Br_2 in the reaction ?

(b) Calculate the rate constant (k).

(c) Determine the rate of reaction when concentration of NO and Br_2 are 0·4 M and 0·2 M, respectively. *1+1+1=3*

24. (a) Write the formula for the following coordination compound :

Potassium tetrahydroxidozincate (II)

(b) Arrange the following complexes in the increasing order of conductivity of their solution :

$[Cr(NH_3)_5Cl]Cl_2$, $[Cr(NH_3)_3Cl_3]$, $[Cr(NH_3)_6]Cl_3$

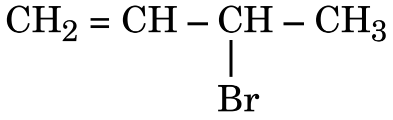
(c) Identify the type of isomerism exhibited by the following complexes :

(i) $[Co(NH_3)_5NO_2]^{2+}$

(ii) $[Co(en)_3]Cl_3$ $1+1+(\frac{1}{2}+\frac{1}{2})=3$

25. (a) Which of the following is an allylic halide ?

(i) $CH_3 - CH = CH - Br$

(ii) 

$CH_2 = CH - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$

(b) Out of chlorobenzene and 2,4,6-trinitrochlorobenzene, which is more reactive towards nucleophilic substitution and why ?

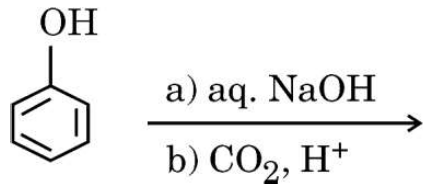
(c) Which isomer of C_4H_9Cl has the lowest boiling point ? *3×1=3*

26. (a) Write the mechanism of the following reaction :

$$CH_3CH_2OH \xrightarrow[443\ K]{H^+} CH_2 = CH_2$$

(b) Write the main product in each of the following reactions :

(i) $CH_3 - CH_2 - CH = CH_2 \xrightarrow[b)\ 3H_2O_2/OH^-]{a)\ B_2H_6}$

(ii) 

1+2=3

27. Answer the following : (any ***three***) *3×1=3*

(a) What is peptide linkage ?

(b) What type of bonds hold a DNA double helix together ?

(c) Which one of the following is a polysaccharide ?

Sucrose, Glucose, Starch, Fructose

(d) Give one example each for water-soluble vitamins and fat-soluble vitamins.

28. Compound (A) ($C_6H_{12}O_2$) on reduction with $LiAlH_4$ gives two compounds (B) and (C). The compound (B) on oxidation with PCC gives compound (D) which upon treatment with dilute NaOH and subsequent heating gives compound (E). Compound (E) on catalytic hydrogenation gives compound (C). The compound (D) is oxidized further to give compound (F) which is found to be a monobasic acid (Molecular weight = 60). Identify the compounds (A), (B), (C), (D), (E) and (F). $6\times\frac{1}{2}=3$

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. Batteries and fuel cells are very useful forms of galvanic cell. Any battery or cell that we use as a source of electrical energy is basically a galvanic cell. However, for a battery to be of practical use it should be reasonably light, compact and its voltage should not vary appreciably during its use. There are mainly two types of batteries — primary batteries and secondary batteries.

In the primary batteries, the reaction occurs only once and after use over a period of time the battery becomes dead and cannot be reused again, whereas the secondary batteries are rechargeable.

Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. To solve this problem, galvanic cells are designed in such a way that energy of combustion of fuels is directly converted into electrical energy, and these are known as fuel cells. One such fuel cell was used in the Apollo space programme.

Answer the following questions :

(a) How do primary batteries differ from secondary batteries ? *1*

(b) The cell potential of Mercury cell is 1·35 V, and remains constant during its life. Give reason. *1*

(c) Write the reactions involved in the recharging of the lead storage battery. *2*

OR

(c) Write two advantages of fuel cells over other galvanic cells. *2*

30. The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometrical shapes of coordination compounds whereas 'The Crystal Field Theory' for coordination compounds is based on the effect of different crystal fields (provided by ligands taken as point charges), on the degeneracy of d-orbital energies of the central metal atom/ion. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields. The crystal field theory attributes the colour of the coordination compounds to d-d transition of the electron. Coordination compounds find extensive applications in metallurgical processes, analytical and medicinal chemistry.

Answer the following questions :

(a) What is crystal field splitting energy ? *1*

(b) Give reason for the violet colour of the complex $[Ti(H_2O)_6]^{3+}$ on the basis of crystal field theory. *1*

(c) $[Cr(NH_3)_6]^{3+}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain why. [Atomic No. : Cr = 24, Ni = 28] *2*

OR

(c) Explain why $[Fe(CN)_6]^{3-}$ is an inner orbital complex, whereas $[Fe(H_2O)_6]^{3+}$ is an outer orbital complex. *2*

[Atomic No. : Fe = 26]

SECTION E

31. (a) (i) At the same temperature, CO_2 gas is more soluble in water than O_2 gas. Which one of them will have higher value of K_H and why ?

(ii) How does the size of blood cells change when placed in an aqueous solution containing more than 0·9% (mass/volume) sodium chloride ?

(iii) 1 molal aqueous solution of an electrolyte A_2B_3 is 60% ionized. Calculate the boiling point of the solution. *1+1+3=5*

(Given : K_b for $H_2O = 0{\cdot}52$ K kg mol^{-1})

OR

(b) (i) The vapour pressures of A and B at 25°C are 75 mm Hg and 25 mm Hg, respectively. If A and B are mixed such that the mole fraction of A in the mixture is 0·4, then calculate the mole fraction of B in vapour phase.

(ii) Define colligative property. Which colligative property is preferred for the molar mass determination of macromolecules ?

(iii) Why are equimolar solutions of sodium chloride and glucose not isotonic ? *2+2+1=5*

32. Answer any ***five*** questions of the following : *5×1=5*

(a) N,N-diethyl-benzenesulphonamide is insoluble in alkali. Give reason.

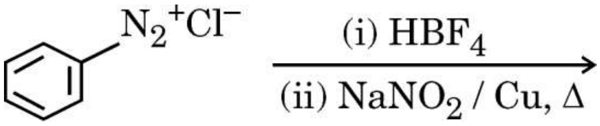
(b) Aniline does not undergo Friedel-Crafts reaction. Why ?

(c) Write a simple chemical test to distinguish between methylamine and aniline.

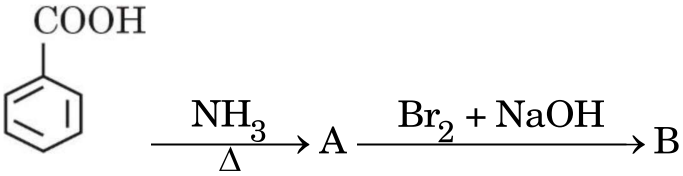
(d) Write the chemical reaction involved in Gabriel phthalimide synthesis.

(e) How will you convert aniline to *p*-bromoaniline ?

(f) Complete the following reaction :



(g) Write the structures of A and B in the following reaction :



33. (a) (i) Account for the following :

(1) The melting and boiling points of Zn, Cd and Hg are low.

(2) Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidizing.

(3) E^0 value of Cu^{2+}/Cu is + 0·34 V.

(ii) Complete and balance the following chemical equations :

(1) $KMnO_4 \xrightarrow{heat}$

(2) $Cr_2O_7^{2-} + 6\,I^- + 14\,H^+ \longrightarrow$ *3+2=5*

OR

(b) (i) Out of Cu_2Cl_2 and $CuCl_2$, which is more stable in aqueous solution and why ?

(ii) Write the general electronic configuration of f-block elements.

(iii) Predict which of the following will be coloured in aqueous solution and why ?

Sc^{3+}, Fe^{3+}, Zn^{2+}

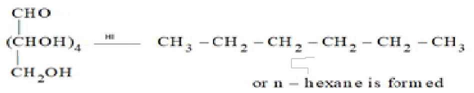
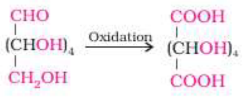
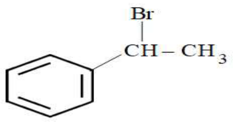
[Atomic number : Sc = 21, Fe = 26, Zn = 30]

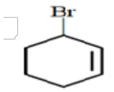
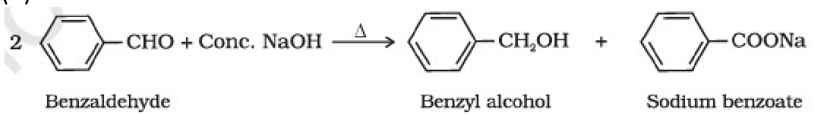
(iv) How can you obtain potassium dichromate from sodium chromate ?

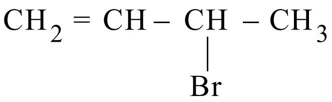
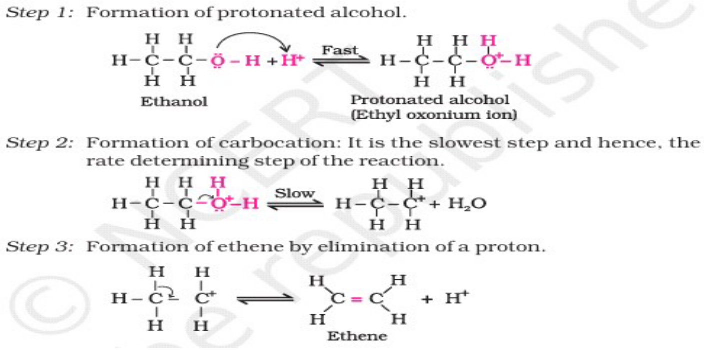
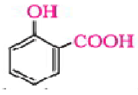
(v) Why do transition metals and their compounds show catalytic activities ? *5×1=5*

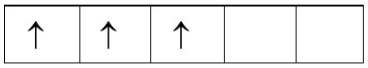
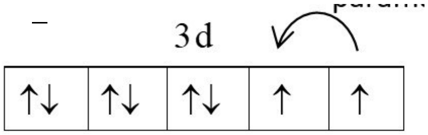
MARKING SCHEME 2023

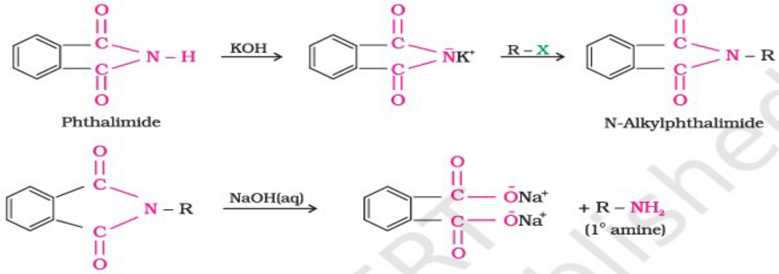
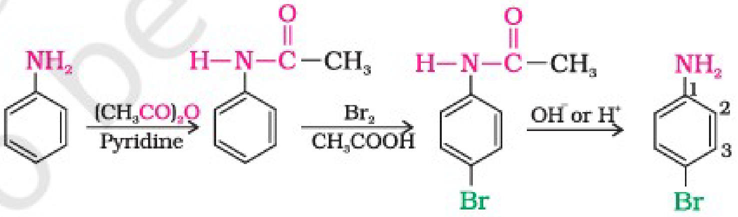
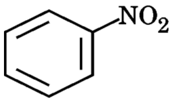
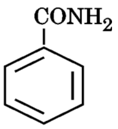
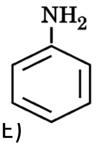
CHEMISTRY (Theory)- 043
QP CODE 56/1/1

Q.No	Value points	Mark
	SECTION A	
1	**B**	**1**
2	**D**	**1**
3	**B**	**1**
4	**D**	**1**
5	**A**	**1**
6	**A**	**1**
7	**C**	**1**
8	**A**	**1**
9	**D**	**1**
10	**C**	**1**
11	**A**	**1**
12	**B**	**1**
13	**B**	**1**
14	**A**	**1**
15	**D**	**1**
16	**D**	**1**
	SECTION B	
17	$E_{Fe^{2+}/Fe} = E^{o}_{Fe^{2+}/Fe} - \frac{0{\cdot}059}{2}\log\frac{1}{[Fe^{2+}]}$ $= -0{\cdot}45\ V - \frac{0{\cdot}059}{2}\log\frac{1}{0{\cdot}01}$ $= -0{\cdot}45\ V - 0{\cdot}059\ V$ $= -0{\cdot}509\ V$	½ 1 ½
18	The number of reacting species taking part in an elementary reaction, which must collide simultaneously in order to bring about a chemical reaction is called molecularity of a reaction. When one of the reactants is in excess.	1 1
19	**(a)**  or n – hexane is formed (b)  or Saccharic acid is formed.	1 1
20	(a) (i)  (ii)	1

		1
	OR	
20	(b)(i)It reacts with water to form alkane. (ii)Alcoholic KOH acts as a stronger base than aqueous KOH leads to elimination reaction of alkyl halide. / alkoxide ions in alcoholic KOH acts as a stronger base due to which elimination reaction takes place.	1 1
21	(a) $CH_3COCH_2CH_3 \xrightarrow{\text{Zn-Hg, Conc.HCl}} CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_3$ (b) 	1 1
	SECTION C	
22	Cell constant(G*) = Conductivity x Resistance = $1.35 \times 10^{-2} \times 100$ =1.35 cm^{-1} Cell constant(G*) = Conductivity x Resistance 1.35cm^{-1}= k x 90 1.35/90= k k=0.015 Scm^{-1} Molar conductivity(Λ_m)= k x 1000/C $=\frac{0.015 \times 1000}{0.02}$ = 750 Scm^2/mol (Deduct ½ mark for no unit or incorrect unit)	1 1 1
23	Rate = $k[NO]^p[Br_2]^q$ $1{\cdot}0 \times 10^{-3} = k[0{\cdot}05]^p[0{\cdot}05]^q$ ------Eq-1 $3{\cdot}0 \times 10^{-3} = k[0{\cdot}05]^p[0{\cdot}15]^q$ ------Eq-2 $9{\cdot}0 \times 10^{-3} = k[0{\cdot}15]^p[0{\cdot}05]^q$ -------Eq-3 On Comparing (eq1) and (eq2) $\left(\frac{1}{3}\right) = \left(\frac{1}{3}\right)^q$ q = 1 (eq1) $\div$ (eq3) $\left(\frac{1}{9}\right) = \left(\frac{1}{3}\right)^p$ p = 2	

	(a) Order w·r·t NO = 2 Order w·r·t Br_2 = 1 (b) $1 \times 10^{-3} = k\,(0.05)^2 \times 0.05$ $k = \frac{1\times10^{-3}}{0{\cdot}05\times0{\cdot}05\times0{\cdot}05}$ k = $8\ L^2\ mol^{-2}\ s^{-1}$ (Unit can be ignored) (c) Rate = $k[NO]^2[Br_2]$ $= 8 \times (0.4)^2 \times (0.2)$ $= 2{\cdot}56 \times 10^{-1}$ mol L^{-1}	½ ½ 1 1
24	a) $K_2[Zn(OH)_4]$ (b)$[Cr\,(NH_3)_3Cl_3] < [Cr(NH_3)_5Cl]Cl_2 < [Cr(NH_3)_6]Cl_3$ (c) (i) Linkage isomerism (ii) Optical isomerism	1 1 ½ +½
25	(a)  $CH_2 = CH - \underset{\underset{Br}{\vert}}{CH} - CH_3$ (b) 2, 4, 6– trinitrochlorobenzene, because of electron withdrawing nature of $–NO_2$ group. (c) $(CH_3)_3C$-Cl / tert-butyl chloride	1 ½ + ½ 1
26.	(a)  (b) (i) $CH_3 – CH_2 – CH_2– CH_2– OH$ (ii) 	½ ½ 1 1
27	a) A linkage which joins two amino acids through –CONH-bond. b) Hydrogen bonding c) Starch d) Water soluble – Vitamin B / C Fat soluble – A, D, E, K (Any one) (Any Three)	1 x3
28	(A)→ $CH_3\ CH_2\ CH_2\ COO\ CH_2\ CH_3$ / $CH_3\ COOCH_2CH_2\ CH_2\ CH_3$ (B) → $CH_3\ CH_2\ OH$	½ x6

	(C) → $CH_3CH_2CH_2CH_2OH$ (D) → CH_3CHO (E) → $CH_3-CH=CH-CHO$ (F) → CH_3COOH(Either structure or name of A to F)	
	SECTION D	
29	(a) Primary batteries are not rechargeable while secondary batteries are rechargeable. (Or any other correct difference) (b) Overall reaction does not involve any ion in solution whose concentration can change during its lifetime. (c) Cathode: $PbSO_4(s) + 2e^- \rightarrow Pb(s) + SO_4^{2-}(aq)$ Anode: $PbSO_4(s) + 2H_2O(l) \rightarrow PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^-$ OR (c) (i) More efficiency (ii) Pollution free	1 1 1 1 1+1
30	(a) The energy used in the splitting of degenerate d- orbitals due to the presence of ligands in a definite geometry is called Crystal Field Splitting Energy. (b) Ti^{3+}= $3d^1$ i.e. $t_{2g}{}^1 e_g^0$Due to d – d transition. (c) $Cr^{3+} = 3d^3$  Due to stable $t_{2g}{}^3$ configuration, henceparamagnetic. $Ni^{2+} = 3d^8$  CN⁻ being strong field ligand pair up the electrons and hence diamagnetic. OR (c) CN^- being a strong ligand leads to the pairing of electrons in $[Fe(CN)_6]^{3-}$ leading to d^2sp^3 hybridization.H_2O being a weak ligand does not lead to the pairing of electrons in $[Fe(H_2O)_6]^{3+}$ leading to sp^3d^2 hybridization. / In $[Fe(CN)_6]^{3-}$, (n-1)d orbitals of central metal ion are used in hybridization (d^2sp^3). Hence inner orbital complex whereas in $[Fe(H_2O)_6]^{3+}$ n d orbitals of central metal ion are used in hybridization (sp^3d^2).	1 1 1 1 1+1
	SECTION E	
31	(a)(i)As $K_H \propto \frac{1}{\text{Solubility}}$ of Gas $\therefore O_2$ gas has higher K_H; because higher the K_H value, lower the solubility of gas in liquid. (ii) Blood cells shrink. (iii) $\Delta T_b = iK_b m$ $T_b - T_b^0 = i \times 0{\cdot}52 \text{ K Kg mol}^{-1} \times 1 \text{ mol Kg}^{-1}$ $\alpha = \frac{i-1}{n-1}$ n=5 $0{\cdot}6 = \frac{i-1}{5-1}$ i = 3·4 $T_b - 373\text{ K} = 3{\cdot}4 \times 0{\cdot}52 \times 1$ $T_b = 1{\cdot}768 + 373\text{ K}$ T_b=374.768K(If boiling point of water is 373.15K then T_b= 374.918K)	½ + ½ 1 ½ ½ 1 ½ ½

	OR	
31	(b) (i) $P_T = p_A{}^0 x_A + p_B{}^0 x_B$ $P_T = 75 \times 0{\cdot}4 + 25 \times 0{\cdot}6$ $P_T = 30 + 15 = 45$ mm Hg In Vapour phase $p_B = y_B \times P_T$ $y_B = p_B / P_T = \frac{p_B^0 x_B}{P_T}$ $y_B = \frac{15}{45} = \frac{1}{3} = 0{\cdot}33$ mm Hg (ii)The property which depends upon the number of solute particles but not on the natureof solute. ; Osmotic pressure. (iii)Because sodium chloride undergoes dissociation (i=2) in water while glucose does not./ π= i C R T ; For NaCl , i=2 and for glucose i=1.	½ ½ ½ ½ 1,1 1
32	a) Because N, N – diethyl-benzenesulphonamide does not contain any hydrogen atom attached to nitrogen atom, it is not acidic, hence insoluble in alkali. **b)** Due to salt formation with aluminum chloride, the Lewis acid which is used as a catalyst. c) On reacting with nitrous acid at low temperature aniline forms benzene diazonium chloride which on reacting with phenol forms orange dye whereas methylamine does not. (Or any other suitable chemical test) (d)  (e)  (f)  (g) A →  B →  (ANY FIVE)	1 x5
33	(a) (i)(1) Because of the absence of unpaired electrons in their d-orbitals resulting in weak bonding between the atoms/ due to presence of fully filled d orbitals , weak metallic bonding takes place. (2) Because Cr is more stable in +3 due to stable t_{2g}^3 configuration while Mn	1 1

	is more stable in +2 due to stable d^5 configuration. (3) Because of high ΔaH^0 and low $\Delta_{hyd}H^0$, E^O value for Cu is positive. (ii) 1. $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$ **2.** $Cr_2O_7^{2-} + 6I^- + 14\,H^+ \rightarrow 2\,Cr^{3+} + 3I_2 + 7H_2O$	1 1 1
	OR	
33	(b)(i)$CuCl_2$ is more stable than Cu_2Cl_2 as Cu^{+2} is more stable than Cu^+ due to high$\Delta_{hyd}H^0$/ Cu^+ in aqueous solution undergoes disproportionation, i.e., $2Cu^+(aq) \rightarrow Cu^{2+}(aq) + Cu(s)$ (ii) $(n-2)f^{1-14}\ (n-1)\ d^{0-1}\ ns^2$ (iii) Fe^{3+}, presence of unpaired electron leading to d-d transition. (iv) $2Na_2CrO_4 + 2\,H^+ \rightarrow Na_2Cr_2O_7 + 2\,Na^+ + H_2O$ $Na_2Cr_2O_7 + 2\,KCl \rightarrow K_2Cr_2O_7 + 2\,NaCl$ (v) Because of their ability to show variable oxidation states and complex formation / provide large surface area.	1 1 ½ , ½ ½ ½ 1

Series RRSS2/2

SET-1

प्रश्न-पत्र कोड
Q.P. Code **56/2/1**

रोल नं.
Roll No. | | | | | | | | |

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

नोट	**NOTE**
(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **27** हैं ।	(I) Please check that this question paper contains **27** printed pages.
(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं ।	(II) Please check that this question paper contains **33** questions.
(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।	(III) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**	(IV) **Please write down the serial number of the question in the answer-book before attempting it.**
(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।	(V) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे | *अधिकतम अंक : 70*

Time allowed : 3 hours | *Maximum Marks : 70*

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains **33** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** sections – **Section A, B, C, D** and **E**.*

(iii) ***Section A** – questions number **1** to **16** are multiple choice type questions. Each question carries **1** mark.*

(iv) ***Section B** – questions number **17** to **21** are very short answer type questions. Each question carries **2** marks.*

(v) ***Section C** – questions number **22** to **28** are short answer type questions. Each question carries **3** marks.*

(vi) ***Section D** – questions number **29** and **30** are case-based questions. Each question carries **4** marks.*

(vii) ***Section E** – questions number **31** to **33** are long answer type questions. Each question carries **5** marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculators is **not** allowed.*

SECTION A

*Questions no. **1** to **16** are Multiple Choice type Questions, carrying **1** mark each.* *16×1=16*

1. When MnO_2 is fused with KOH in air, it gives :

(A) $KMnO_4$ (B) K_2MnO_4

(C) Mn_2O_7 (D) Mn_2O_3

2. Ligand $EDTA^{4-}$ is an example of a :

(A) Monodentate ligand

(B) Didentate ligand

(C) Tridentate ligand

(D) Polydentate ligand

3. Which of the following ligand forms chelate complex ?

(A) $C_2O_4^{2-}$

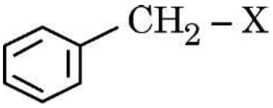
(B) Cl^-

(C) NO_2^-

(D) NH_3

4. Which of the following contains sp^2 hybridised carbon bonded to X ?

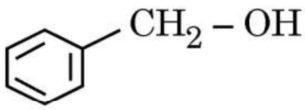
(A) $CH_2 = CH - CH_2 - X$

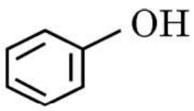
(B) 

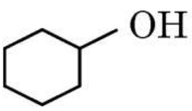
(C) $CH_2 = CH - X$

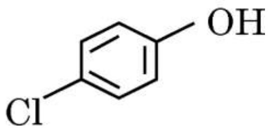
(D) $CH_3 - CH_2 - X$

5. Which of the following is most acidic ?

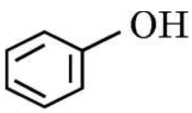
(A) 

(B) 

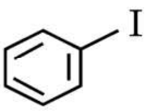
(C) 

(D) 

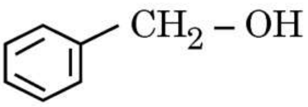
6. Anisole reacts with HI to give :

(A) 

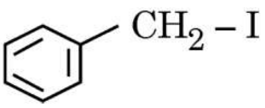
$+ CH_3 - I$

(B) 

$+ CH_3 - OH$

(C) 

$+ CH_3 - I$

(D) 

$+ CH_3 - OH$

7. Ethanol on heating with conc. H_2SO_4 at 413 K gives :

(A) $C_2H_5OSO_3H$

(B) $C_2H_5 - O - CH_3$

(C) $C_2H_5 - O - C_2H_5$

(D) $CH_2 = CH_2$

8. An azeotropic solution of two liquids has boiling point lower than either of them when it :

(A) is saturated

(B) shows positive deviation from Raoult's law

(C) shows negative deviation from Raoult's law

(D) shows no deviation from Raoult's law

9. The relative lowering of vapour pressure of an aqueous solution containing non-volatile solute is 0·0225. The mole fraction of the non-volatile solute is :

(A) 0·80

(B) 0·725

(C) 0·15

(D) 0·0225

10. During electrolysis of aqueous solution of NaCl :

(A) H_2 (g) is liberated at cathode

(B) Na is formed at cathode

(C) O_2 (g) is liberated at anode

(D) Cl_2 (g) is liberated at cathode

11. The addition of catalyst during a chemical reaction alters which of the following quantities of the reaction ?

(A) Enthalpy

(B) Activation energy

(C) Entropy

(D) Internal energy

12. For the elementary reaction $P \rightarrow Q$, the rate of disappearance of 'P' increases by a factor of 8 upon doubling the concentration of 'P'. The order of the reaction with respect to 'P' is :

(A) 3

(B) 4

(C) 2

(D) 1

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* Aliphatic primary amines can be prepared by Gabriel phthalimide synthesis.

Reason (R) : Alkyl halides undergo nucleophilic substitution with anion formed by phthalimide.

14. *Assertion (A) :* Uracil base is present in DNA.

Reason (R) : DNA undergoes self-replication.

15. *Assertion (A) :* Diazonium salts of aromatic amines are more stable than those of aliphatic amines.

Reason (R) : Diazonium salts of aliphatic amines show resonance.

16. *Assertion (A) :* *p*-nitroaniline is a weaker base than *p*-toluidine.

Reason (R) : The electron withdrawing effect of $-NO_2$ group in *p*-nitroaniline makes it a weaker base.

SECTION B

17. A 6% solution of glucose (molar mass = 180 g mol^{-1}) is isotonic with 2·5% solution of an unknown organic substance. Calculate the molecular weight of the unknown organic substance. *2*

18. A first order reaction has a rate constant $1{\cdot}25 \times 10^{-3}\ s^{-1}$. How long will 5 g of this reactant take to reduce to 2·5 g ? *2*

[log 2 = 0·301, log 3 = 0·4771, log 4 = 0·6021]

19. (a) What is lanthanoid contraction ? Actinoid contraction is greater from element to element than lanthanoid contraction. Why ? *1+1=2*

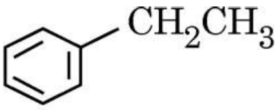
OR

(b) Why do transition metals have high enthalpy of atomization ? Which element of 3d-series has lowest enthalpy of atomization ? *1+1=2*

20. (a) In the following pair of compounds, which compound undergoes S_N2 reaction faster and why ?

OR

(b) Write the major product in the following : *1+1=2*



$$\xrightarrow{Cl_2\text{ , UV light}}$$

21. Define the following terms : *2×1=2*

(a) Denaturation of protein

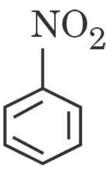
(b) Invert sugar

SECTION C

22. Write the structures of A, B and C in the following reactions : $2\times1\frac{1}{2}=3$

(a) $CH_3-CH_2-Br \xrightarrow{KCN} A \xrightarrow[\text{Partial hydrolysis}]{OH^-} B \xrightarrow{NaOH + Br_2} C$

(b)



$$\xrightarrow{Fe + HCl} A \xrightarrow[273-278\text{ K}]{NaNO_2 + HCl} B \xrightarrow{C_2H_5OH} C$$

23. Write the reaction involved in the following : *3×1=3*

(a) Wolff-Kishner reduction

(b) Decarboxylation reaction

(c) Cannizzaro reaction

24. Give the equations of reactions for the preparation of : (any ***three***) *3×1=3*

(a) Phenol from chlorobenzene

(b) Salicylaldehyde from phenol

(c) 2-Methoxyacetophenone from anisole

(d) Picric acid from phenol

25. Give reasons for the following : *3×1=3*

(a) Chlorine is ortho/para directing in electrophilic aromatic substitution reactions, though chlorine is an electron withdrawing group.

(b) Racemic mixture is optically inactive.

(c) Allyl chloride is hydrolysed more readily than n-propyl chloride.

26. The vapour pressure of a solvent at 283 K is 100 mm Hg. Calculate the vapour pressure of a dilute solution containing 1 mole of a strong electrolyte AB in 50 moles of the solvent at 283 K (assuming complete dissociation of solute AB). *3*

27. Calculate emf of the following cell : *3*

Zn (s) | Zn^{2+} (0·1 M) || Sn^{2+} (0·001 M) | Sn (s)

Given : $E^0_{Zn^{2+}/Zn} = -0{\cdot}76$ V, $E^0_{Sn^{2+}/Sn} = -0{\cdot}14$ V

[log 10 = 1]

28. The rate of a gaseous reaction triples when temperature is increased from 17°C to 27°C. Calculate the energy of activation for this reaction. *3*

[Given : 2·303 R = 19·15 JK^{-1} mol^{-1}, log 3 = 0·48]

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. Carbohydrates are essential for life in both plants and animals. Carbohydrates are used as storage molecules as starch in plants and glycogen in animals. Chemically they are polyhydroxy aldehydes or ketones. On the basis of their behaviour on hydrolysis, carbohydrates are classified as monosaccharides, oligosaccharides and polysaccharides. All monosaccharides are reducing sugars, i.e., they are oxidized by Tollens' reagent and Fehling's solution. A monosaccharide like glucose is aldohexose and its molecular formula was found to be $C_6H_{12}O_6$. After reacting with different reagents like HI, H_2N-OH, Bromine water, $(CH_3CO)_2O$, etc. its structure was found to contain one aldehyde group, one primary alcoholic group, $(-CH_2OH)$ and four secondary alcoholic groups ($>$CHOH). Despite having the aldehyde group, glucose does not give some of the reactions of aldehyde group like Schiff's test, $NaHSO_3$ addition. This explains the existence of glucose in two cyclic hemiacetal forms which differ only in the configuration of the hydroxyl group at C – 1.

Answer the following questions :

(a) What are reducing sugars ? *1*

(b) Classify the following into monosaccharide and disaccharide : Fructose, Sucrose, Lactose, Galactose *1*

(c) Name the polysaccharide which is known as 'animal starch'. Why is it called 'animal starch' ? *2*

OR

(c) (i) Name the isomers of glucose which in the cyclic form differ only in the configuration of the – OH group at C – 1.

(ii) Presence of which functional group was detected when glucose reacted with Br_2 water ? *2×1=2*

30. Transition metals have incomplete d-subshell either in neutral atom or in their ions. The presence of partly filled d-orbitals in their atoms makes transition elements different from that of the non-transition elements. With partly filled d-orbitals, these elements exhibit certain characteristic properties such as display of a variety of oxidation states, formation of coloured ions and entering into complex formation with a variety of ligands. The transition metals and their compounds also exhibit catalytic properties and paramagnetic behaviour. The transition metals are very hard and have low volatility. An examination of the $E^{0}_{M^{2+}/M}$ values shows the varying trends :

$E^{o}_{M^{2+}/M}$	
V	– 1·18
Cr	– 0·91
Mn	– 1·18
Fe	– 0·44
Co	– 0·28
Ni	– 0·25
Cu	+ 0·34
Zn	– 0·76

Answer the following questions :

(a) On what basis can we say that Cu is a transition element but Zn is not ? (Atomic number : Cu = 29, Zn = 30) *1*

(b) Why do transition elements show variety of oxidation states ? *1*

(c) (i) Why do $E^{o}_{M^{2+}/M}$ values show irregular trend from Vanadium to Zinc ?

(ii) How is the variability in oxidation states of transition metals different from that of the non-transition elements ? *2×1=2*

OR

(c) (i) Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidizing. Why ? (Atomic number : Cr = 24, Mn = 25)

(ii) Complete the following ionic equation : *2×1=2*

$$2MnO_4^- + H_2O + I^- \longrightarrow$$

SECTION E

31. Answer any ***five*** of the following : *5×1=5*

(a) How is the crystal field splitting energy for octahedral complex (Δ_o) related to that of tetrahedral complex (Δ_t) ?

(b) Write the IUPAC name of the following complex :

$[PtCl_2(en)_2] (NO_3)_2$

(c) Write the geometry and magnetic behaviour of the complex $[Ni(CO)_4]$ on the basis of Valency Bond Theory (VBT).

(d) What type of isomerism is shown by the complex

$[Co(NH_3)_6] [Cr(CN)_6]$?

(e) For the coordination compound on the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_o < P$. Is the coordination compound a high spin or low spin complex ?

(f) Out of $[Co(NH_3)_6]^{3+}$ and $[Co(NH_3)_4Cl_2]^+$, which complex is heteroleptic and why ?

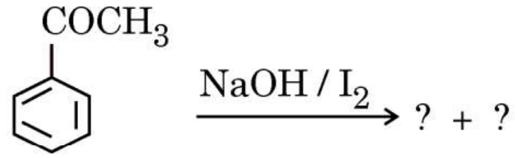
(g) Draw the structures of optical isomers of $[PtCl_2(en)_2]^{2+}$.

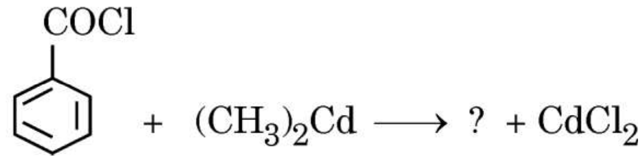
32. (a) (i) Account for the following :

(1) Oxidation of aldehydes is easier as compared to ketones.

(2) The alpha (α) hydrogen atoms of aldehydes are acidic in nature.

(ii) Write the products in the following reactions :

(1) 

(2) 

(iii) Give a simple chemical test to distinguish between ethanoic acid and ethanal. *2+2+1=5*

OR

(b) (i) Draw structure of the 2,4-dinitrophenylhydrazone of benzaldehyde.

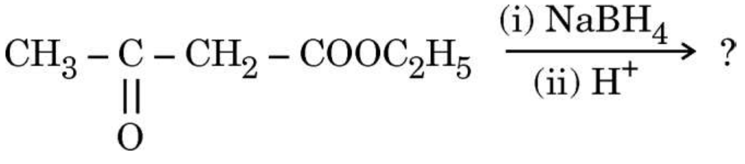
(ii) Arrange the following in increasing order of their reactivity towards HCN :

CH_3COCH_3 , $(CH_3)_3C - COCH_3$, CH_3CHO

(iii) How can you convert phenyl magnesium bromide to benzoic acid ?

(iv) Give a simple chemical test to distinguish between benzaldehyde and ethanal.

(v) Write the main product in the following reaction :



$$CH_3 - \underset{\underset{O}{||}}{C} - CH_2 - COOC_2H_5 \xrightarrow[\text{(ii) } H^+]{\text{(i) } NaBH_4} ?$$

5×1=5

33. (a) (i) The resistance of 0·05 M CH_3COOH solution is found to be 100 ohm. If the cell constant is 0·0354 cm^{-1}, calculate the molar conductivity of the acetic acid solution.

(ii) State Faraday's first law of electrolysis. How much charge in Faraday is required for the reduction of 1 mol of MnO_4^- to Mn^{2+} ? *3+2=5*

OR

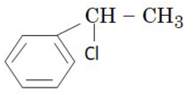
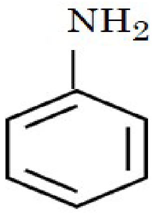
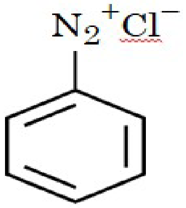
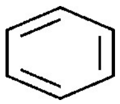
(b) (i) The conductivity of 0·0025 mol L^{-1} acetic acid is $5{\cdot}25 \times 10^{-5}$ S cm^{-1}. Calculate its degree of dissociation if Λ_m^o for acetic acid is 390 S cm^2 mol^{-1}.

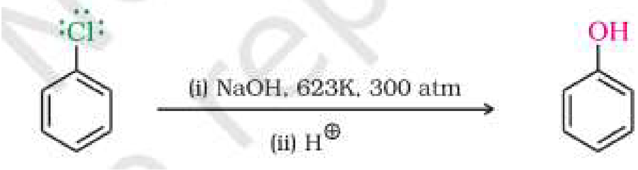
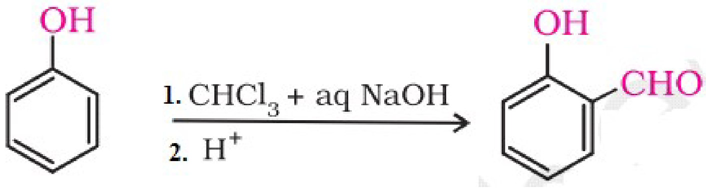
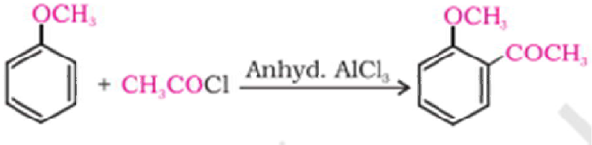
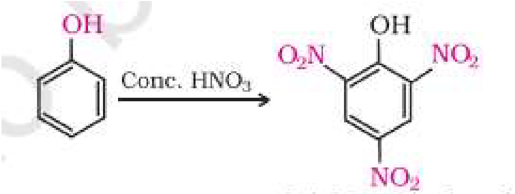
(ii) Write anode, cathode and overall reaction of lead storage battery. *3+2=5*

MARKING SCHEME 2023

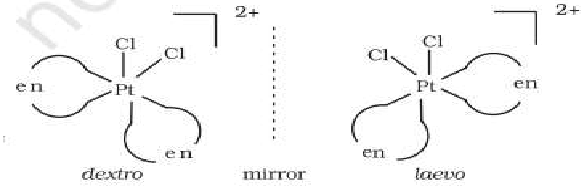
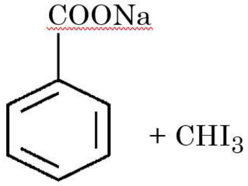
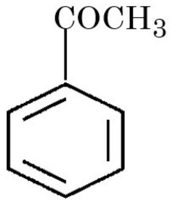
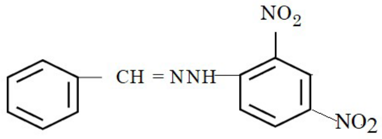
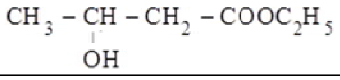
CHEMISTRY (Theory) - 043
QP CODE 56/2/1

Q.No	Value points	Mark
	SECTION A	
1	(B)	1
2	(D)	1
3	(A)	1
4	(C)	1
5	(D)	1
6	(A)	1
7	(C)	1
8	(B)	1
9	(D)	1
10	(A)	1
11	(B)	1
12	(A)	1
13	(A)	1
14	(D)	1
15	(C)	1
16	(A)	1
	SECTION B	
17	$\pi_{Glucose} = \pi_{Unknown}$ $C_G = C_U$ $\frac{W_G}{M_G} = \frac{W_U}{M_U}$ $\frac{6}{180} = \frac{2\cdot5}{M_U}$ $M_U = \frac{2\cdot5\times180}{6}\ g\ mol^{-1}$ $= 75\ g\ mol^{-1}$	½ 1 ½
18	$k = \frac{2\cdot303}{t}\log\frac{[R]_o}{[R]}$ $1\cdot25\times10^{-3} = \frac{2\cdot303}{t}\log\left(\frac{5}{2\cdot5}\right)$ $t = \frac{2\cdot303}{1\cdot25\times10^{-3}}\log 2$ $t = \frac{2\cdot303\times0\cdot301}{1\cdot25\times10^{-3}}$ $t = 554\cdot5$ s or 5.54×10^{2} s	½ 1 ½
19	The steady decrease in atomic or ionic radii with increase in atomic number due to poor shielding effect of 4f subshell. Because shielding effect of 5f subshell is poorer as compared to that of 4f subshell.	1 1

	OR	
19	(b)Because of large number of unpaired electrons in their atoms they have stronger interatomic interaction and hence stronger bonding between atoms. Zinc / Zn	1 1
20	(i)  due to larger size of I than Br/I$^-$ is a better leaving group (ii) 	½ , ½ 1
21	(i)When a protein in its native form, is subjected to physical change like change in pH, temperature etc it loses its biological activity.(Or destruction of secondary and tertiary structure.) (ii)Hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (−) and the product is named an invert sugar.	1 1
	SECTION C	
22	(a) A =CH_3CH_2CN B = $CH_3CH_2CONH_2$ C = $CH_3CH_2NH_2$ (b) A =  B =  C = 	½ ×3 ½ ×3
23	(a)  (b) $Ar/RCOONa + NaOH \xrightarrow{CaO,\ \Delta} Ar - H/R- H + Na_2CO_3$ (c) $2HCHO \xrightarrow[\Delta]{Conc \cdot NaOH} HCOO^-Na^+ + CH_3OH$ (Or any other correct reaction)	1 1 1
24	(a)	

	 (b)  (c)  (d)  (Any three)	1 × 3
25	(a)Because of the stabilisation of intermediate carbocation through resonance. / Through resonance, chlorine tends to stabilize the carbocation and the effect is more pronounced at ortho- and para- positions. (b)Because mixture contains two enantiomers in equal proportionsresulting in Zero Optical Rotation. / Due to the external compensation of equal percentage of (+) and (-) forms resulting in Zero Optical Rotation. (c)Because of the resonance stabilization of allyl carbocation.	1 1 1
26	$\frac{P^o - P_s}{P^o} = i \times \chi$ $AB \longrightarrow A^+ + B^-$ i=2 $\frac{100-P_s}{100} = 2 \times \frac{n_{AB}}{n_{solvent}}$ (For dilute solution) $\frac{100 - P_s}{100} = 2\frac{1}{50}$ $100 - P_s = 4$ P_S = 96 mm Hg (Deduct ½ mark for incorrect or no units.)	½ ½ 1 1
27	$E_{Cell} = (E^o{}_c - E^o{}_a) - \frac{0.059}{2} \log\left[\frac{Zn^{2+}}{Sn^{2+}}\right]$	1

	$= [(-\ 0\cdot14)-(-0\cdot76)]-\frac{0\cdot059}{2}log\frac{0\cdot1}{0\cdot001}$ $= +0\cdot62-\frac{0\cdot059}{\cancel{2}}\times\cancel{2}$ $= (0\cdot62-0\cdot059)V$ = 0·561V (Deduct ½ mark for incorrect or no units.)	1 1
28	log $\frac{k_2}{k_1}$= $\frac{E_a}{2\cdot303R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$ or $\frac{E_a}{2\cdot303R}\left[\frac{T2-T1}{T_1T2}\right]$ log $\frac{3k_1}{k_1}=\frac{E_a}{19\cdot15}\left[\frac{1}{290}-\frac{1}{300}\right]$ 0·48 = $\frac{E_a}{19\cdot15}\left[\frac{10}{290\times300}\right]$ $E_a = \frac{0\cdot48\times19\cdot15\times290\times300}{10}$ E_a= 79970Jmol^{-1}or79.970kJmol^{-1} (Deduct ½ mark for incorrect or no units.)	1 1 1
	SECTION D	
29	(a)Sugars which reduce Tollens' reagent or Fehling's solution. (b)Monosaccharides :- Fructose, Galactose Disaccharides :- Sucrose, lactose (c)Glycogen, because its structure is similar to amylopectin. OR (c)(i)Anomers / α-D-Glucose and β-D-Glucose (ii)Aldehyde /-CHO group	1 ½ ½ 1+1 1 1
30	(a)Cu has incomplete d-orbital in +2 oxidation state whereas Zn has fully filled d- orbital in ground state as well as in +2 oxidation state. (b)Because both (n-1)d and ns subshell electrons take part in the bond formation due to their comparable energies/ due to the presence of unpaired electrons in d-orbitals. (c)(i)Because of irregular values of ($\Delta_iH_1+\Delta_iH_2$) and sublimation enthalpies. (ii)In transition metals, oxidation states differ by +1 whereas in non-transition metals differ by +2. OR (c)(i)Because Cr^{2+} will be converted to Cr^{3+} which has more stable half filled t_{2g} configuration while Mn^{3+} changes to Mn^{2+} which has more stable half-filled d^5 configuration. (ii) $2\,MnO_4^- + H_2O + I^- \longrightarrow 2\,MnO_2 + 2\,OH^- + IO_3^-$	1 1 1 1 1 1
	SECTION E	
31	(a) $\Delta_t = \left(\frac{4}{9}\right)\Delta_o$ (b) Dichloridobis(ethane −1, 2− diamine)platinum (IV) nitrate (c) sp^3, diamagnetic (d) Coordination isomerism (e) $t_{2g}^3\ e_g^1$, high spin (f) $\left[Co(NH_3)_4Cl_2\right]^+$, as the metal is bound to more than one donor group(ligand). (g)	1 × 5

	 (Any five)	
32	(a)(i)(1)Because oxidation of aldehyde involves cleavage of C – H bond which is weaker than C – C bond of ketone. (2) Electron withdrawing nature of carbonyl group/ Due to resonance stabilization of the conjugate base. (ii)(1)  (2)  (iii)On heating with NaOH + I_2, ethanal gives yellow ppt.Of CHI_3whereas ethanoic acid does not. (or any other suitable chemical test)	1 1 ½ , ½ 1 1
	OR	
32	(b)(i)  (ii)$(CH_3)_3$ C – $COCH_3$ < CH_3COCH_3 < CH_3CHO (iii)$P\text{▯}M_gBr \xrightarrow{CO_2,\ dry\ et\text{▯}er} P\text{▯}COOM_gBr \xrightarrow{H_2O/\ H+} P\text{▯}COOH$ (iv)On heating with NaOH and I_2, ethanal gives yellow ppt of CHI_3, whereas benzaldehyde does not. (Or any other correct test.) (v)  $CH_3-\underset{\mid \atop OH}{CH}-CH_2-COOC_2H_5$	1 1 1 1 1
33	(a)(i) $K = \frac{1}{R}\left(\frac{L}{A}\right)$ or k= G*/R	½

	k = $\frac{1}{100}$ (0·0354) = $3{\cdot}54 \times 10^{-4} \Omega^{-1}$ cm^{-1}	1
	$\Lambda_m = \frac{K}{M} \times 1000$	½
	= $\frac{3 \cdot 54 \times 10^{-4}}{0 \cdot 05} \times 1000$ =7· 08 Ω^{-1} cm^{2} mol^{-1}or 7· 08 S cm^{2} mol^{-1}	1
	(Deduct ½ mark for no or incorrect unit)	
	(ii)The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte. / m=ZIt where m= mass of the substance deposited , Z= electrochemical equivalent, I= current, t= time.	1
	5F	1
	OR	
33	(b)(i)	½
	$\Lambda_m = \frac{K}{M} \times 1000$	
	$\Lambda_m = \frac{5.25 \times 10^{-5}}{0.0025} \times 1000$	1
	= 21 S cm^2 mol^{-1}	½
	$\alpha = \frac{\Lambda_m}{\Lambda_m^{\circ}}$	
	= $\frac{21 \text{ S cm}^2 \text{ mol}^{-1}}{390 \text{ S cm}^2 \text{ mol}^{-1}}$	½
	=0.053	½
	(ii)Anode : Pb + $SO_4$2− ⟶ $PbSO_4$+2e−	½
	Cathode : PbO_2+ SO_4^{2-} + 4H^++2e- ⟶ $PbSO_4$+2H_2O	½
	Overall : Pb+ PbO_2+2H_2SO_4 ⟶ 2$PbSO_4$+2H_2O	1

Series SSRR3/3 **SET-1**

प्रश्न-पत्र कोड
Q.P. Code **56/3/1**

रोल नं.
Roll No. | | | | | | | | |

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

नोट

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **27** हैं ।

(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं ।

(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

NOTE

(I) Please check that this question paper contains **27** printed pages.

(II) Please check that this question paper contains **33** questions.

(III) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(IV) **Please write down the serial number of the question in the answer-book before attempting it.**

(V) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे *अधिकतम अंक : 70*

Time allowed : 3 hours *Maximum Marks : 70*

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains* ***33*** *questions.* ***All*** *questions are* ***compulsory****.*

(ii) *This question paper is divided into* ***five*** *sections –* ***Section A, B, C, D*** *and* ***E****.*

(iii) ***Section A*** *– questions number* ***1*** *to* ***16*** *are multiple choice type questions. Each question carries* ***1*** *mark.*

(iv) ***Section B*** *– questions number* ***17*** *to* ***21*** *are very short answer type questions. Each question carries* ***2*** *marks.*

(v) ***Section C*** *– questions number* ***22*** *to* ***28*** *are short answer type questions. Each question carries* ***3*** *marks.*

(vi) ***Section D*** *– questions number* ***29*** *and* ***30*** *are case-based questions. Each question carries* ***4*** *marks.*

(vii) ***Section E*** *– questions number* ***31*** *to* ***33*** *are long answer type questions. Each question carries* ***5*** *marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculators is* ***not*** *allowed.*

SECTION A

Questions no. ***1*** *to* ***16*** *are Multiple Choice type Questions, carrying* ***1*** *mark each.* *16×1=16*

1. Which of the following does ***not*** show variable oxidation states ?

(A) Fe

(B) Cu

(C) Mn

(D) Sc

2. The type of isomerism shown by the complex $[CoCl_2(en)_2]^+$ is :

(A) Ionisation isomerism

(B) Geometrical isomerism

(C) Linkage isomerism

(D) Coordination isomerism

3. Which of the following is diamagnetic in nature ?

(A) Co^{3+}, octahedral complex with strong field ligand

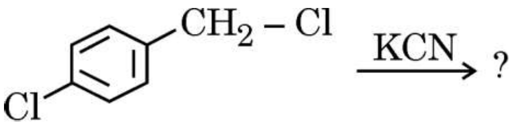
(B) Co^{3+}, octahedral complex with weak field ligand

(C) Co^{3+}, in a square planar complex

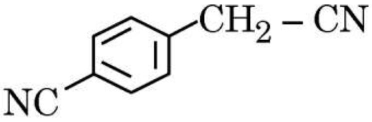
(D) Co^{3+}, in a tetrahedral complex

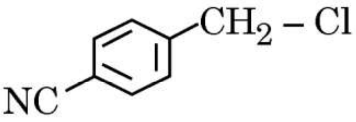
[Atomic number : Co = 27]

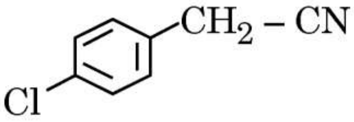
4. Consider the following reaction :

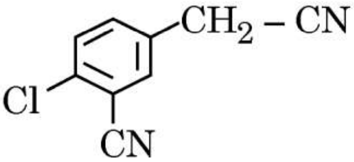


The major product of the reaction is :

(A)


(B)


(C)


(D)


5. Which one of the following compounds has the lowest pK_a value ?

(A) *p*-Cresol

(B) *p*-Nitrophenol

(C) *m*-Nitrophenol

(D) 2,4,6-Trinitrophenol

6. $(CH_3)_2CH - O - CH_3$ when treated with HI gives :

(A) $(CH_3)_2CH - I + CH_3OH$

(B) $(CH_3)_2CH - OH + CH_3 - I$

(C) $(CH_3)_2CH - I + CH_3 - I$

(D) $(CH_3)_2CH - OH + CH_3OH$

7. Which of the following compounds on treatment with benzene sulphonyl choride forms an alkali-soluble precipitate ?

(A) CH_3CONH_2

(B) $(CH_3)_3N$

(C) $(CH_3)_2NH$

(D) $CH_3CH_2NH_2$

8. The order of increasing basicities of CH_3NH_2 (I), $(CH_3)_2NH$ (II), $(CH_3)_3N$ (III) and $C_6H_5NH_2$ (IV) in aqueous media is :

(A) IV < III < I < II

(B) II < I < IV < III

(C) I < II < III < IV

(D) II < III < I < IV

9. The vitamin which plays an important role in coagulating blood is :

(A) Vitamin A

(B) Vitamin E

(C) Vitamin D

(D) Vitamin K

10. When a catalyst increases the rate of a chemical reaction, then the rate constant (k) :

(A) remains constant

(B) decreases

(C) increases

(D) may increase or decrease depending on the order of the reaction

11. A 1% solution of solute 'X' is isotonic with a 6% solution of sucrose (molar mass = 342 g mol^{-1}). The molar mass of solute 'X' is :

(A) 34·2 g mol^{-1}

(B) 57 g mol^{-1}

(C) 114 g mol^{-1}

(D) 3·42 g mol^{-1}

12. During the electrolysis of aqueous NaCl, the cathodic reaction is :

(A) Oxidation of Cl^- ion

(B) Reduction of Na^+ ion

(C) Oxidation of H_2O

(D) Reduction of H_2O

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* Addition of ethylene glycol to water lowers its freezing point.

Reason (R) : Ethylene glycol is insoluble in water due to lack of its ability to form hydrogen bonds with water molecules.

14. *Assertion (A) :* Order of reaction and molecularity are always same for complex reactions.

Reason (R) : Order is determined experimentally and molecularity is applicable only for elementary reactions.

15. *Assertion (A) :* The boiling point of ethanol is higher than that of dimethyl ether.

Reason (R) : Ethanol molecules are associated through hydrogen bonding whereas in dimethyl ether, it is not possible.

16. *Assertion (A) :* Aniline does not undergo Friedel-Crafts reaction.

Reason (R) : Friedel-Crafts reaction is an electrophilic substitution reaction.

SECTION B

17. (a) Define molal depression constant. How is it related to enthalpy of fusion ? *2*

OR

(b) What type of deviation is shown by ethanol and acetone mixture ? Give reason. What type of azeotropic mixture is formed by that deviation ? *2*

18. (a) In a reaction, if the concentration of reactant 'X' is tripled, the rate of reaction becomes twenty-seven times. What is the order of the reaction ?

(b) State a condition under which a bimolecular reaction is kinetically a first-order reaction. Give an example of such a reaction. *1+1=2*

19. Complete the following ionic equations : *2×1=2*

(a) $2MnO_4^- + 5SO_3^{2-} + 6H^+ \rightarrow$

(b) $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow$

20. (a) Which halogen compound in the following pair will react faster in S_N2 reactions and why ?

$CH_3 - CH_2 - I$ OR $CH_3 - CH_2 - Br$

(b) Why is chloroform stored in closed dark coloured bottles ? *1+1=2*

21. Give reaction of glucose with the following : *2×1=2*

(a) HCN

(b) Conc. HNO_3

SECTION C

22. A solution is prepared by dissolving 5 g of a non-volatile solute in 200 g of water. It has a vapour pressure of 31·84 mm Hg at 300 K. Calculate the molar mass of the solute. *3*

(Vapour pressure of pure water at 300 K = 32 mm Hg)

23. The conductivity of 0·2 M solution of KCl is $2{\cdot}48 \times 10^{-2}$ S cm^{-1}. Calculate its molar conductivity and degree of dissociation (α). *3*

Given :

$\lambda^o_{K^+} = 73{\cdot}5$ S cm^2 mol^{-1}

$\lambda^o_{Cl^-} = 76{\cdot}5$ S cm^2 mol^{-1}

24. A first-order reaction is 25% complete in 40 minutes. Calculate the value of rate constant. In what time will the reaction be 80% complete ? *3*

[Given : log 2 = 0·30, log 3 = 0·48, log 4 = 0·60, log 5 = 0·69]

25. (a) What type of nucleophilic substitution (S_N1 or S_N2) occurs in the hydrolysis of 2-Bromobutane to form (±)-Butan-2-ol ? Give reason.

(b) What happens when chlorobenzene and methyl chloride are treated with sodium metal in dry ether ? *2+1=3*

26. (a) Write the equations of the reactions involved in the following :

(i) Reimer-Tiemann reaction

(ii) Kolbe's reaction

(b) Name the reagent used in the bromination of phenol to form 2,4,6-Tribromophenol. *2+1=3*

27. How will you bring about the following conversions ? (any ***three***) *3×1=3*

(a) Benzoic acid to Benzaldehyde

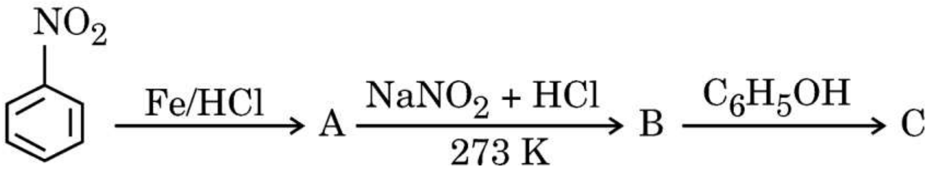
(b) Ethanal to Propanone

(c) Acetophenone to Benzoic acid

(d) Bromobenzene to 1-Phenylethanol

28. Give the structures of A, B and C in the following reactions : $2 \times 1\frac{1}{2} = 3$

(a) $$CH_3CH_2Cl \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[0^\circ C]{HNO_2} C$$

(b) 

$$\xrightarrow{Fe/HCl} A \xrightarrow[273\ K]{NaNO_2 + HCl} B \xrightarrow{C_6H_5OH} C$$

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. The involvement of (n – 1)d electrons in the behaviour of transition elements impart certain distinct characteristics to these elements. Thus, in addition to variable oxidation states, they exhibit paramagnetic behaviour, catalytic properties and tendency for the formation of coloured ions. The transition metals react with a number of non-metals like oxygen, nitrogen and halogens. $KMnO_4$ and $K_2Cr_2O_7$ are common examples.

The two series of inner transition elements, lanthanoids and actinoids, constitute the f-block of the periodic table. In the lanthanoids, there is regular decrease in atomic size with increase in atomic number due to the imperfect shielding effect of 4f-orbital electrons which causes contraction.

Answer the following questions :

(a) Why do transition metals and their compounds act as good catalysts ? *1*

(b) What is the cause of contraction in the atomic size of lanthanoids ? *1*

(c) Define lanthanoid contraction. How does it affect the atomic radii of the third transition series and the second transition series ? *2*

OR

(c) In aqueous media, which is a stronger reducing agent — Cr^{2+} or Fe^{2+} and why ? *2*

30. Proteins are the most abundant biomolecules of the living system. Proteins are the polymers of about twenty different α-amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. In zwitter ionic form, amino acids show amphoteric behaviour as they react both with acids and bases.

On the basis of their molecular shape, proteins are classified into two types : Fibrous and Globular proteins. Structure and shape of proteins can be studied at four different levels i.e., primary, secondary, tertiary and quaternary, each level being more complex than the previous one. The secondary or tertiary structure of proteins get disturbed on change of pH or temperature and they are not able to perform their functions. This is called denaturation of proteins.

Answer the following questions :

(a) What are essential amino acids ? *1*

(b) What is meant by zwitter ionic form of amino acids ? *1*

(c) (i) Give one example each for Fibrous protein and Globular protein.

(ii) What type of linkages hold monomers of proteins together ? *2×1=2*

OR

(c) (i) What is the structural feature which characterises a reducing sugar ?

(ii) What is the structural difference between nucleoside and nucleotide ? *2×1=2*

SECTION E

31. (a) (i) Calculate emf of the following cell at 25ºC :

$$\text{Zn (s)} \mid \text{Zn}^{2+}\,(0{\cdot}001\text{M}) \parallel \text{Cd}^{2+}\,(0{\cdot}1\text{ M}) \mid \text{Cd (s)}$$

Given : $E^o_{Zn^{2+}/Zn} = -\,0{\cdot}76$ V, $E^o_{Cd^{2+}/Cd} = -\,0{\cdot}40$ V [log 10 = 1]

(ii) State Faraday's second law of electrolysis. How will the pH of aqueous NaCl solution be affected when it is electrolysed ? *3+2=5*

OR

(b) (i) Calculate the Δ_rG^o and log K_c for the following cell reaction :

$$\text{Fe (s)} + \text{Ag}^+\text{(aq)} \rightleftharpoons \text{Fe}^{2+}\text{(aq)} + \text{Ag (s)}$$

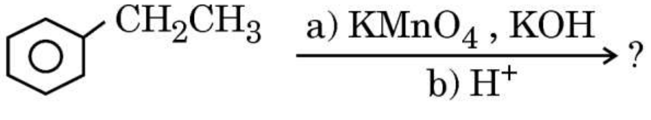
Given : $E^o_{Fe^{2+}/Fe} = -\,0{\cdot}44$ V, $E^o_{Ag^+/Ag} = +\,0{\cdot}80$ V,

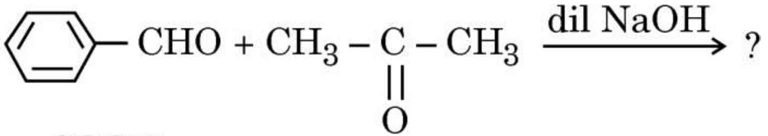
1 F = 96500 C mol^{-1}

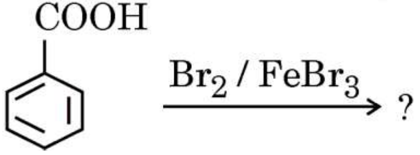
(ii) Write any two advantages of the fuel cells over primary and secondary batteries ?

(iii) How many Faradays are required for the oxidation of 1 mole of H_2O to O_2 ? *3+1+1=5*

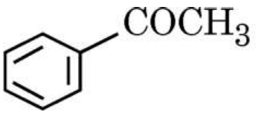
32. (a) (i) Write the major product(s) in the following reactions :

(1) 

(2) 

(3) 

(ii) Give simple chemical tests to distinguish between the following pairs of compounds :

(1)  and 

(2) Pentanal and Pentan-3-one *3+2=5*

OR

(b) (i) Give reasons for the following :

(1) In semicarbazide, only one $-NH_2$ group is involved in the formation of semicarbazone.

(2) Acetaldehyde is more reactive than acetone towards addition of HCN.

(ii) (1) Arrange the following in decreasing order of their acidic strength :

$CH_3COOH, \quad O_2N-CH_2-COOH, \quad HCOOH$

(2) Name the reagent in the following reaction :

$$CH_3-CH=CH-CH_2-CN \xrightarrow{?} CH_3-CH=CH-CH_2-CHO$$

(iii) Write the reaction involved in Hell-Volhard-Zelinsky reaction.

2+2+1=5

33. Attempt any ***five*** of the following : *5×1=5*

(a) Write the IUPAC name of the complex :

$[Co(H_2O)(CN)(en)_2]^{2+}$

(b) Why is geometrical isomerism not possible in tetrahedral complexes having two different types of unidentate ligands coordinated with the central metal ion ?

(c) Arrange the following complex ions in increasing order of their crystal field splitting energy (Δ_o) :

$$[Co(NH_3)_6]^{3+},\ [CoF_6]^{3-},\ [Co(CN)_6]^{3-}$$

(d) Write the hybridization and magnetic character of the complex $[Ni(CO)_4]$ on the basis of valence bond theory.

[Atomic No. : Ni = 28]

(e) Out of $[CoF_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$, which one complex is :

(i) more stable ?

(ii) the high spin complex ?

(f) What is the difference between an ambidentate ligand and bidentate ligand ?

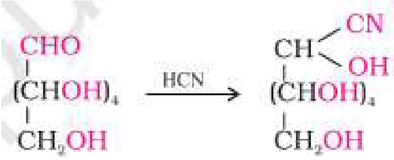
(g) Write the electronic configuration of d^5 in terms of t_{2g} and e_g in an octahedral field when :

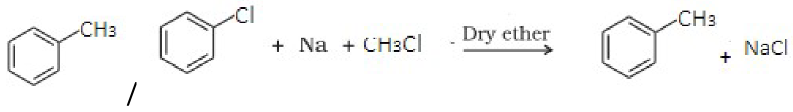
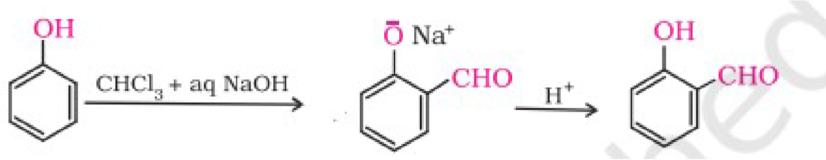
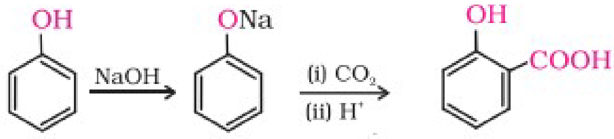
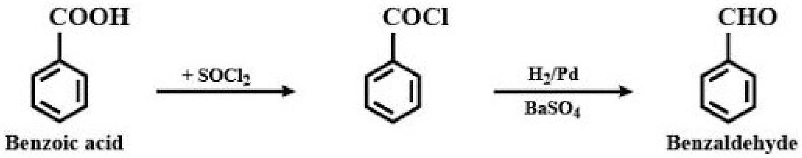
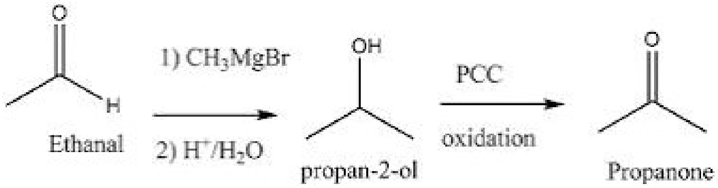
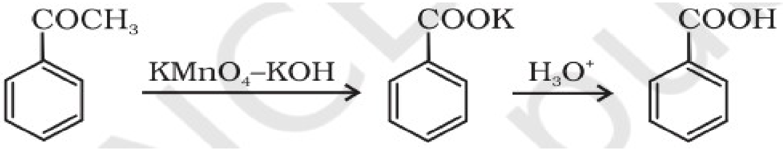
(i) $\Delta_o > P$, and (ii) $\Delta_o < P$

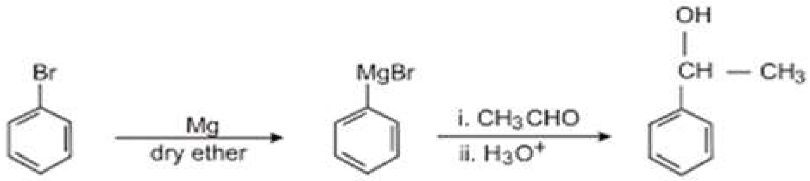
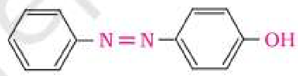
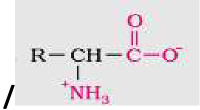
MARKING SCHEME 2023

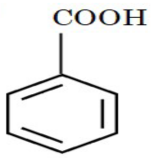
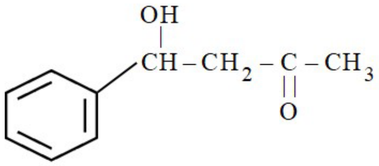
CHEMISTRY (Theory) - 043
QP CODE 56/3/1

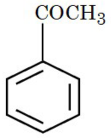
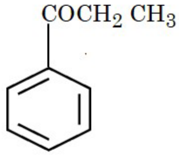
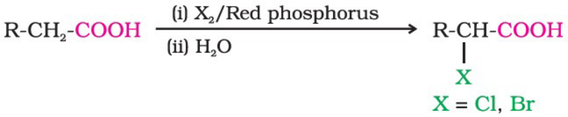
Q.No	Value points	Mark
	SECTION A	
1	(D)	1
2	(B)	1
3	(A)	1
4	(C)	1
5	(D)	1
6	(B)	1
7	(D)	1
8	(A)	1
9	(D)	1
10	(A)	1
11	(B)	1
12	(D)	1
13	(C)	1
14	(D)	1
15	(A)	1
16	(B)	1
	SECTION B	
17	(a)Molal depression constant is the depression in freezing point observed in 1 molal solution./ The depression in freezing point when one mole of non-volatile solute is dissolved in 1 kg or 1000g of the solvent. $K_f = \dfrac{R \times M_{solvent} \times T_f^0}{1000 \times \Delta_{fus}H^0}$	1 1
	OR	
17	(b) Positive deviation.Because ethanol – acetone interaction is weaker than pure ethanol and pure acetone molecular interactions. Minimum boiling azeotropes	½ , ½ 1
18	(a)Rate = $k[X]^p$ 27 Rate = $k[3X]^p$ $\therefore 27 = 3^p$ $(3)^3 = 3^p$ $\boxed{p = 3}$ Third order **/ Third order** **(b)**When one of the reactants is in excess. **Example** : Hydrolysis of ester / sucrose (Or any other correct example)	1 ½ ½
19	(a) $2MnO_4^- + 5SO_3^{2-} + 6H^+ \longrightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$ (b) $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$	1 1
20	(a) CH_3-CH_2-I , As iodide is a better leaving group / due to larger size of I.	½ +½

	(b) In presence of light and air, chloroform forms poisonous gas phosgene.	1
21	(a)  $CHO(CHOH)_4CH_2OH \xrightarrow{HCN} CH(CN)(OH)(CHOH)_4CH_2OH$ (b)  $CHO(CHOH)_4CH_2OH \xrightarrow{conc.HNO3} COOH(CHOH)_4COOH$	1 1
	SECTION C	
22	$\frac{p_1^0 - p_1}{p_1^0} = \frac{w_2 \times M_1}{M_2 \times w_1}$ $\frac{(32-31.84)}{32} = \frac{5g}{M_2} \times \frac{18}{200g}$ M_2= 90 g/ mol (Deduct half mark for no or incorrect unit)	1 1 1
23	$\Lambda_m = k/C$ $\Lambda_m = \frac{k \times 1000}{M}$ $= \frac{1000\ cm^3/L \times 2.48 \times 10^{-2}\ Scm^{-1}}{0.2\ mol\ L^{-1}}$ $= 124\ S\ cm^2\ mol^{-1}$ $\Lambda^\circ_m = \lambda^\circ_+ + \lambda^\circ_-$ $=(73.5 + 76.5)\ S\ cm^2\ mol^{-1}$ $=150\ S\ cm^2\ mol^{-1}$ $\alpha = \Lambda_m / \Lambda^\circ_m$ $= \frac{124\ S\ cm^2\ mol^{-1}}{150\ S\ cm^2\ mol^{-1}}$ $= 0.826$ (approx.)	½ ½ ½ ½ ½ ½
24	$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$ $k = \frac{2.303}{40min} \log \frac{4}{3}$ $k = \frac{2.303}{40min} \times 0.12$ $= 0.0069\ min^{-1}$	½ ½ ½

	For 80% completion, time required is, $t= \frac{2.303}{0.0069}\log5$ $= \frac{2.303 \times 0.69}{0.0069}$ = 230.3 min	½ ½ ½
25	a)SN1 Due to the formation of planar carbocation which can be attacked from both sides./SN1 reactions are accompanied by racemization. b)Toluene is formed / 	1 1 1
26.	(a)(i)  (ii)  (b) Br$_2$ water	1 1 1
27	(a)  (or any other suitable method) (b)  (c)  (d)	1 x 3

	 **(Any Three)**	
28	(a) **A:** CH_3CH_2CN **B:** $CH_3CH_2CH_2NH_2$ **C:** $CH_3CH_2CH_2OH$ (b) **A:** $C_6H_5NH_2$ **B:** $C_6H_5N_2Cl$**C :** 	½ x3 ½ x3
	SECTION D	
29	(a)Due to their ability to show multiple oxidation states and to form complexes / provide large surface area. (b)Due topoor shielding effect of *4f* orbital . (c) The overall decrease in atomic and ionic radii from La to Lu is known as lanthanoid contraction. Atomic radii of second and third transition series are very similar. **OR** (c) Cr^{2+} is stronger reducing agent than Fe^{2+} Reason: $d^4 \rightarrow d^3$ occurs in case of Cr^{2+} to Cr^{3+} But $d^6 \rightarrow d^5$ occurs in case of Fe^{2+} to Fe^{3+} In a medium (like water) d^3 is more stable as compared to d^5	1 1 1,1 1,1
30	(a)Amino acids which cannot be synthesised in the body and must be obtained through diet. (b) Dipolar ion formation /Ion having both anionic and cationic parts **/**  $R-\underset{^{+}NH_3}{\underset{\vert}{CH}}-\overset{\overset{O}{\Vert}}{C}-O^-$ (c)(i) Keratin, myosin (any one) – Fibrous Albumin, Insulin (any one) – Globular (ii) Peptide linkage / structure **OR** (c)(i)Free aldehydic or ketonic group/ Aldehydic (or carbonyl) group is not involved in glycosidic linkage. (ii)In nucleotide, phosphate group is attached to 5′-position of sugar moiety while phosphate group is absent in nucleoside **/** Nucleoside consist of a molecule of sugar linked to nitrogenous base Nucleotide consist of a molecule of sugar ,nitrogenous base and phosphoric acid	1 1 ½+½ 1 1 1
	SECTION E	
31	(a)(i) $E^o cell = E^o cathode - E^o anode$ $= -0.40-(-0.76)V$ $= 0.36V$ $E_{cell} = E^o{}_{Cell} - \frac{0.059}{2} \log \frac{[Zn^{2+}]}{[Cd^{2+}]}$	½ ½ 1

	$= 0.36 \frac{-0.059}{2} \log \frac{[0.001]}{[0.1]}$ $= 0.36 \frac{-0.059}{2} \log 10^{-2}$ $= 0.36 + 0.059$ $= 0.419$ V (ii) When same amount of electricity is passed through the electrolytic solutions connected in series, weight of substance deposited or liberated at each electrode is directly proportional to its chemical equivalent weights. pH of solution will increase	½ ½ 1 1
	OR	
3`	(b)(i) $E^o_{cell} = E^o_{cathode} - E^o_{anode}$ = 0.80V- (-0.44V) = 1.24 V $\Delta G^o = -nFE^o_{cell}$ $= -2 \times 96500 \times 1.24 \text{ J mol}^{-1}$ $= -239320 \text{ J mol}^{-1}$ $\log k_c = \frac{nE^o_{cell}}{0.059}$ $= \frac{2 \times 1.24 \text{ V}}{0.059}$ $= 42.0$ (ii) More efficiency and Pollution free (Any other two correct advantages) (iii) 2F / $2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$ 1 mole = 2 e^- ∴ $\boxed{2 F}$	½ ½ ½ ½ ½ ½ ½ , ½ 1
32	(a)(i) (1)  (2)  (3)	1 1

		1
	(ii) (1)  On heating with NaOH and I_2 forms yellow ppt. of CHI_3	1
	 whereas it does not give yellow ppt with NaOH and I_2 .	
	(2) On heating with Tollens' reagent Pentanal forms silver mirror whereas pentan-3-one does not.(or any other suitable test**)**	1
	OR	
32	(b)(i) (1) Because one – NH_2 group adjacent to carbonyl group is involved in resonance with it .	1
	(2) Steric and electronic reasons / In acetone two alkyl groups reduce the electrophilicity of the carbonyl carbon more effectively than in acetaldehyde.	1
	(ii) (1) $O_2N-CH_2COOH > HCOOH > CH_3COOH$	1
	(2) DIBAL H / H_2O	1
	(iii)  $\text{R-CH}_2\text{-COOH} \xrightarrow[\text{(ii) } H_2O]{\text{(i) } X_2/\text{Red phosphorus}} \text{R-}\underset{X}{\text{CH}}\text{-COOH}$ X = Cl, Br	1
33	(a) Aquacyanidobis(ethane-1,2-diamine)cobalt(III) ion	1x5
	(b) Because of same relative positions of the unidentate ligands attached to the central metal atom.	
	(c) $[CoF_6]^{3-} < [Co(NH_3)_6]^{3+} < [Co(CN)_6]^{3-}$	
	(d) sp^3, diamagnetic	
	(e) (i) $[Co(C_2O_4)_3]^{3-}$ (ii) $[CoF_6]^{3-}$	
	(f) An ambidentate ligand is one which can ligate through either of the two different donor atoms while bidentate ligand is bound to metal through two donor atoms.	
	(g) (i) $t_{2g}^5\ e_g^0$ (ii) $t_{2g}^3\ e_g^2$	
	(Any Five)	

SET-1

Series PP4QQ/4

प्रश्न-पत्र कोड
Q.P. Code 56/4/1

रोल नं.
Roll No. ☐☐☐☐☐☐☐☐

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

नोट

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।

(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं ।

(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

NOTE

(I) Please check that this question paper contains **23** printed pages.

(II) Please check that this question paper contains **33** questions.

(III) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(IV) **Please write down the serial number of the question in the answer-book before attempting it.**

(V) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

रसायन विज्ञान (सैद्धांतिक)
CHEMISTRY (Theory)

*निर्धारित समय : **3** घण्टे* | *अधिकतम अंक : **70***
*Time allowed : **3** hours* | *Maximum Marks : **70***

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains **33** questions. **All** questions are **compulsory**.*

(ii) *Question paper is divided into **FIVE** sections – Section **A, B, C, D** and **E**.*

(iii) ***Section A** – question number **1** to **16** are multiple choice type questions. Each question carries **1** mark.*

(iv) ***Section B** – question number **17** to **21** are very short answer type questions. Each question carries **2** marks.*

(v) ***Section C** – question number **22** to **28** are short answer type questions. Each question carries **3** marks.*

(vi) ***Section D** – question number **29** and **30** are case-based questions. Each question carries **4** marks.*

(vii) ***Section E** – question number **31** to **33** are long answer type questions. Each question carries **5** marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the Sections except Section –**A**.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculator is NOT allowed.*

SECTION – A

16 × 1 = 16

Question No. **1** to **16** are Multiple Choice type questions carrying **1** mark each.

1. The molar ionic conductivities of Ca^{2+} and Cl^- are 119.0 and 76.3 S cm^2 mol^{-1} respectively. The value of limiting molar conductivity of $CaCl_2$ will be :

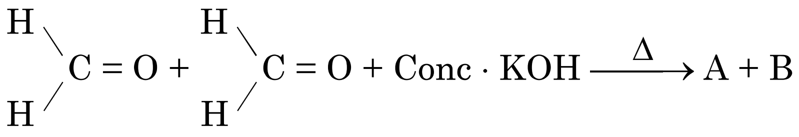
(A) 195.3 S cm^2 mol^{-1}

(B) 43.3 S cm^2 mol^{-1}

(C) 314.3 S cm^2 mol^{-1}

(D) 271.6 S cm^2 mol^{-1}

2. Consider the following reaction :



$$\begin{array}{l}H\diagdown\\ \quad C = O + \\ H\diagup\end{array}\begin{array}{l}H\diagdown\\ \quad C = O + \mathrm{Conc}\cdot\mathrm{KOH}\xrightarrow{\Delta} A + B\\ H\diagup\end{array}$$

Identify A and B from the given options :

(A) A – Methanol, B – Potassium formate

(B) A – Ethanol, B – Potassium formate

(C) A – Methanal, B – Ethanol

(D) A – Methanol, B – Potassium acetate

3. Which of the following acids represents Vitamin C ?

(A) Saccharic acid (B) Gluconic acid

(C) Ascorbic acid (D) Benzoic acid

4. Rosenmund reduction is used for the preparation of Aldehydes. The catalyst used in this reaction is

(A) $Pd - BaSO_4$ (B) Anhydrous $AlCl_3$

(C) Iron (III) oxide (D) $HgSO_4$

5. Which alkyl halide from the given options will undergo S_N1 reaction faster ?

(A) $(CH_3)_3C–Br$ (B) $(CH_3)_2CH–Br$

(C) $CH_3–CH_2–Br$ (D) $(CH_3)_3C–CH_2–Br$

6. From the elements of 3d series given below, which element shows the maximum number of oxidation states ?

(A) Scandium (B) Manganese

(C) Chromium (D) Titanium

7. The correct Mathematical expression of Arrhenius equation is

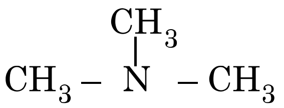
(A) $k = -Ae^{Ea/RT}$

(B) $k = e^{Ea/RT}$

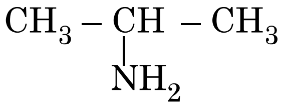
(C) $k = Ae^{-Ea/RT}$

(D) $k = -Ae^{-Ea/RT}$

8. Identify the tertiary amine from the following :

(A) 

$CH_3-\overset{\overset{CH_3}{|}}{N}-CH_3$

(B) 

$CH_3-\underset{\underset{NH_2}{|}}{CH}-CH_3$

(C) $CH_3-NH-CH_2-CH_3$

(D) $(C_2H_5)_2CHNH_2$

9. Nucleophilic addition of Grignard reagent to ketones followed by hydrolysis with dilute acids forms :

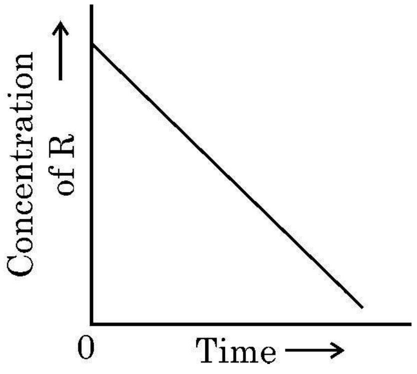
(A) Alkene

(B) Primary alcohol

(C) Tertiary alcohol

(D) Secondary alcohol

10. In a given graph of zero order reaction, the slope and intercept are :



(A) Slope = k, Intercept = $[R]_0$

(B) Slope = –k, Intercept = $[R]_0$

(C) Slope = k/2.303, Intercept = $\ln[R]_0$

(D) Slope = –k/2.303, Intercept = ln A

11. Match the reagents required for the given reactions :

I.	Oxidation of primary alcohols to aldehydes	(p)	$NaBH_4$
II.	Butan-2-one to Butan-2-o*l*	(q)	85% phosphoric acid at 440 K
III.	Bromination of Phenol to 2, 4, 6-Tribromophenol	(r)	PCC
IV.	Dehydration of propan-2-ol to propene	(s)	Bromine water

(A) I – (r), II – (p), III – (s), IV – (q)
(B) I – (q), II – (r), III – (p), IV – (s)
(C) I – (s), II – (q), III – (p), IV – (r)
(D) I – (p), II – (s), III – (r), IV – (q)

12. The general electronic configuration of d-block elements is :

(A) $(n-1)\,d^{1-10}ns^{1-2}$
(B) $(n-1)\,d^{10}ns^{1-2}$
(C) $(n-1)\,d^{10}ns^{2-3}$
(D) $(n-1)\,d^{0}ns^{1-2}$

For questions number **13** to **16**, two statements are given – one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. **Assertion (A) :** p-nitrophenol is less acidic than phenol.

Reason (R) : Nitro group is electron withdrawing and helps in the stabilisation of p-nitrophenoxide ion.

14. **Assertion (A) :** Benzoic acid does not undergo Friedel – Crafts reaction.

Reason (R) : Carboxyl group is deactivating and the catalyst aluminium chloride gets bonded to the carboxyl group.

15. **Assertion (A) :** Fructose is a reducing sugar.

Reason (R) : Fructose does not reduce Fehling solution and Tollen's reagent.

16. **Assertion (A) :** For a Daniell cell, $Zn/Zn^{2+}(1M) \,||\, Cu^{2+}\ (1M)/Cu$ with $E^{o}cell = 1.1$ V, if the external opposing potential is more than 1.1 V, the electrons flow from Cu to Zn.

Reason (R) : Cell acts like a galvanic cell.

SECTION – B

17. Define the following terms :

(a) Order of a reaction

(b) Activation energy **1 × 2**

18. 18 g of a non-volatile solute is dissolved in 200 g of H_2O freezes at 272.07 K. Calculate the molecular mass of solute (K_f for water = 1.86 K kg mol^{-1}) **2**

19. (a) Which compound in the given pair would undergo S_N2 reaction at a faster rate and why ?

$CH_3 - CH_2 - I$ and $CH_3 - CH_2 - Br$

(b) Arrange the following compounds in the increasing order of their boiling points :

Butane, 1–Bromobutane, 1–Iodobutane, 1–Chlorobutane **1 × 2**

20. (a) Write the stepwise mechanism of nucleophilic addition reactions in the carbonyl compounds. **2**

OR

(b) How will you convert the following :

(i) Toluene to benzoic acid.

(ii) Ethanol to 3-Hydroxybutanal **1 × 2**

21. (a) What happens when glucose reacts with bromine water ? Write chemical equation.

(b) Two bases are mentioned below, identify which is present in DNA and which one is present in RNA :

(i) Thymine, (ii) Uracil. **1 × 2**

SECTION – C

22. (a) Draw the geometrical isomers of the given complex :

$[Pt(en)_2Cl_2]^{2+}$

(b) Write the electronic configuration for d^4 ion if $\Delta_0 < P$ on the basis of crystal field theory.

(c) What is meant by a unidentate ligand ? Give an example. **1 × 3**

23. Calculate emf of the following cell at 25 °C :

Sn/Sn^{2+} (0.001 M) $||$ H^+ (0.01 M) $|$ $H_{2(g)}$(1 bar) $|$ $Pt_{(s)}$

Given : $E°(Sn^{2+}/Sn) = -0.14$ V, $E°\ H^+/H_2 = 0.00$ V (log 10 = 1) **3**

24. Write chemical equations for the following reactions : (Do any **three**)

(a) Hydroboration – oxidation reaction

(b) Williamson Synthesis

(c) Friedel-Crafts Alkylation of Anisole

(d) Reimer-Tiemann Reaction **1 × 3**

25. (a) Give chemical tests to distinguish between the following pairs of compounds :

(i) Phenol and Benzoic acid

(ii) Propanal and Propanone

(b) Which one of the given compounds is a stronger acid and why ?

$CH_2FCH_2CH_2COOH$ or CH_3CHFCH_2COOH **2 + 1**

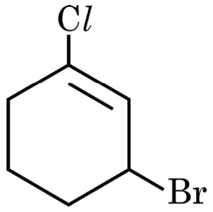
26. Explain the following terms :

(a) Essential amino acids

(b) Peptide bond

(c) Denaturation **1 × 3**

27. (a) Write the IUPAC name of the given compound :



(b) The presence of $-NO_2$ group at ortho or para position increases the reactivity of haloarenes towards nucleophilic substitution reactions. Give reason to explain the above statement.

(c) What happens when ethyl chloride is treated with alcoholic potassium hydroxide ? **1 × 3**

28. Show that the time required for 99.9% completion in a first order reaction is 10 times of half-life ($t_{1/2}$) of the reaction [log 2 = 0.3010, log 10 = 1]. **3**

SECTION – D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. The nature of bonding, structure of the coordination compound can be explained to some extent by valence bond theory. The central metal atom/ion makes available a number of vacant orbitals equal to its coordination number. The appropriate atomic orbitals (s, p and d) of the metal hybridise to give a set of equivalent orbitals of definite geometry such as square planar, tetrahedral, octahedral and so on. A strong covalent bond is formed only when the orbitals overlap to the maximum extent. The d-orbitals involved in the hybridisation may be either inner d-orbitals i.e. (n–1) d or outer d-orbitals i.e. nd. The complexes formed are called inner orbital complex (low spin complex) and outer orbital complex (high spin complex) respectively. Further, the complexes can be paramagnetic or diamagnetic in nature. The drawbacks of this theory are that this involves number of assumptions and also does not explain the colour of the complex.

Answer the following questions :

(a) Predict whether $[CoF_6]^{3-}$ is diamagnetic or paramagnetic and why ? [Atomic number : Co = 27] **1**

(b) What is the coordination number of Co in $[Co(en)_2 Cl_2]^+$? **1**

(c) (i) Write the IUPAC name of the given complex :

$$[Pt(NH_3)_2Cl_2]^{2+}$$

(ii) Explain $[Co(NH_3)_6]^{3+}$ is an inner orbital or outer orbital complex. **1 + 1**

OR

(c) Using valence bond theory, deduce the shape and hybridisation of $[Ni(NH_3)_6]^{2+}$ [Atomic number of Ni = 28] **2**

30. In a galvanic cell, chemical energy of a redox reaction is converted into electrical energy, whereas in an electrolytic cell the redox reaction occurs on passing electricity. The simplest galvanic cell is in which Zn rod is placed in a solution of $ZnSO_4$ and Cu rod is placed in a solution of $CuSO_4$. The two rods are connected by a metallic wire through a voltmeter. The two solutions are joined by a salt bridge. The difference between the two electrode potentials of the two electrodes is known as electromotive force. In the process of electrolysis, the decomposition of a substance takes place by passing an electric current. One mole of electric charge when passed through a cell will discharge half a mole of a divalent metal ion such as Cu^{2+}. This was first formulated by Faraday in the form of laws of electrolysis.

Answer the following questions :

(a) What is the function of a salt bridge in a galvanic cell ? **1**

(b) When does galvanic cell behave like an electrolytic cell ? **1**

(c) Can copper sulphate solution be stored in a pot made of zinc ? Explain with the help of the value of E° cell.

($E^\circ\ Cu^{2+} / Cu = 0.34\ V$)

($E^\circ\ Zn^{2+} / Zn = -\ 0.76\ V$) **2**

OR

(c) How much charge in terms of Faraday is required for the following :

(i) 1 mol of MnO_4^- to Mn^{2+}

(ii) 1 mol of H_2O to O_2 **2**

SECTION – E

31. Attempt any **five** of the following :

(a) Why Zinc is not regarded as a transition element ?

(b) What is Lanthanoid contraction ?

(c) Why is first ionization enthalpy of chromium lower than that of Zn ?

(d) Why are transition elements good catalysts ?

(e) Compounds of transition metals are generally coloured. Give reason.

(f) Out of $KMnO_4$ and K_2MnO_4, which one is paramagnetic and why ?

(g) Complete the following ionic equation :

$$Cr_2O_7^{2-} + 14\,H^+ + 6e^- \longrightarrow$$ **1 × 5**

32. (a) (i) Define reverse osmosis.

(ii) Why are aquatic species more comfortable in cold water in comparison to warm water ?

(iii) A solution containing 2 g of glucose (M = 180 g mol^{-1}) in 100 g of water is prepared at 303 K. If the vapour pressure of pure water at 303 K is 32.8 mm Hg, what would be the vapour pressure of the solution ? **1 + 1 + 3**

OR

(b) (i) Predict whether Van't Hoff factor will be less or greater than one, when Ethanoic acid is dissolved in benzene.

(ii) Define ideal solution.

(iii) Calculate the mass of $CaCl_2$ (molar mass = 111 g mol^{-1}) to be dissolved in 500 g of water to lower its freezing point by 2K, assuming that $CaCl_2$ undergoes complete dissociation. **1 + 1 + 3**

(K_f for water = 1.86 K kg mol^{-1})

33. (a) An amide 'A' with molecular formula C_7H_7ON undergoes Hoffmann Bromamide degradation reaction to give amine 'B'. B' on treatment with nitrous acid at 273-278 K form 'C' and on treatment with chloroform and ethanolic potassium hydroxide forms 'D'. 'C' on treatment, with ethanol gives 'E'. Identify 'A', 'B', 'C' 'D' and 'E.' and write the sequence of chemical equations. **5**

OR

(b) (i) (1) What is Hinsberg's reagent ?

(2) Arrange the following compounds in the increasing order of their basic strength in gaseous phase :

$C_2H_5NH_2$, $(C_2H_5)_3$ N, $(C_2H_5)_2$ NH

(ii) Give reasons for the following :

(1) Methyl amine is more basic than aniline.

(2) Aniline readily reacts with bromine water to give 2, 4, 6-tribromoaniline.

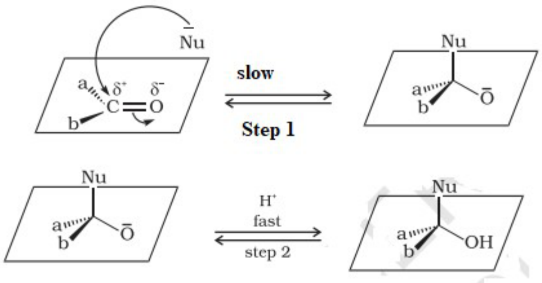
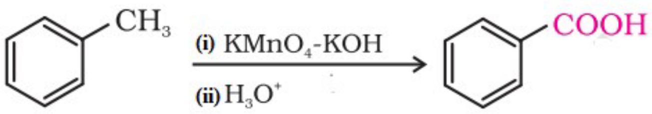
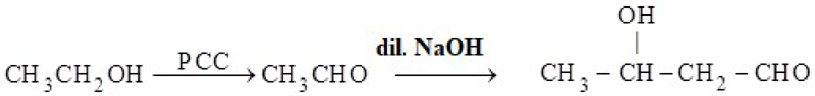
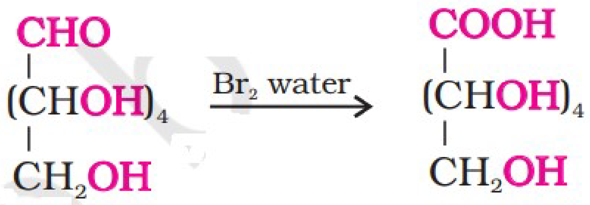
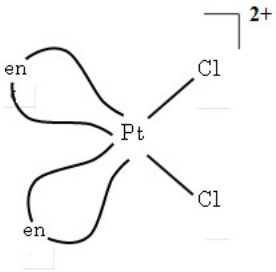
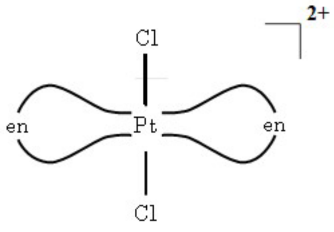
(3) Primary amines have higher boiling points than tertiary amines. **2 + 3**

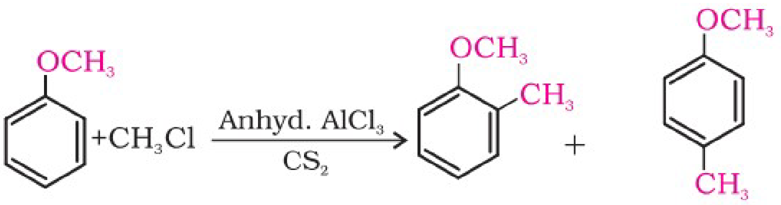
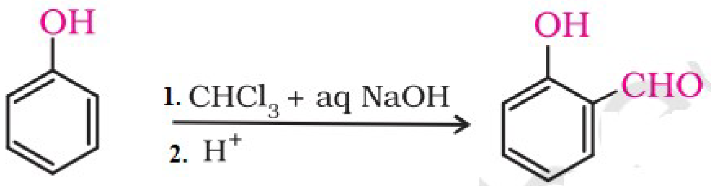
MARKING SCHEME 2023

CHEMISTRY (Theory) - 043

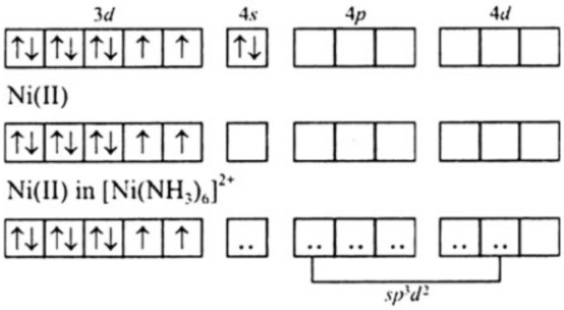
QP CODE 56/4/1

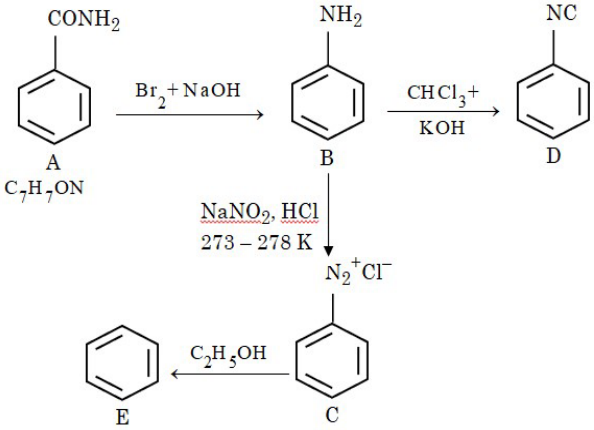
Q.No	Value points	Mark
	SECTION A	
1	(D)	1
2	(A)	1
3	(C)	1
4	(A)	1
5	(A)	1
6	(B)	1
7	(C)	1
8	(A)	1
9	(C)	1
10	(B)	1
11	(A)	1
12	(A)	1
13	(D)	1
14	(A)	1
15	(C)	1
16	(C)	1
	SECTION B	
17	(a) The sum of powers of the concentration of the reactants in the rate law expression. (b) The energy required to form activated complex / The minimum amount of extra energy required by reactingmolecules to get converted into a product.	1 1
18	$\Delta T_f = K_f m$ $M_B = \frac{K_f \times w_B \times 1000}{w_A \times \Delta T_f}$ $\Delta T_f = T^o_f - T_f$ $\Delta T_f = 273 \cdot 15 - 272 \cdot 07 = 1 \cdot 08$ K $M_B = \frac{1 \cdot 86 \times 18 \times 1000}{200 \times 1 \cdot 08}$ $= 155 \text{ g mol}^{-1}$	½ 1 ½
19	a) $CH_3- CH_2- I$; Iodide is a better leaving group/ due to larger size of iodine. b) Butane < 1 – Chlorobutane < 1– Bromobutane < 1 – Iodobuatane.	½ , ½ 1
20		

	a) 	1 1
	OR	
20	**(b)** **(i)**  **(ii)**  $CH_3CH_2OH \xrightarrow{PCC} CH_3CHO \xrightarrow{\text{dil. NaOH}} CH_3-\overset{OH}{\overset{\vert}{C}H}-CH_2-CHO$ **(Or by any other suitable method)**	1 1
21	(a)  (b) Thymine – DNA, Uracil – RNA	1 ½ , ½
	SECTION C	
22	(a)  Cis isomer  **Trans isomer** (b) $t_{2g}^{3}\ e_{g}^{1}$ (c) When a ligand is bound to a metal atom or ion through a single donor atom. Example: Cl^- / H_2O / NH_3(or any other one correct example)	½ , ½ 1 ½ ½

23	$E_{cell} = E^{o}_{cell} - \frac{0.059}{2} \log \frac{[Sn^{2+}]}{[H^{+}]^{2}}$ $E^{o}_{cell} = 0 - (-0.14\ V) = 0.14\ V$ $E_{cell} = 0.14 - \frac{0.059}{2} \log \frac{(0.001)}{(0.01)^{2}}$ $= 0.14 - \frac{0.059}{2} \log 10$ $= 0.14 - 0.0295 = 0.1105\ V$ or 0.11 V (Deduct ½ marks for incorrect or no unit) (Or by any other suitable method)	½ ½ 1 1
24	(a) $CH_3-CH=CH_2 \xrightarrow[2.\ H_2O_2,\ \bar{O}H]{1.\ B_2H_6} CH_3-CH_2-CH_2-OH$ (b) $R-X + R'-\bar{\ddot{O}}\overset{+}{Na} \longrightarrow R-\ddot{O}-R' + Na\ X$ (or any other correct equation) (c)  (d)  (Any three)	1 × 3
25	(a) (i) On adding neutral $FeCl_3$, phenol gives violet colouration whereasbenzoic acid does not give violet colour. (ii) On adding Tollens reagent, propanal gives silver mirror whereas propanone does not. (or any other suitable chemical test). (b) $CH_3CHF\ CH_2\ COOH$; due to stronger – I effect or electron withdrawing nature of F, as F is closer to the carboxyl group.	1 1 ½ , ½
26.	(a) Amino acids that cannot be synthesised in the body and must be obtained through diet. (b) The amide linkage between – COOH group and $-NH_2$ group. / The amide linkage (-CONH-)which joins two amino acids. (c) When a protein in its native form, is subjected to physical change like change in pH, temperature etc it loses itsbiological activity (Or destruction of secondary and tertiary structure.)	1 1 1

27	(a) 3 – Bromo– 1 – chlorocyclohexene	1
	(b) Nitro group is electron withdrawing group, it withdraws electron density from the benzene ring and facilitates the attack of nucleophile on haloarene.	1
	(c) $CH_3-CH_2-Cl+KOH(alc)\longrightarrow CH_2=CH_2+KCl+H_2O$ / Ethene is formed.	1
28.	$k=\frac{2\cdot303}{t}\log\frac{[R]_0}{[R]}$	½
	For 99·9 % completion Let $[R]_0$ = 100, $[R]$ = 100 – 99·9 % = 0·1	
	$t_{99\cdot9\,\%}=\frac{2\cdot303}{k}\log\frac{100}{0\cdot1}$	½
	$=\frac{2\cdot303}{k}\log\ 1000$ $=\frac{2\cdot303}{k}\times3$ …………………… (i)	½
	Let $[R]_0$ = 100, $[R]$ = 100 – 50 = 50	
	$t_{50\,\%}=\frac{2\cdot303}{k}\log\frac{100}{50}$	½
	$=\frac{2\cdot303}{k}\log\ 2$	
	$=\frac{2\cdot303}{k}\times0\cdot3010$ ……………………… (ii)	½
	Divide (i) by (ii)	
	$\frac{t_{99\cdot9\,\%}}{t_{50\,\%}}=\frac{\frac{2\cdot303}{k}\times3}{\frac{2\cdot303}{k}\times0\cdot3010}$	½
	$\frac{t_{99\cdot9\,\%}}{t_{50\,\%}}=10$ or $t_{99\cdot9\,\%}=10t_{50\,\%}$ (or by any other suitable method)	
	SECTION D	

29.	(a) Paramagnetic, F^- does not cause pairing of electrons and hence unpaired electrons are left. (b) 6 (c) (i) diamminedichloridoplatinum(IV) ion (ii) It uses inner d orbitals because NH_3 causes pairing of electrons OR c)  Shape: Octahedral ; Hybridization : sp^3d^2	½ , ½ 1 1 1 1 ½ , ½
30	(a) It allows flow of ions and the circuit is completed / itmaintains the electrical neutrality. (or any other correct reason). (b) When $E_{ext} > E_{cell}$ (c) $E^o_{cell} = E^o_{Cu^{2+}/Cu} - E^o_{Zn^{2+}/Zn}$ $= 0 \cdot 34 - (-0 \cdot 76) = 1 \cdot 10\ V$ As E^o_{cell} = +ve, the reaction takes place, so copper sulphate cannot be stored ina zinc pot. OR (c) (i) 5F (ii) 2 F	1 1 1 1 1 1
	SECTION E	
31	(a) Zn hasfully filled d-orbital configuration in ground state and in its oxidized state. (b) The filling of 4f orbital before 5d orbital results in steady decrease in atomic radii and ionic radii. / The steady decrease in the atomic radii or ionic radii of the elements with increase in atomic number. (c) In chromium an electron is removed from $4s^1$ while in Zn it is from fully filled $4s^2$orbital. (d) Due to variable oxidation stateandcomplex formation /provide large surface area. (e) Due to d–d transition of electrons in d– orbitals / unpaired electrons in d-orbital. (f) K_2MnO_4, due to the presence of one unpaired electron. (g) $Cr_2O_7^{2-} + 14\,H^+ + 6\,e^- \longrightarrow 2\,Cr^{3+} + 7\,H_2O$ (Any five)	1 x 5
32.	(a) (i) If a pressure larger than the osmotic pressure is applied to the solution side, resulting in the movement of solvent particles from solution to solvent. (ii) Solubility of gases in water decreases with rise in temperature. More oxygen will be available in the cold water. (iii) $\frac{p_1^0 - p_1}{p_1^0} = \frac{n_2}{n_1}$ $\frac{p_1^0 - p_1}{p_1^0} = \frac{w_2 \times M_1}{M_2 \times w_1}$ $\frac{32.8 - p_1}{32.8} = \frac{2 \times 18}{180 \times 100}$	1 1 1 1

	32.8- p_1 = 0.0656 p_1= 32.734 mm Hg (Deduct ½ mark for no unit or incorrect unit)	 1
	OR	
32	(a) (i) i will be less than 1. (ii) Solution which obeys Raoult's law over the entire range of concentration. (iii) i = 3 $\Delta T_f = i \times K_f \times m$ $\Delta T_f = \frac{i \times K_f \times w_B \times 1000}{M_B \times w_A}$ $2\,K = \frac{3 \times 1.86 \times w_B \times 1000}{111 \times 500}$ $w_B = \frac{2 \times 111 \times 500}{3 \times 1 \cdot 86 \times 1000}$ $= 19 \cdot 89$ g (Deduct ½ mark for no unit or incorrect unit)	1 1 1 1 1
33	 **(1 mark for identification of A, ½ + ½ each for identification and reaction of formation of B, C, D, E).**	1 x 5
	OR	
33	(b) (i) (1) Benzene Sulphonyl Chloride ($C_6H_5SO_2Cl$) (Name or formula) (2)$C_2H_5NH_2 < (C_2H_5)_2NH < (C_2H_5)_3N$ (ii) (1) In methylamine, electron donating effect of – CH_3 group increases the availability of lone pair of electrons on nitrogen of the amino group. / In aniline, benzene withdraws electrons due to resonance therefore electron pair is less easily available for protonation. (2) Due to strong activating effect of amino group. (3) Due to intermolecular hydrogen bonding in primary amines.	1 1 1 1 1

SET-1

Series RP5PS/5

प्रश्न-पत्र कोड
Q.P. Code 56/5/1

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

नोट

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।

(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं ।

(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

NOTE

(I) Please check that this question paper contains **23** printed pages.

(II) Please check that this question paper contains **33** questions.

(III) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(IV) **Please write down the serial number of the question in the answer-book before attempting it.**

(V) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

रसायन विज्ञान (सैद्धांतिक)

CHEMISTRY (Theory)

*निर्धारित समय : **3** घण्टे* | *अधिकतम अंक : **70***

*Time allowed : **3** hours* | *Maximum Marks : **70***

GENERAL INSTRUCTIONS :

Read the following instructions carefully and follow them :

(i) *This question paper contains* ***33 questions****.* ***All*** *questions are* ***compulsory****.*

(ii) *Question paper is divided into* ***FIVE*** *sections –* ***Section A, B, C, D and E.***

(iii) ***Section A –*** *question number* ***1*** *to* ***16*** *are multiple choice type questions. Each question carries* ***1*** *mark.*

(iv) ***Section B –*** *question number* ***17*** *to* ***21*** *are very short answer type questions. Each question carries* ***2*** *marks.*

(v) ***Section C –*** *question number* ***22*** *to* ***28*** *are short answer type questions. Each question carries* ***3*** *marks.*

(vi) ***Section D –*** *question number* ***29*** *and* ***30*** *are case-based questions. Each question carries* ***4*** *marks.*

(vii) ***Section E –*** *question number* ***31*** *to* ***33*** *are long answer type questions. Each question carries* ***5*** *marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the Sections except section* ***A****.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculator is NOT allowed.*

SECTION – A

Question No. 1 to 16 are Multiple Choice type Questions, carrying 1 mark each. **16 × 1 = 16**

1. The specific sequence in which amino acids are arranged in a protein is called its

(A) Primary structure

(B) Secondary structure

(C) Tertiary structure

(D) Quaternary structure

2. The correct name of the given reaction is

$Ar - N_2^+ X^- \xrightarrow{\text{Cu CN/KCN}} Ar - CN + N_2$

(A) Sandmeyer's reaction

(B) Gabriel Phthalimide synthesis

(C) Carbyl amine reaction

(D) Hoffmann bromamide degradation reaction

3. Out of the following alkenes, the one which will produce tertiary butyl alcohol on acid catalysed hydration is

(A) $CH_3CH_2CH = CH_2$ (B) $CH_3CH = CH_2$

(C) $CH_3 - CH = CH - CH_3$ (D) $(CH_3)_2C = CH_2$

4. Auto-oxidation of chloroform in air and light produces a poisonous gas known as

(A) Phosphine (B) Mustard gas

(C) Phosgene (D) Tear gas

5. Transition metals are known to make interstitial compounds. Formation of interstitial compounds makes the transition metal

(A) more hard (B) more soft

(C) more ductile (D) more metallic

6. Isotonic solutions have the same

(A) density (B) refractive index

(C) osmotic pressure (D) volume

7. Which of the following cell was used in Apollo space programme ?

(A) Mercury cell (B) $H_2 - O_2$ fuel cell

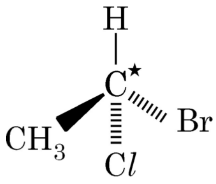
(C) Dry cell (D) Ni-Cd cell

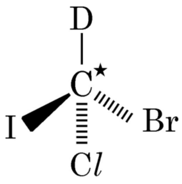
8. The rate of a reaction increases sixteen times when the concentration of the reactant increases four times. The order of the reaction is

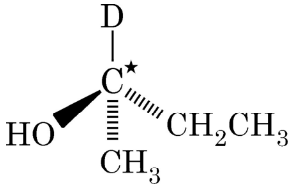
(A) 2.5 (B) 2.0

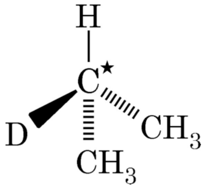
(C) 1.5 (D) 0.5

9. In which of the following molecules, C atom marked with asterisk is chiral ?

(I)


(II)


(III)


(IV)


(A) I, II, III (B) I, II, III, IV

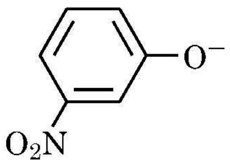
(C) II, III, IV (D) I, III, IV

10. Which of the following species can act as the strongest base ?

(A) OH^-

(B) $C_6H_5O^-$

(C) RO^-

(D) 

11. Dilution affects both conductivity as well as molar conductivity. Effect of dilution on both is as follows :

(A) both increase with dilution.

(B) both decrease with dilution.

(C) conductivity increases whereas molar conductivity decreases on dilution.

(D) conductivity decreases whereas molar conductivity increases on dilution.

12. Van't Hoff factor for $Na_2SO_4 \cdot 10H_2O$ solution, assuming complete ionization is

(A) 1

(B) 3

(C) 13

(D) 2

For questions number **13** to **16**, two statements are given one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. **Assertion (A) :** Zr and Hf are of almost similar atomic radii.

Reason (R) : This is due to Lanthanoid contraction.

14. **Assertion (A) :** The units of rate constant of a zero order reaction and rate of reaction are the same.

Reason (R) : In zero order reaction, the rate of reaction is independent of the concentration of reactants.

15. **Assertion (A) :** Inversion of configuration is observed in S_N2 reaction.

Reason (R) : The reaction proceeds with the formation of carbocation.

16. **Assertion (A) :** p-methoxyphenol is a stronger acid than p-nitrophenol.

Reason (R) : Methoxy group shows +I effect whereas nitro group shows –I effect.

SECTION – B

17. State :

(a) Kohlrausch law of independent migration of ions.

(b) Faraday's first law of electrolysis. **1 × 2**

18. Classify the following sugars into monosaccharides and disaccharides : **2**

Galactose, Glucose, Lactose and Maltose

19. (a) Carry out the following conversions :

(i) Nitrobenzene to Aniline **1**

(ii) Aniline to Phenol **1**

OR

(b) (i) Write a chemical test to distinguish between Dimethyl amine and Ethanamine. **1**

(ii) Write the product formed when benzene diazonium chloride is treated with KI. **1**

20. Show that in case of a first order reaction, the time taken for completion of 99% reaction is twice the time required for 90% completion of the reaction. (log 10 = 1) **2**

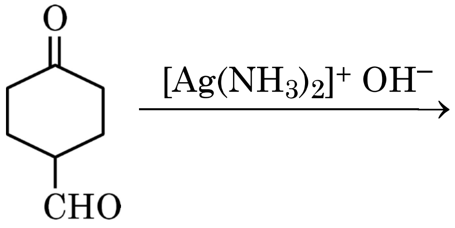
21. Resistance of a conductivity cell filled with 0.2 mol L^{-1} KCl solution is 200 Ω. If the resistance of the same cell when filled with 0.05 mol L^{-1} KCl solution is 620 Ω, calculate the conductivity and molar conductivity of 0.05 mol L^{-1} KCl solution. The conductivity of 0.2 mol L^{-1} KCl solution is 0.0248 S cm^{-1}. **2**

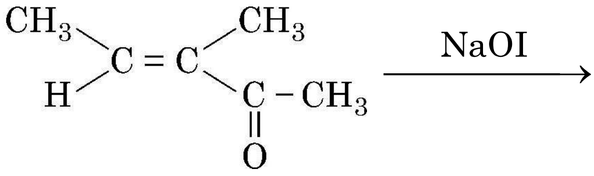
SECTION – C

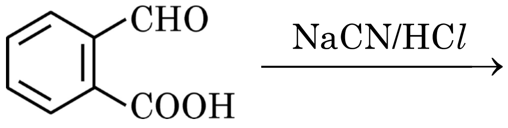
22. Write the IUPAC names of the following coordination compounds (any **three**) : **1 × 3**
    - (a) $[Co(NH_3)_4Cl(NO_2)]Cl$
    - (b) $[Ni(NH_3)_6]Cl_2$
    - (c) $K_3[Cr(C_2O_4)_3]$
    - (d) $[Co(en)_2Br_2]^+$

23. Give the structure of the major product expected from the following reactions : **1 × 3**
    - (a) Reaction of Ethanal with methyl-magnesium bromide followed by hydrolysis.
    - (b) Hydration of But-1-ene in the presence of dilute sulphuric acid.
    - (c) Reaction of phenol with bromine water.

24. Draw the structures of major product(s) in each of the following reactions : **1 × 3**

(a) 

(b) 

(c) 

25. Calculate the emf of the following cell : **3**

$Ni(s) + 2Ag^+(0.01\ M) \longrightarrow Ni^{2+}\ (0.1\ M) + 2Ag(s)$

Given that $E^\circ_{cell} = 1.05\ V$, $\log 10 = 1$

26. Account for the following : **1 × 3**
    - (a) Haloalkanes react with AgCN to form isocyanide as main product.
    - (b) Allyl chloride shows high reactivity towards S_N1 reaction.
    - (c) Haloarenes are extremely less reactive towards nucleophilic substitution reactions.

27. The rate constant of a reaction quadruples when the temperature changes from 300 K to 320 K. Calculate the activation energy for this reaction.

[log 2 = 0.30, log 4 = 0.60, 2.303 R = 19.15 J $K^{-1}mol^{-1}$] **3**

28. A compound ‘X’ with molecular formula C_3H_9N reacts with $C_6H_5SO_2Cl$ to give a solid, insoluble in alkali. Identify ‘X’ and give the IUPAC name of the product. Write the reaction involved. **3**

SECTION – D

The following questions are case-based questions. Read the case carefully and answer the questions that follow :

29. The oxidation number of the central atom in a complex is defined as the charge it would carry if all the ligands are removed along with the electron pairs that are shared with the central atom. Similarly the charge on the complex is the sum of the charges of the constituent parts i.e. the sum of the charges on the central metal ion and its surrounding ligands. Based on this, the complex is called neutral if the sum of the charges of the constituents is equal to zero. However, for an anion or cationic complex, the sum of the charges of the constituents is equal to the charge on the coordination sphere.

Based on the above information, answer the following questions :

(a) Define ambidentate ligand with an example. **1**

(b) What type of isomerism is shown by $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$? **1**

(c) Define Chelate effect. How it affects the stability of complex ? **2**

OR

(c) Find the coordination number and oxidation state of chromium in $Na_3[Cr(C_2O_4)_3]$. **2**

30. Certain organic compounds are required in small amounts in our diet but their deficiency causes specific disease. These compounds are called vitamins. Most of the vitamins cannot be synthesized in our body but plants can synthesize almost all of them. So they are considered as essential food factors. However, the bacteria of the gut can produce some of the vitamins required by us. All the vitamins are generally available in our diet. The term 'vitamin' was coined from the words vital + amine, since the earlier identified compounds had amino group. Vitamins are classified into two groups depending upon their solubility in water or fat namely-fat soluble vitamins and water soluble vitamins.

Answer the following questions :

(a) What is the other name of vitamin B_6 ? **1**

(b) Name the vitamin whose deficiency causes increased blood clotting time. **1**

(c) Xerophthalmia is caused by the deficiency of which vitamin ? Give two sources of this vitamin. **2**

OR

(c) Why can't vitamin C be stored in our body ? Name the disease caused by the deficiency of this vitamin. **2**

SECTION – E

31. Attempt any **five** of the following : **1 × 5**

(a) Ce(III) is easily oxidised to Ce(IV). Comment.

(b) $E^\circ(Mn^{2+}/Mn)$ is –1.18 V. Why is this value highly negative in comparison to neighbouring d block elements ?

(c) Which element of 3d series has lowest enthalpy of atomisation and why ?

(d) What happens when sodium chromate is acidified ?

(e) Zn, Cd and Hg are soft metals. Why ?

(f) Why is permanganate titration not carried out in the presence of HC*l* ?

(g) The lower oxides of transition metals are basic whereas the highest are amphoteric/acidic. Give reason.

32. (a) (i) Ishan's automobile radiator is filled with 1.0 kg of water. How many grams of ethylene glycol (Molar mass = 62 g mol^{-1}) must Ishan add to get the freezing point of the solution lowered to – 2.8 °C. K_f for water is 1.86 K kg · mol^{-1}. **3**

(ii) What type of deviation from Raoult's law is shown by ethanol and acetone mixture ? Give reason. **2**

OR

(b) (i) Boiling point of water at 750 mm Hg pressure is 99.68 °C. How much sucrose (Molar mass = 342 g mol^{-1}) is to be added to 500 g of water such that it boils at 100 °C ? (K_b for water = 0.52 K kg mol^{-1}).

(ii) State Henry's law and write its any one application. **3 + 2**

33. (a) An organic compound (A) with the molecular formula $C_9H_{10}O$ forms 2, 4-DNP derivative, reduces Fehling solution and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1, 2-benzene dicarboxylic acid.

(i) Identify the compound (A) and write its IUPAC name.

(ii) Write the reaction of compound (A) with

(1) 2, 4-Dinitrophenyl hydrazine and

(2) Fehling solution

(iii) Write the equation of compound (A) when it undergoes Cannizzaro reaction. **2 + 2 + 1**

OR

(b) (i) Account for the following : **1 × 2**

(1) The alpha (α)-hydrogens of aldehydes and ketones are acidic in nature.

(2) Oxidation of aldehydes is easier than ketones.

(ii) Arrange the following in : **1 × 2**

(1) Decreasing reactivity towards nucleophilic addition reaction propanal, acetone, benzaldehyde.

(2) Increasing order of boiling point :

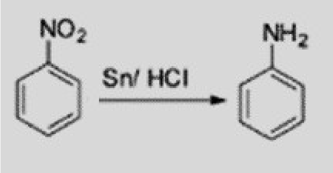
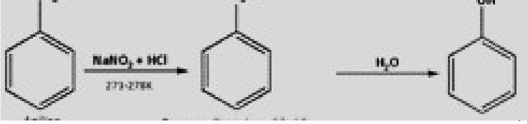
Propane, Ethanol, Dimethylether, Propanal

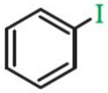
(iii) Give simple chemical test to distinguish between Benzoic acid and Benzaldehyde. **1**

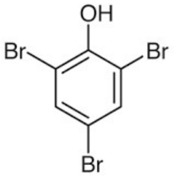
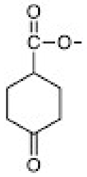
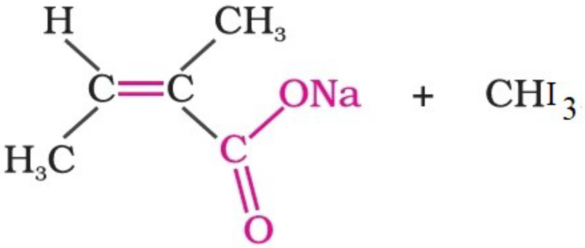
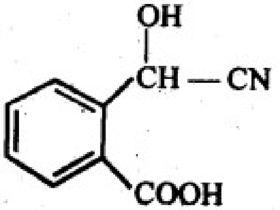
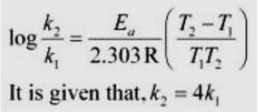
MARKING SCHEME – CHEMISTRY (43) (2024)

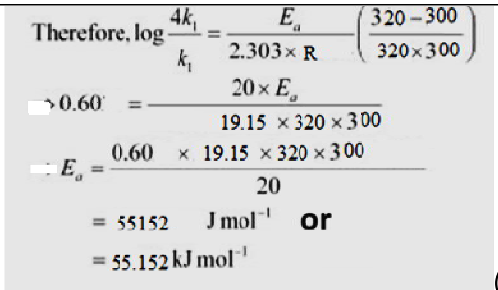
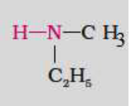
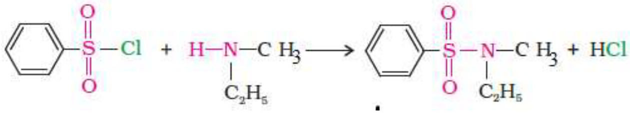
CLASS – XII

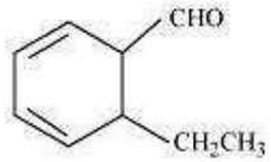
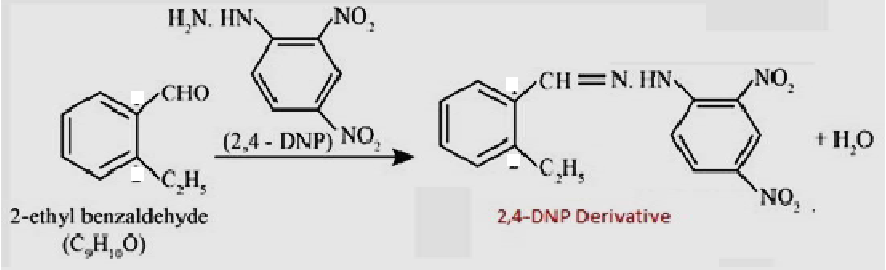
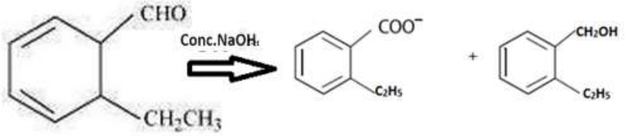
QP Code 56/5/1

Q.No	Value Points	Marks
	SECTION A	
1	A	1
2	A	1
3	D	1
4	C	1
5	A	1
6	C	1
7	B	1
8	B	1
9	A	1
10	C	1
11	D	1
12	B	1
13	A	1
14	A OR B	1
15	C	1
16	D	1
	SECTION B	
17	a) Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte / $\Lambda_m^\circ = \nu_+ \lambda_+^\circ + \nu_- \lambda_-^\circ$ Here, λ°_+ and λ°_- are the limiting molar conductivities of the cation and anion respectively. b) The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte. / m=ZIt where m= mass of the substance deposited , Z= electrochemical equivalent, I= current, t= time.	1 1
18	Monosaccharides: Galactose, Glucose Disaccharides : Lactose, Maltose	½+½ ½+½
19	a) (i)  (ii)  Or any other suitable method)	1 1
	OR	
19	(b)(i) On reaction with alc. KOH and chloroform, ethanamine gives foul smelling isocyanide whereas dimethylamine does not. (Or any other suitable test)	1

	(ii)  / iodobenzene	1
20	$t = \frac{2.303}{k}\log\frac{[A]_0}{[A]}$ Time required for the completion of 99% reaction $t_{99\%} = \frac{2.303}{k}\log\frac{100}{1}$ $t_{99\%} = \frac{2.303}{k} \times 2$ Time required for the completion of 90% reaction $t_{90\%} = \frac{2.303}{k}\log\frac{100}{10}$ $t_{90\%} = \frac{2.303}{k}\log 10$ $t_{90\%} = \frac{2.303}{k}$ $\frac{t_{99\%}}{t_{90\%}} = \frac{\left(\frac{2.303}{k}\right) \times 2}{\frac{2.303}{k}}$ $\frac{t_{99\%}}{t_{90\%}} = 2$ **$t_{99\%} = 2 \times t_{90\%}$**	½ ½ ½ ½
21	Cell constant = G^* = conductivity × resistance= 0.0248 S/cm × 200 ohm = 4.96 cm^{-1} Conductivity of 0.05 mol L^{-1}KCl solution = cell constant / resistance =* G/R=4.96/620= 0.008 S cm^{-1} Molar conductivity = $\Lambda_m = \frac{k \times 1000}{c}$ = 0.008 x 1000 /0.05 = 160 S $cm^2 mol^{-1}$	½ ½ ½ ½
	SECTION C	
22	a) Tetraamminechloridonitrito-N-cobalt (III) chloride b) Hexaamminenickel(II) chloride c) Potassium trioxalatochromate (III) d) Dibromidobis(ethane-1,2-diamine)cobalt (III) ion (Any three)	1×3
23	a)$CH_3CH(OH)CH_3$ b) $CH_3CH(OH)CH_2CH_3$	1 1

	c) 	1
24	a)  b)  c) 	1 ½+½ 1
25	E°$_{cell}$=1.05 V $E_{cell}=1.05-\frac{0.059}{2}\log\frac{[Ni]^{2+}}{[Ag+]^2}$ $=1.05-0.059/2\log\frac{(0.1)}{(0.01)^2}$ =1.05−0.0825 =0.9615 V(Deduct ½ mark for incorrect unit or no unit)	1 1 1
26.	a) AgCN is mainly covalent in nature and only nitrogen is free to donate electron pair forming isocyanide as the main product. b) Allyl carbocation formed isresonance stabilized./  c)Due to Resonance, a partial double bond is formedbetween C-X / sp^2 hybridization of carbon atom in C—X bond / Instability of phenyl cation.	1 1 1
27	 $\log\frac{k_2}{k_1}=\frac{E_a}{2.303\mathrm{R}}\left(\frac{T_2-T_1}{T_1T_2}\right)$ It is given that, $k_2=4k_1$	1

	 Therefore, $\log\frac{4k_1}{k_1} = \frac{E_a}{2.303\times R}\left(\frac{320-300}{320\times300}\right)$ $0.60 = \frac{20\times E_a}{19.15\times320\times300}$ $E_a = \frac{0.60\times19.15\times320\times300}{20}$ $= 55152\ \text{J mol}^{-1}$ **or** $= 55.152\ \text{kJ mol}^{-1}$ (Deduct ½ mark for no or incorrect unit)	1 1
28	X=  IUPAC name of the product- N-Ethyl-N-methylbenzene sulphonamide 	1 1 1
	SECTION D	
29	a) Ligand which has two different donor atoms and either of the two ligates in the complex. Examples :- NO_2^- / SCN^- / CN^-(any one) b) Ionization isomerism c) When a bi-dentate or polydentate ligand ligates to the metal atom or ion that forms a ring. More is the chelation more is the stability. OR c)Coordination number: 6 Oxidation state : +3	½ , ½ 1 1 1 1+1
30	a) Pyridoxine b) Vitamin K c) Vitamin A Sources-Fish liver oil, carrots. (Any other suitable sources) OR c) Water soluble and are readily excreted in urine Scurvy	1 1 1 ½ , ½ 1+1
	SECTION E	
31	a) Ce(IV) ion has more stable configuration ($4f^0$) than Ce(III)ion. b) Due to extra stability of half filled (d^5) orbitals in Mn^{2+} c) Zinc, due to completely filled d-orbitals/ weak metallic bonding. d) It gets converted to sodium dichromate/colour changes fromyellow to orange/ correct equation. e) Due to completely filled d-orbitals/ weak metallic bonding f) HCl is oxidized by $KMnO_4$ to Cl_2. g) Lower oxides of transition metals are ionic& ionic character decreases orcovalent character increasewith increase in oxidation state.(Any five)	1×5
32	a) (i) $\Delta T_f=2.8^0C$ $\Delta T_f= K_f \times w_B/ M_B \times W_A$ (kg) $2.8 = 1.86 \times w_B /62 \times 1$ $w_B= (2.8\times62)/1.86$ $w_B= 93.33$ g(Deduct ½ mark for incorrect unit or no unit) (ii) Positive deviation Interaction between ethanol-ethanol is stronger than ethanol-acteone.	1 1 1 1 1
	OR	

32	b) (i) $\Delta T_b = 100-99.68^0C = 0.32^0C$ $\Delta T_b = K_b \times w_B / M_B \times W_A$ (kg) $0.32 = 0.52 \times w_B \times 1000 / 342 \times 500$ $w_B = 0.32 \times 342 / 0.52 \times 2 = 105.23$ g (Deduct ½ mark for incorrect unit or no unit.) (ii) At a constant temperature, the solubility of a gas in a liquid is directlyproportional to the partial pressure of the gas present above the surface of liquid or solution. / The partial pressure of the gas in vapour phase (***p***) is proportional to the mole fraction of the gas (***x***) in the solution. Application: To increase the solubility of CO_2 in soft drinks and soda water, thebottle is sealed under high pressure. (or any other)	 1 1 1 1+1
33	a) (i)  2 – Ethylbenzaldehyde (A) ii) (1)  (2) Aromatic aldehydes do not give fehling'stest ,**1 mark to be given if attemptedin any way**. (iii) 	1+1 1 1 1
	OR	
33	b) (i) (1) Electron withdrawing nature of carbonyl group/ Due to resonance stabilization of the conjugate base. (2) Due to cleavage of C-H bond in aldehydes is easier than C-C bond in ketones. (ii) (1) propanal> benzaldehyde > Acetone (2) Propane < dimethyl ether <propanal< ethanol (iii) Benzoic acid will give brisk effervescence on reacting with sodium bicarbonate whereas benzaldehyde does not. (or any other suitable test)	1 1 1 1 1

Series : ZYWX1

SET ~ 1

रोल नं.
Roll No.

प्रश्न-पत्र कोड
Q.P. Code **56/1/1**

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

नोट / NOTE

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।
Please check that this question paper contains **23** printed pages.

(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं ।
Please check that this question paper contains **33** questions.

(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें ।**
Please write down the serial number of the question in the answer-book at the given place before attempting it.

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।
15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

~

रसायन विज्ञान (सैद्धांतिक)
CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे
Time allowed : 3 hours

अधिकतम अंक : 70
Maximum Marks : 70

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains **33** questions. **All** questions are* **compulsory**.

(ii) *This question paper is divided into **five** sections – Section **A, B, C, D** and **E**.*

(iii) ***Section A** – questions number **1** to **16** are multiple choice type questions. Each question carries **1** mark.*

(iv) ***Section B** – questions number **17** to **21** are very short answer type questions. Each question carries **2** marks.*

(v) ***Section C** – questions number **22** to **28** are short answer type questions. Each question carries **3** marks.*

(vi) ***Section D** – questions number **29** and **30** are case-based questions. Each question carries **4** marks.*

(vii) ***Section E** – questions number **31** to **33** are long answer type questions. Each question carries **5** marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section –**A**.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculator is **NOT** allowed.*

You may use the following values of physical constants wherever necessary :

$c = 3 \times 10^8$ m/s

$h = 6.63 \times 10^{-34}$ Js

$e = 1.6 \times 10^{-19}$ C

$\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N m^2 C^{-2}

Mass of electron (m_e) = 9.1×10^{-31} kg.

Mass of neutron = 1.675×10^{-27} kg.

Mass of proton = 1.673×10^{-27} kg.

Avogadro's number = 6.023×10^{23} per gram mole

Boltzmann's constant = 1.38×10^{-23} JK^{-1}

SECTION – A

(16 × 1 = 16)

Questions No. **1** to **16** are Multiple Choice type questions carrying **1** mark each.

1. In case of association, abnormal molar mass of solute will

(A) increase (B) decrease
(C) remain same (D) first increase and then decrease

2. Standard electrode potential for Sn^{4+}/Sn^{2+} couple is +0.15 V and that for the Cr^{3+}/Cr couple is –0.74 V. The two couples in their standard states are connected to make a cell. The cell potential will be

(A) +1.19 V (B) +0.89 V
(C) +0.18 V (D) +1.83 V

3. The magnetic moment is associated with its spin angular momentum and orbital angular momentum. Spin only magnetic moment value of Cr^{3+} ion (Atomic no. : Cr = 24) is _________.

(A) 2.87 B.M. (B) 3.87 B.M.
(C) 3.47 B.M. (D) 3.57 B.M.

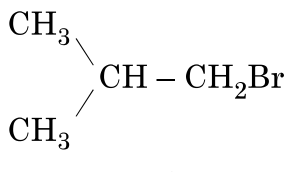
4. Acidified $KMnO_4$ oxidises sulphite to

(A) $S_2O_3^{2-}$ (B) $S_2O_8^{2-}$
(C) $SO_2(g)$ (D) SO_4^{2-}

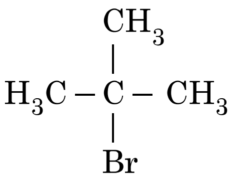
5. The correct IUPAC name of $[Pt(NH_3)_2Cl_2]^{2+}$ is

(A) Diamminedichloridoplatinum (II)
(B) Diamminedichloridoplatinum (IV)
(C) Diamminedichloridoplatinum (O)
(D) Diamminedichloridoplatinate (IV)

6. Arrange the following compounds in increasing order of their boiling points :

(i) 

(ii) $CH_3CH_2CH_2CH_2Br$

(iii) 

$H_3C-\underset{Br}{\overset{CH_3}{C}}-CH_3$

The correct order is

(A) (ii) < (i) < (iii) (B) (i) < (ii) < (iii)
(C) (iii) < (i) < (ii) (D) (iii) < (ii) < (i)

7. Alkyl halides undergoing nucleophilic bimolecular substitution reaction involve

(A) retention of configuration
(B) formation of racemic mixture
(C) inversion of configuration
(D) formation of carbocation

8. Which is the correct order of acid strength from the following ?

(A) $C_6H_5OH > H_2O > ROH$
(B) $C_6H_5OH > ROH > H_2O$
(C) $ROH > C_6H_5OH > H_2O$
(D) $H_2O > C_6H_5OH > ROH$

9. The acid formed when propyl magnesium bromide is treated with CO_2 followed by acid hydrolysis is :

(A) C_3H_7COOH
(B) C_2H_5COOH
(C) CH_3COOH
(D) C_3H_7OH

10. The best reagent for converting propanamide into propanamine is _________.

(A) excess H_2
(B) Br_2 in aqueous NaOH
(C) iodine in the presence of red phosphorus
(D) $LiAlH_4$ in ether

11. Which of the following statements is not true about glucose ?

(A) It is an aldohexose.
(B) On heating with HI it forms n-hexane.
(C) It exists in furanose form.
(D) It does not give Schiff's test.

12. An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because _________.

(A) it gains water due to osmosis
(B) it loses water due to reverse osmosis
(C) it gains water due to reverse osmosis
(D) it loses water due to osmosis

For questions number **13** to **16**, two statements are given – one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. **Assertion (A) :** $[Cr(H_2O)_6]Cl_2$ and $[Fe(H_2O)_6]Cl_2$ are examples of homoleptic complexes.

    Reason (R) : All the ligands attached to the metal are the same.

14. **Assertion (A) :** The boiling points of alkyl halides decrease in the order : $RI > RBr > RCl > RF$.

    Reason (R) : The boiling points of alkyl chlorides, bromides and iodides are considerably higher than that of the hydrocarbon of comparable molecular mass.

15. **Assertion (A) :** The boiling point of ethanol is higher than that of methoxymethane.

    Reason (R) : There is intramolecular hydrogen bonding in ethanol.

16. **Assertion (A) :** All naturally occurring α-amino acids except glycine are optically active.

    Reason (R) : Most naturally occurring amino acids have L-configuration.

SECTION – B

17. (A) Give reasons : **(1 + 1 = 2)**

(a) Cooking is faster in pressure cooker than in an open pan.

(b) On mixing liquid X and liquid Y, volume of the resulting solution decreases. What type of deviation from Raoult's law is shown by the resulting solution ? What change in temperature would you observe after mixing liquids X and Y ?

OR

(B) Define Azeotrope. What type of Azeotrope is formed by negative deviation from Raoult's law ? Give an example. **2**

18. Complete and balance the following chemical equations : **2**

(a) $2MnO_4^-(aq) + 10I^-(aq) + 16H^+(aq) \longrightarrow$

(b) $Cr_2O_7^{2-}(aq) + 6Fe^{2+}(aq) + 14H^+(aq) \longrightarrow$

19. Would you expect benzaldehyde to be more reactive or less reactive in nucleophilic addition reactions than propanal ? Justify your answer. **2**

20. Identify A and B in each of the following reaction sequence : **(1 + 1 = 2)**

(a) $CH_3CH_2Cl \xrightarrow{NaCN} A \xrightarrow{H_2/Ni} B$

(b) $C_6H_5NH_2 \xrightarrow[0-5\ °C]{NaNO_2/HCl} A \xrightarrow[H^+]{C_6H_5NH_2} B$

21. Write the reactions involved when D-glucose is treated with the following reagents : **(1 + 1 = 2)**

(a) HCN

(b) Br_2 water

SECTION – C

22. A solution of glucose (molar mass = 180 g mol^{-1}) in water has a boiling point of 100.20 °C. Calculate the freezing point of the same solution. Molal constants for water K_f and K_b are 1.86 K kg mol^{-1} and 0.512 K kg mol^{-1} respectively. **3**

23. (a) State the following : **3**

    (i) Kohlrausch law of independent migration of ions and

    (ii) Faraday's first law of electrolysis.

    (b) Using E°_{values} of X and Y given below, predict which is better for coating the surface of iron to prevent corrosion and why ?

    Given $E^\circ_{X^{2+}/X} = -2.36$ V,

    $E^\circ_{Y^{2+}/Y} = -0.14$ V,

    $E^\circ_{Fe^{2+}/Fe} = -0.44$ V

24. A certain reaction is 50% complete in 20 minutes at 300 K and the same reaction is 50% complete in 5 minutes at 350 K. Calculate the activation energy if it is a first order reaction. **3**

    [R = 8.314 J K^{-1} mol^{-1}; log 4 = 0.602]

25. The elements of 3d transition series are given as : **(1 + 1 + 1 = 3)**

    Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn

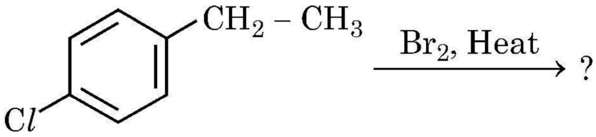
    Answer the following :

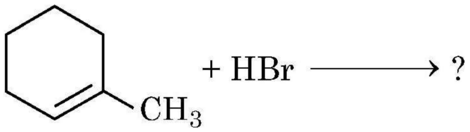
    (a) Copper has exceptionally positive $E^\circ_{M^{2+}/M}$ value, why ?

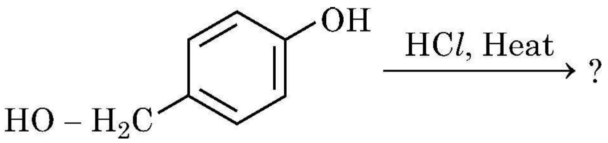
    (b) Which element is a strong reducing agent in +2 oxidation state and why ?

    (c) Zn^{2+} salts are colourless. Why ?

26. (A) Draw the structure of the major monohalo product for each of the following reaction : **(1 + 1 + 1 = 3)**

(a) 

(b) 

(c) 

OR

(B) How do you convert : **(3 × 1 = 3)**

(a) Chlorobenzene to biphenyl

(b) Propene to 1-Iodopropane

(c) 2-bromobutane to but-2-ene.

27. (a) Arrange the following compounds in increasing order of their boiling point : **(1 + 2 = 3)**

$(CH_3)_2NH$, $CH_3CH_2NH_2$, CH_3CH_2OH.

(b) Give plausible explanation for each of the following :

(i) Aromatic primary amines cannot be prepared by Gabriel Phthalimide synthesis.

(ii) Amides are less basic than amines.

28. (a) What is the difference between native protein and denatured protein ? **(1 + 1 + 1 = 3)**

(b) Which one of the following is a disaccharide ?

Glucose, Lactose, Amylose, Fructose

(c) Which vitamin is responsible for the coagulation of blood ?

SECTION – D

The following questions are case based questions. Read the passage carefully and answer the questions that follow.

29. The rate of a chemical reaction is expressed either in terms of decrease in the concentration of reactants or increase in the concentration of a product per unit time. Rate of the reaction depends upon the nature of reactants, concentration of reactants, temperature, presence of catalyst, surface area of the reactants and presence of light. Rate of reaction is directly related to the concentration of reactant. Rate law states that the rate of reaction depends upon the concentration terms on which the rate of reaction actually depends, as observed experimentally. The sum of powers of the concentration of the reactants in the Rate law expression is called order of reaction while the number of reacting species taking part in an elementary reaction which must collide simultaneously in order to bring about a chemical reaction is called molecularity of the reaction.

Answer the following questions :

(a) (i) What is a rate determining step ? **(1 + 1 = 2)**

(ii) Define complex reaction.

(b) What is the effect of temperature on the rate constant of a reaction ? **1**

OR

(b) Why is molecularity applicable only for elementary reactions whereas order is applicable for elementary as well as complex reactions ? **1**

(c) The conversion of molecule X to Y follows second order kinetics. If concentration of X is increased 3 times, how will it affect the rate of formation of Y ? **1**

30. Phenols undergo electrophilic substitution reactions readily due to the strong activating effect of OH group attached to the benzene ring. Since, the OH group increases the electron density more to o– and p– positions therefore OH group is ortho, para-directing. Reimer-Tiemann reaction is one of the examples of aldehyde group being introduced on the aromatic ring of phenol, ortho to the hydroxyl group. This is a general method used for the ortho-formylation of phenols.

Answer the following questions :

(a) What happens when phenol reacts with **2**

(i) Br_2/CS_2

(ii) Conc. HNO_3

(b) Why phenol does not undergo protonation readily ? **1**

(c) Which is a stronger acid – phenol or cresol ? Give reason. **1**

OR

(c) Write the IUPAC name of the product formed in the Reimer-Tiemann reaction. **1**

SECTION – E

31. (A) (a) Write the cell reaction and calculate the e.m.f. of the following cell at 298 K : **(3 + 2 = 5)**

$Sn(s) \mid Sn^{2+}\ (0.004\ M) \mid\mid H^+\ (0.02\ M) \mid H_2(g)\ (1\ Bar) \mid Pt\ (s)$

(Given : $E^\circ_{Sn^{2+}/Sn} = -0.14\ V$, $E^\circ_{H^+ \mid H_2(g),\ Pt} = 0.00V$)

(b) Account for the following ;

(i) On the basis of E° values, O_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaC*l*.

(ii) Conductivity of CH_3COOH decreases on dilution.

OR

31. (B) (a) Write the anode and cathode reactions and the overall cell reaction occurring in a lead storage battery during its use. **(2 + 3 = 5)**

(b) Calculate the potential for half-cell containing 0.01 M $K_2Cr_2O_7$(aq), 0.01 M Cr^{3+} (aq) and 1.0×10^{-4} M H^+(aq).

The half cell reaction is

$$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \longrightarrow 2Cr^{3+}(aq) + 7H_2O(l)$$

and the standard electrode potential is given as E° = 1.33 V.

[Given : log 10 = 1]

32. (A) Answer the following : **5**

(a) Low spin tetrahedral complexes are not known.

(b) Co^{2+} is easily oxidised to Co^{3+} in the presence of a strong ligand [At. No. of Co = 27]

(c) What type of isomerism is shown by the complex $[Co(NH_3)_6][Cr(CN)_6]$?

(d) Why a solution of $[Ni(H_2O)_6]^{2+}$ is green while a solution of $[Ni(CN)_4]^{2-}$ is colourless. (At. No. of Ni = 28)

(e) Write the IUPAC name of the following complex : $[Co(NH_3)_5(CO_3)]Cl$

OR

32. (B) (a) What is meant by 'Chelate effect' ? Give an example. **(2 + 2 + 1 = 5)**

(b) Write the hybridization and magnetic behaviour of $[Fe(CN)_6]^{4-}$.

(Atomic number : Fe = 26)

(c) If $PtCl_2 \cdot 2NH_3$ does not react with $AgNO_3$, what will be its formula ?

33. (A) (a) Carry out the following conversions : **(2 + 3 = 5)**

(i) Ethanal to But-2-enal

(ii) Propanoic acid to ethane

(b) An alkene A with molecular formula C_5H_{10} on ozonolysis gives a mixture of two compounds B and C. Compound B gives positive Fehling test and also reacts with iodine and NaOH solution. Compound C does not give Fehling solution test but forms iodoform. Identify the compounds A, B and C.

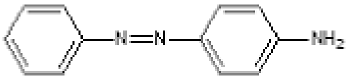
OR

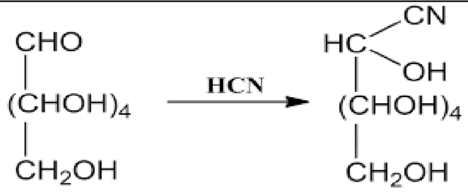
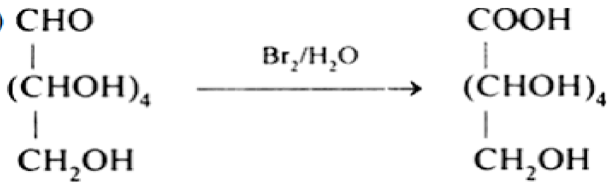
33. (B) An organic compound (A) (molecular formula $C_8H_{16}O_2$) was hydrolysed with dilute sulphuric acid to get a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with chromic acid produced (B). (C) on dehydration gives But-l-ene. Identify (A), (B) and (C) and write chemical equations for the reactions involved. **5**

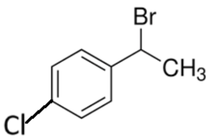
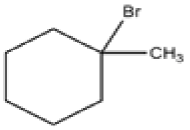
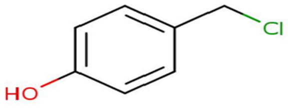
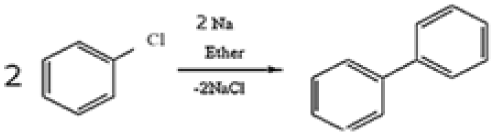
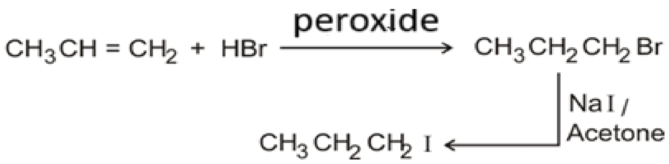
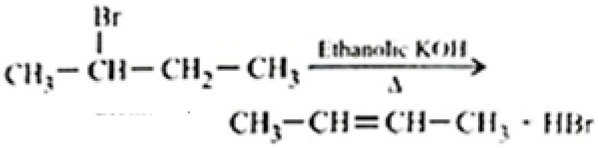
MARKING SCHEME 2024-25

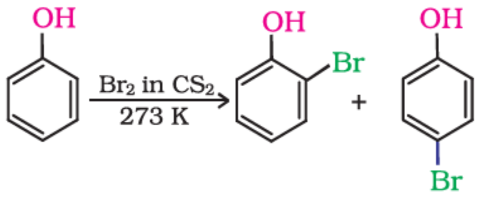
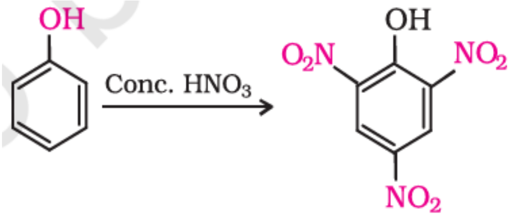
CHEMISTRY (Theory)- 043

QP CODE 56/1/1 **MM: 70**

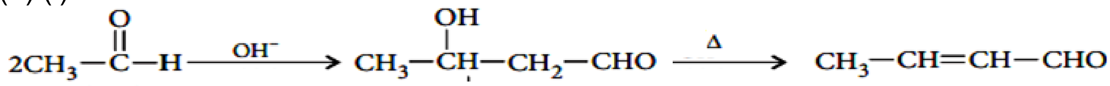
Q. No	Value points	Mark
	SECTION A	
1	(A)	**1**
2	(B)	**1**
3	(B)	**1**
4	(D)	**1**
5	(B)	**1**
6	(C)	**1**
7	(C)	**1**
8	(A)	**1**
9	(A)	**1**
10	(D)	**1**
11	(C)	**1**
12	(D)	**1**
13	(A)	**1**
14	(B)	**1**
15	(C)	**1**
16	(B)	**1**
	SECTION B	
17	(A) (a) Due to high pressure inside the pressure cooker, higher is the boiling point and faster is the cooking. (b) Negative deviation Temperature increases.	1 ½ ½
	OR	
17	(B) Same composition in liquid and in vapour phase and boil at a constant temperature. Maximum Boiling Azeotrope 68% HNO_3 + 32% H_2O (Or any other correct example) (Percentage can be ignored)	1 ½ ½
18	(a) $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$ (b) $Cr_2O_7^{2-} + 14\ H^+ + 6\ Fe^{2+} \rightarrow 2\ Cr^{3+} + 6\ Fe^{3+} + 7\ H_2O$	1 1
19	- Less reactive, - The carbon atom of the carbonyl group of benzaldehyde is less electrophilic than carbon atom of the carbonyl group present in propanal. / The polarity of the carbonyl group is reduced in benzaldehyde due to resonance.	1 1
20	(a) A = CH_3CH_2CN ; B= $CH_3CH_2\ CH_2NH_2$ (b) A = $C_6H_5N^+_2Cl^-$; B = 	½ x 4

21	(a)  (b) 	1 1
	SECTION C	
22	T_b of glucose solution = 100.20°C $\Delta T_b = T_b - T^o_b$ $= 100.20\,^{\circ} - 100\,^{\circ}C = 0.20\,^{\circ}C$ or 0.20 K $\triangle T_b = K_b\,.m$ $m = \frac{0.20}{0.512} = 0.390$ mol/kg $\Delta T_f = K_f\,.\,m$ $\Delta T_f = 1.86$ K kg/mol × 0.390 mol/kg $\Delta T_f = 0.725$ K Freezing point of solution $= 273.15 - 0.725$ $= 272.425$ K Or -0.725 °C	½ ½ ½ 1 ½
23	(a) (i) The limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte. (ii) The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte. (b) 'X' is better, as X has more negative electrode potential than Fe / X has more oxidation potential than Fe.	1 1 ½ , ½
24	$t_{1/2} = \frac{0.693}{k}$ $k_1 = \frac{0.693}{20} = 0.03465 / 3.465 \times 10^{-2}$ min^{-1} $k_2 = \frac{0.693}{5} = 0.1386 / 1.386 \times 10^{-1}$ min^{-1} $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$ $\log \frac{0.1386}{0.03465} = \frac{Ea}{2.303 \times 8.314} \frac{[350-300]}{[350 \times 300]}$ $\log 4 = \frac{Ea}{19.15} \frac{[50]}{[350 \times 300]}$ Ea = 24209 J mol^{-1} or 24.209 kJ mol^{-1} (Deduct ½ mark for no or incorrect unit)	½ ½ ½ ½ 1

25	(a) Its high $\Delta_a H^o$ and low $\Delta_{hyd} H^o$. (b) Cr Cr^{3+} (d^4 to d^3) / stable half-filled t_{2g} level (c) Fully-filled d-orbitals hence no d-d transition / due to the absence of unpaired electron.	1 ½ , ½ 1
26.	(A) (a)  (b)  (c) 	1 1 1
	OR	
26	(B) (a)  (b)  (c)  (or any other suitable method of conversion)	1 1 1
27	(a) $(CH_3)_2NH < CH_3CH_2NH_2 < CH_3CH_2OH$ (b) (i) aromatic halides do not undergo nucleophilic substitution with the anion formed by phthalimide. (ii)  /Due to resonance the lone pair on nitrogen is less available for donation/ Due to +R effect lone pair of electrons is not easily available on N of $-NH_2$ group/ Due to -R effect of carbonyl group, electron density on N atom of $-NH_2$ group decreases.	1 1 1

<table>
<tr><td>28</td><td>(a)
<table><tr><th>Native protein</th><th>Denatured protein</th></tr><tr><td>Three-dimensional structure is intact.
Biologically active</td><td>Three-dimensional structure is destroyed.
Biologically inactive</td></tr></table>(Or any other one correct difference)</td><td>1</td></tr>
<tr><td></td><td>(b) Lactose</td><td>1</td></tr>
<tr><td></td><td>(c) Vitamin K</td><td>1</td></tr>
<tr><td></td><td>SECTION D</td><td></td></tr>
<tr><td>29</td><td>(a) (i) Slowest step.</td><td>1</td></tr>
<tr><td></td><td>(ii) Series of elementary reactions / Reactions involving two or more steps.</td><td>1</td></tr>
<tr><td></td><td>(b) Increases with increase in temperature.</td><td>1</td></tr>
<tr><td></td><td>OR</td><td></td></tr>
<tr><td></td><td>(b) Molecularity is defined only for elementary reactions whereas order is experimentally determined hence applicable for both / Because molecularity of each elementary reaction in complex reaction may be different and hence meaningless for overall complex reaction whereas order of a complex reaction is experimentally determined by the slowest step in its mechanism and is therefore applicable for both.</td><td>1</td></tr>
<tr><td></td><td>(c) 9 times</td><td>1</td></tr>
<tr><td>30</td><td>(a)
(i)

/ 2-Bromophenol and 4-Bromophenol is formed.</td><td>1</td></tr>
<tr><td></td><td>(ii)

/ 2,4,6-Trinitrophenol / Picric acid is formed.</td><td>1</td></tr>
<tr><td></td><td>b)Due to resonance, the lone pair of electrons on oxygen is not easily available for protonation.</td><td>1</td></tr>
<tr><td></td><td>c)
Phenol</td><td>½</td></tr>
<tr><td></td><td>Due to electron releasing effect (+I effect) of methyl group/ phenoxide ion formed is less stable in cresol.</td><td>½</td></tr>
<tr><td></td><td>OR</td><td></td></tr>
<tr><td></td><td>c) 2-Hydroxybenzaldehyde / 2- Hydroxybenzenecarbaldehyde.</td><td>1</td></tr>
</table>

	SECTION E	
31	(A) (a) The cell reaction is $Sn(s)+2H^+(aq) \rightarrow Sn^{2+}(aq)+H_2(g)$	1
	$E_{Cell} = (E^o{}_c - E^o{}_a) - \frac{0\cdot059}{2}\log\frac{[Sn^{2+}]}{[H^+].^2}$	1
	$= [(0)-(-0\cdot14)] - \frac{0\cdot059}{2} log \frac{0\cdot004}{(0\cdot02).^2}$ = 0.14 - 0.0295 log 10 = 0.1105 V	1
	b) (i) overpotential of O_2	1
	(ii) Number of ions carrying current per unit volume decreases on dilution	1
	OR	
31	B) a) At anode: $Pb+SO_4^{-2} \rightarrow PbSO_4+2e^-$	½
	At cathode: $PbO_2+ SO_4^{-2}+4H^++2e^- \rightarrow PbSO_4+2H_2O$	½
	Overall reaction: $Pb+PbO_2+2 SO_4^{-2}+4H^+ \rightarrow 2PbSO_4+2H_2O$	1
	b) $E_{Cell} = E^o{}_{Cell} - \frac{0\cdot059}{n} log\left[\frac{[Cr^{3+}]^2}{[Cr2O7^{2-}]\ [H+]^{14}}\right]$	1
	$Ecell = 1.33 - \frac{0.059}{6} \log (10^{-2})^2/(10^{-2})(1 X10^{-4})^{14}$ $= 1.33 - \frac{0.059}{6} (54) \log 10$ = 1.33 – 0.059 x 9 = 1.33 – 0.531	1
	= 0.799 V	1
32	A)a) The orbital splitting energies are not sufficiently large for forcing paring of electrons.	1
	b) In the presence of strong field ligand, d^7 is converted into more stable d^6 configuration / Strong field effect stabilises higher oxidation state.	1
	c) Co-ordination isomerism.	1
	d) $[Ni(H_2O)_6]^{2+}$ has unpaired electrons whereas $[Ni(CN)_4]^{2-}$ has no unpaired electron.	1
	e) Pentaamminecarbonatocobalt(III) chloride	1
	OR	
32	B)(a) The higher stability of complexes involving chelating ligands as compare to complexes having non-chelating ligand.	1
	Example: $[Co(en)_3]^{3+}$ (or any other correct example)	1
	(b) d^2sp^3 , diamagnetic	1+1
	(c) $[Pt (NH_3)_2 Cl_2]$	1

33	(A) (a) (i)  $2CH_3-\overset{O}{\overset{\Vert}{C}}-H \xrightarrow{OH^-} CH_3-\overset{OH}{\overset{\vert}{C}H}-CH_2-CHO \xrightarrow{\Delta} CH_3-CH=CH-CHO$ (ii) $CH_3CH_2COOH + NaOH + CaO$ + heat $\longrightarrow CH_3-CH_3$ (b) A = $(CH_3)_2CH=CHCH_3$ / 2-Methylbut-2-ene B = CH_3CHO / Ethanal C = CH_3COCH_3/ Acetone/ Propanone	1 1 1 1 1
	OR	
33	A= $C_3H_7COOC_4H_9$ / Butyl butanoate B= C_3H_7COOH / Butanoic acid C= C_4H_9OH / Butan-1-ol $C_3H_7COOC_4H_9$+ dil.$H_2SO_4 \rightarrow C_3H_7COOH + C_4H_9OH$ C_4H_9OH + Conc. Sulphuric acid + Heat$\rightarrow CH_3CH_2CH=CH_2$ $C_4H_9OH \xrightarrow{CrO_3 / CH_3COOH} C_3H_7COOH$	1 ½ ½ 1 1 1

Series : W2YXZ

SET ~ 1

रोल नं.
Roll No.

प्रश्न-पत्र कोड
Q.P. Code 56/2/1

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।
Candidates must write the Q.P. Code on the title page of the answer-book.

नोट / NOTE

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं ।
Please check that this question paper contains **23** printed pages.

(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं ।
Please check that this question paper contains **33** questions.

(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें ।**
Please write down the serial number of the question in the answer-book at the given place before attempting it.

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।
15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

~

रसायन विज्ञान (सैद्धांतिक)
CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे — *अधिकतम अंक : 70*

Time allowed : 3 hours — *Maximum Marks : 70*

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains* ***33*** *questions.* ***All*** *questions are* ***compulsory****.*

(ii) *This question paper is divided into* ***FIVE*** *sections – Section* ***A, B, C, D*** *and* ***E****.*

(iii) ***Section A*** *– questions number* ***1*** *to* ***16*** *are multiple choice type questions. Each question carries* ***1*** *mark.*

(iv) ***Section B*** *– questions number* ***17*** *to* ***21*** *are very short answer type questions. Each question carries* ***2*** *marks.*

(v) ***Section C*** *– questions number* ***22*** *to* ***28*** *are short answer type questions. Each question carries* ***3*** *marks.*

(vi) ***Section D*** *– questions number* ***29*** *and* ***30*** *are case-based questions. Each question carries* ***4*** *marks.*

(vii) ***Section E*** *– questions number* ***31*** *to* ***33*** *are long answer type questions. Each question carries* ***5*** *marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section –****A****.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculator is NOT allowed.*

You may use the following values of physical constants wherever necessary :

$c = 3 \times 10^{8}$ m/s

$h = 6.63 \times 10^{-34}$ Js

$e = 1.6 \times 10^{-19}$ C

$\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}$ N m^2 C^{-2}

Mass of electron (m_e) = 9.1×10^{-31} kg.

Mass of neutron = 1.675×10^{-27} kg.

Mass of proton = 1.673×10^{-27} kg.

Avogadro's number = 6.023×10^{23} per gram mole

Boltzmann's constant = 1.38×10^{-23} JK^{-1}

SECTION – A

16 × 1 = 16

Question No. **1** to **16** are Multiple Choice type questions carrying **1** mark each.

1. The charge required for the reduction of 1 mol of MnO_4^- to MnO_2 is
   (A) 1 F　(B) 3 F
   (C) 5 F　(D) 6 F

2. Which among the following is a false statement ?
   (A) Rate of zero order reaction is independent of initial concentration of reactant.
   (B) Half-life of a zero order reaction is inversely proportional to the rate constant.
   (C) Molecularity of a reaction may be zero.
   (D) For a first order reaction, $t_{1/2} = 0.693/k$.

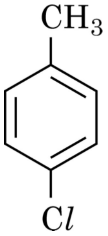
3. The number of molecules that react with each other in an elementary reaction is a measure of the :
   (A) activation energy of the reaction　(B) stoichiometry of the reaction
   (C) molecularity of the reaction　(D) order of the reaction

4. The element having $[Ar]3d^{10}4s^1$ electronic configuration is
   (A) Cu　(B) Zn
   (C) Cr　(D) Mn

5. The complex ions $[Co(NH_3)_5(NO_2)]^{2+}$ and $[Co(NH_3)_5(ONO)]^{2+}$ are called
   (A) Ionization isomers　(B) Linkage isomers
   (C) Co-ordination isomers　(D) Geometrical isomers

6. The diamagnetic species is :
   (A) $[Ni(CN)_4]^{2-}$　(B) $[NiCl_4]^{2-}$
   (C) $[Fe(CN)_6]^{3-}$　(D) $[CoF_6]^{3-}$
   [At. No. Co = 27, Fe = 26, Ni = 28]

7. Which is the correct IUPAC name for



(A)	Methylchlorobenzene	(B)	Toluene
(C)	1–Chloro–4–Methylbenzene	(D)	1–Methyl–4–Chlorobenzene

8. What will be formed after oxidation reaction of secondary alcohol with chromic anhydride (CrO_3) ?

(A)	Aldehyde	(B)	Ketone
(C)	Carboxylic acid	(D)	Ester

9. The conversion of phenol to salicylic acid can be accomplished by

(A)	Reimer-Tiemann reaction	(B)	Friedel-Crafts reaction
(C)	Kolbe reaction	(D)	Coupling reaction

10. Which of the following is/are examples of denaturation of protein ?

(A)	Coagulation of egg white	(B)	Curdling of milk
(C)	Clotting of blood	(D)	Both (A) and (B)

11. Nucleotides are joined together by

(A)	Glycosidic linkage	(B)	Peptide linkage
(C)	Hydrogen bonding	(D)	Phosphodiester linkage

12. Scurvy is caused due to deficiency of

(A)	Vitamin B1	(B)	Vitamin B2
(C)	Ascorbic acid	(D)	Glutamic acid

For question number **13** to **16**, two statements are given – one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. **Assertion (A) :** In a first order reaction, if the concentration of the reactant is doubled, its half-life is also doubled.

    Reason (R) : The half-life of a reaction does not depend upon the initial concentration of the reactant in a first order reaction.

14. **Assertion (A) :** Cu cannot liberate H_2 on reaction with dilute mineral acids.

    Reason (R) : Cu has positive electrode potential.

15. **Assertion (A) :** Aromatic primary amines cannot be prepared by Gabriel Phthalimide synthesis.

    Reason (R) : Aryl halides do not undergo nucleophilic substitution reaction with the anion formed by phthalimide.

16. **Assertion (A) :** Vitamin D cannot be stored in our body.

    Reason (R) : Vitamin D is fat soluble vitamin and is not excreted from the body in urine.

SECTION – B

17. (A) The rate constant for a zero order reaction A → P is 0.0030 mol $L^{-1}s^{-1}$. How long will it take for the initial concentration of A to fall from 0.10 M to 0.075 M ? **2**

OR

(B) The decomposition of NH_3 on platinum surface is zero order reaction. What are the rates of production of N_2 and H_2 if $k = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1} ? **2**

18. Define the following terms : **2 × 1**

(a) Pseudo first order reaction

(b) Half-life period of reaction ($t_{1/2}$)

19. Examine the following observations : **2 × 1**

(a) Transition elements generally form coloured compounds.

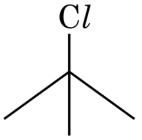
(b) Zinc is not regarded as a transition element.

20. Name the following coordination compounds according to IUPAC norms : **2 × 1**

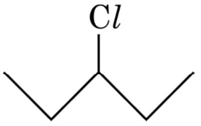
(a) $[Co(NH_3)_4(H_2O)Cl]Cl_2$

(b) $[CrCl_2(en)_2]Cl$

21. (a) In the following pair of halogen compounds, which compound undergoes S_N1 reaction faster and why ? **1**



and



(b) Arrange the following compounds in increasing order of their reactivity towards S_N2 displacement : **1**

2–Bromo–2–methylbutane, 1–Bromopentane, 2–Bromopentane.

SECTION – C

22. At 25 °C the saturated vapour pressure of water is 24 mm Hg. Find the saturated vapour pressure of a 5% aqueous solution of urea at the same temperature. (Molar mass of urea = 60 g mol^{-1}) **3**

23. The electrical resistance of a column of 0.05 M NaOH solution of area 0.8 cm^2 and length 40 cm is 5×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity. **3**

24. Complete and balance the following chemical equations : **3 × 1**

(a) $MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow$

(b) $KMnO_4 \xrightarrow[513\ K]{Heat}$

(c) $Cr_2O_7^{2-} + H_2S + H^+ \longrightarrow$

25. Using valence bond theory, explain the hybridization and magnetic character of the following : **2 × 1½ = 3**

(a) $[Co(NH_3)_6]^{3+}$

(b) $[Ni(CO)_4]$

[At. no. : Co = 27, Ni = 28]

26. (a) Define the following : **2 + 1 = 3**

(i) Enantiomers

(ii) Racemic mixture

(b) Why is chlorobenzene resistant to nucleophilic substitution reaction ?

27. (A) Explain the following reactions and write chemical equation involved :

3 × 1 = 3

(a) Wolff-Kishner reduction

(b) Etard reaction

(c) Cannizzaro reaction

OR

(B) Write the structures of A, B and C in the following sequence of reactions : **2 × 1½ = 3**

(a) $CH_3COOH \xrightarrow{SOCl_2} A \xrightarrow{H_2,\ Pd\text{-}BaSO_4} B \xrightarrow{H_2N\text{–}NH_2} C$

(b) $CH_3CN \xrightarrow[2.\ H_2O]{1.(DIBAL\text{–}H)} A \xrightarrow{Dil.\ NaOH} B \xrightarrow{\Delta} C$

28. Define the following terms : **3 × 1 = 3**

(a) Glycosidic linkage

(b) Invert sugar

(c) Oligosaccharides

SECTION – D

29. The spontaneous flow of the solvent through a semipermeable membrane from a pure solvent to a solution or from a dilute solution to a concentrated solution is called osmosis. The phenomenon of osmosis can be demonstrated by taking two eggs of the same size. In an egg, the membrane below the shell and around the egg material is semipermeable. The outer hard shell can be removed by putting the egg in dilute hydrochloric acid. After removing the hard shell, one egg is placed in distilled water and the other in a saturated salt solution. After some time, the egg placed in distilled water swells-up while the egg placed in salt solution shrinks. The external pressure applied to stop the osmosis is termed as osmotic pressure (a colligative property). Reverse osmosis takes place when the applied external pressure becomes larger than the osmotic pressure.

(a) Define reverse osmosis. Name one SPM which can be used in the process of reverse osmosis. **2**

(b) (i) What do you expect to happen when red blood corpuscles (RBC's) are placed in 0.5% NaC*l* solution ? **1**

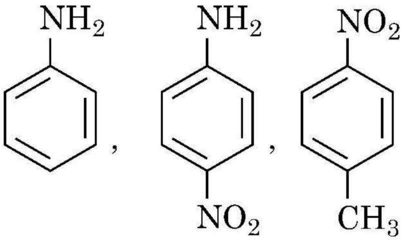
OR

(b) (ii) Which one of the following will have higher osmotic pressure in 1 M KC*l* or 1 M urea solution. Justify your answer. **1**

(c) Why osmotic pressure is a colligative property ? **1**

30. Amines have a lone pair of electrons on nitrogen atom due to which they behave as Lewis base. Greater the value of K_b or smaller the value of pK_b, stronger is the base. Amines are more basic than alcohols, ethers, esters, etc. The basic character of aliphatic amines should increase with the increase of alkyl substitution. But it does not occur in a regular manner as a secondary aliphatic amine is unexpectedly more basic than a tertiary amine in aqueous solutions. Aromatic amines are weaker bases than ammonia and aliphatic amines. Electron releasing groups such as $-CH_3$, $-OCH_3$, $-NH_2$, etc., increase the basicity while electron-withdrawing substituents such as $-NO_2$, –CN, halogens etc., decrease the basicity of amines. The effect of these substitute is more at p^- than at m^- position.

(a) Arrange the following in the increasing order of their basic character. Give reason : **2**



(b) Why pK_b of aniline is more than that of methylamine ? **1**

(c) (i) Arrange the following in the increasing order of their basic character in an aqueous solution : **1**

$(CH_3)_3N$, $(CH_3)_2NH$, NH_3, CH_3NH_2

OR

(c) (ii) Why ammonolysis of alkyl halides is not a good method to prepare pure amines ? **1**

SECTION – E

31. (A) (a) Give IUPAC name of $CH_3 - CH = CH - CHO$. **1**

(b) Give a simple chemical test to distinguish between propanal and propanone. **1**

(c) How will you convert the following : **3**

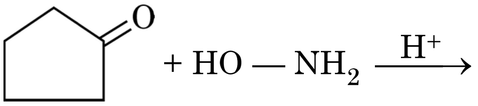
(i) Toluene to benzoic acid

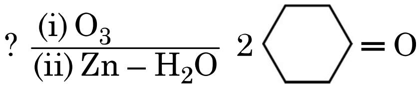
(ii) Ethanol to propan–2–ol

(iii) Propanal to 2–hydroxy propanoic acid

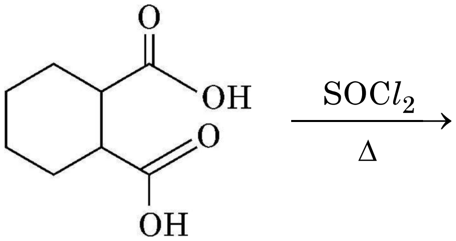
OR

31. (B) Complete each synthesis by giving missing starting material, reagent or products : **5 × 1 = 5**

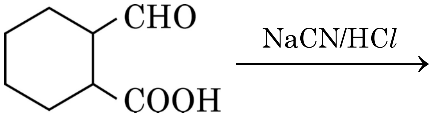
(a) 

(b) 

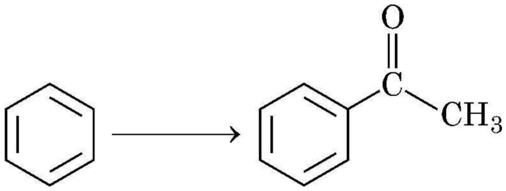
(c)



(d)



(e)



32. (A) (a) Calculate the standard Gibbs energy ($\Delta_r G^\circ$) of the following reaction at 25 °C : **3 + 2**

$\mathrm{Au(s) + Ca^{2+}(1M) \rightarrow Au^{3+}(1M) + Ca(s)}$

$E^\circ_{Au^{3+}/Au} = + 1.5\ \mathrm{V}, E^\circ_{Ca^{2+}/Ca} = - 2.87\ \mathrm{V}$

Predict whether the reaction will be spontaneous or not at 25 °C.

$[1\ \mathrm{F} = 96500\ \mathrm{C\ mol^{-1}}]$

(b) Tarnished silver contains Ag_2S. Can this tarnish be removed by placing tarnished silverware in an aluminium pan containing an inert electrolytic solution such as NaCl ? The standard electrode potential for half reaction :

$\mathrm{Ag_2S(s) + 2e^- \longrightarrow 2Ag(s) + S^{2-}}$ is -0.71 V and for

$\mathrm{A}l^{3+} + 3e^- \longrightarrow 2\mathrm{A}l\mathrm{(s)}$ is -1.66 V

OR

32. (B) (a) Define the following : **2 + 3**

(i) Cell potential

(ii) Fuel cell

(b) Calculate emf of the following cell at 25 °C :

$\mathrm{Zn(s)\,|\,Zn^{2+}_{(0.1M)}\;||\;Cd^{2+}_{(0.01M)}\;|\;Cd(s)}$

Given : $E^{\circ}_{Cd^{2+}/Cd} = -0.40\ V$

$E^{\circ}_{Zn^{2+}/Zn} = -0.76\ V$

[log 10 = 1]

33. (A) An organic compound 'A', molecular formula C_2H_6O oxidises with CrO_3 to form a compound 'B'. Compound 'B' on warming with iodine and aqueous solution of NaOH gives a yellow precipitate of compound 'C'. When compound 'A' is heated with conc. H_2SO_4 at 413 K gives a compound 'D', which on reaction with excess HI gives compound 'E'. Identify compounds 'A', 'B', 'C', 'D' and 'E' and write chemical equations involved. **5**

OR

33. (B) (a) Write chemical equations of the following reactions : **3 + 1 + 1 = 5**

(i) Phenol is treated with conc. HNO_3

(ii) Propene is treated with B_2H_6 followed by oxidation by H_2O_2/OH^-.

(iii) Sodium t-butoxide is treated with CH_3Cl.

(b) Give a simple chemical test to distinguish between butan–1–ol and butan–2–ol.

(c) Arrange the following in increasing order of acid strength :

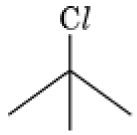
phenol, ethanol, water

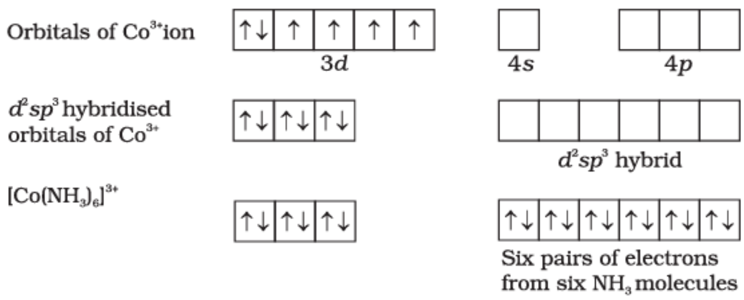
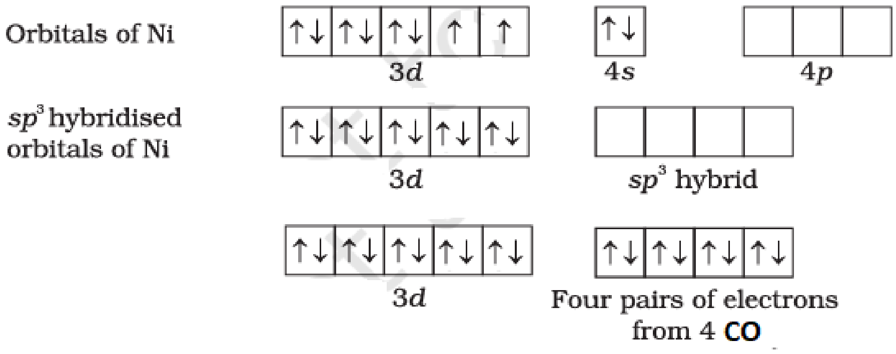
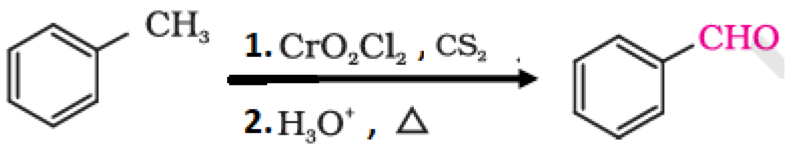
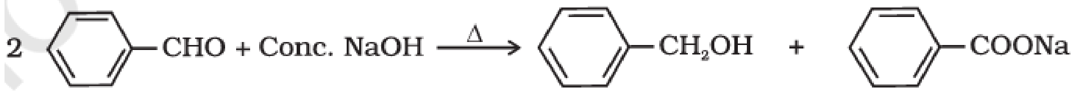
MARKING SCHEME 2024-25

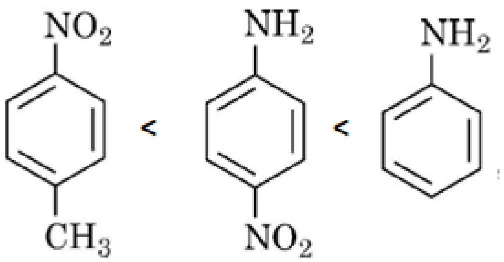
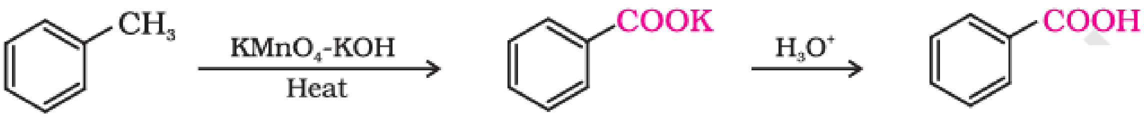
CHEMISTRY (Theory)- 043

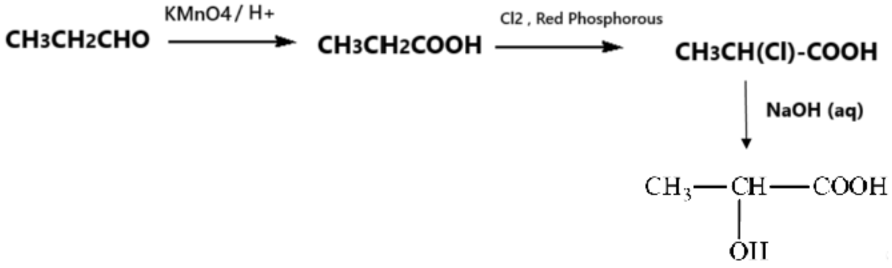
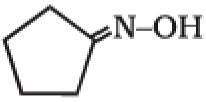
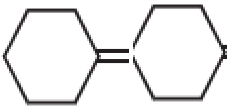
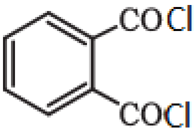
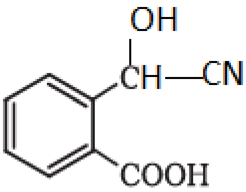
QP CODE 56/2/1 **MM: 70**

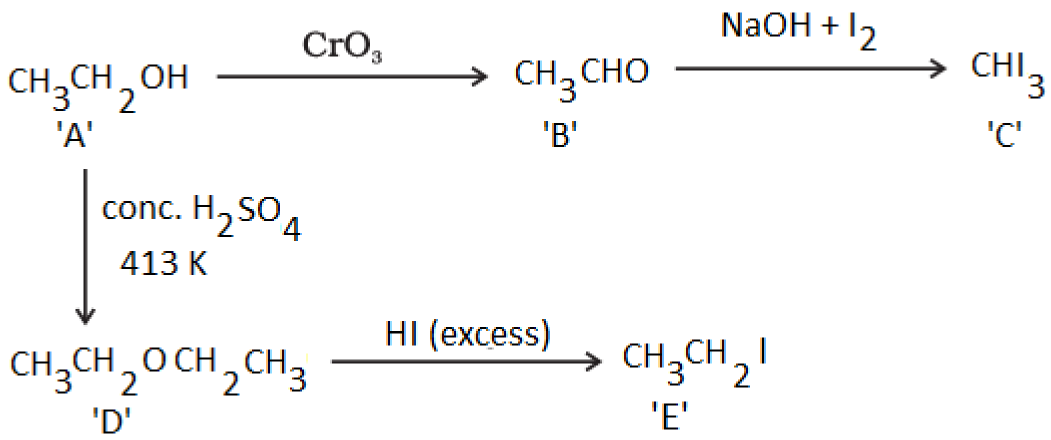
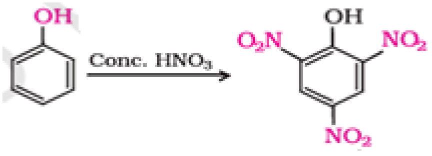
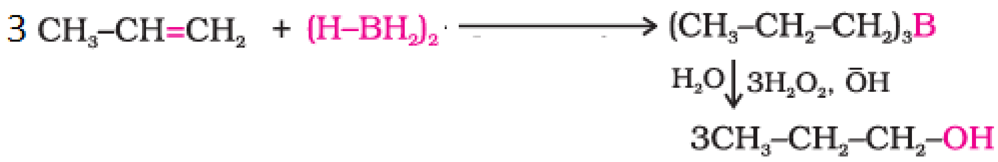
Q. No.	Value points	Mark
	SECTION A	
1	(B)	1
2	(C)	1
3	(C)	1
4	(A)	1
5	(B)	1
6	(A)	1
7	(C)	1
8	(B)	1
9	(C)	1
10	(D)	1
11	(D)	1
12	(C)	1
13	(D)	1
14	(A)	1
15	(A)	1
16	(D)	1
	SECTION B	
17	$k = \frac{[R]_0 - [R]}{t}$ $t = \frac{0.10 - 0.075}{0.0030}$ $t = \frac{0.025}{0.0030}$ $t = .\ 8.33\ s$	½ 1 ½
	OR	
17	Rate $= \frac{-1}{2}\frac{\Delta[NH3]}{\Delta t} = \frac{\Delta[N2]}{\Delta t} = \frac{+1}{3}\frac{\Delta[H2]}{\Delta t}$ $\frac{-1}{2}\frac{\Delta[NH3]}{\Delta t} = \frac{\Delta[N2]}{\Delta t} = \frac{+1}{3}\frac{\Delta[H2]}{\Delta t} = k$ $\frac{\Delta[N2]}{\Delta t} = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1} $\frac{\Delta[H2]}{\Delta t} = 3 \times 2.5 \times 10^{-4}$ $= 7.5 \times 10^{-4}$ mol L^{-1} s^{-1}	½ ½ ½ ½
18	(a) The reaction that seems to be of higher order but under certain conditions is of first order. (b) The time in which the concentration of a reactant is reduced to one half of its initial concentration / The time in which half of the reaction is completed.	1 1
19	(a) Due to the presence of unpaired electron in d sub shell/ due to d-d transition. (b) Due to the presence of fully filled d- subshell in ground state and oxidized state.	1 1
20	(a) Tetraammineaquachloridocobalt(III) chloride (b) Dichloridobis(ethane-1,2-diamine)chromium(III) chloride	1 1

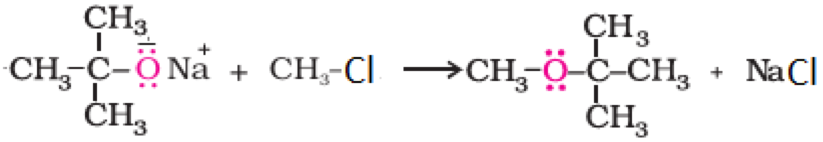
21	(a)  , due to the formation of more stable tertiary carbocation. (b) 2-Bromo-2-methylbutane < 2-Bromopentane < 1-Bromopentane.	½ , ½ 1
	SECTION C	
22	$\frac{p_1^0 - p_1}{p_1^0} = \frac{w_2 \times M_1}{M_2 \times w_1}$ $\frac{24 - p_1}{24} = \frac{5 \times 18}{60 \times 95}$ $\frac{24 - p_1}{24} = \frac{3}{190}$ $24 - p_1 = \frac{3 \times 24}{190}$ $p_1 =$ 23.62 mm Hg / 23.64 mm Hg (Deduct ½ mark for no or incorrect unit).	1 1 1
23	$\rho = \frac{RA}{l}$ $= \frac{5 \times 10^3 \times 0.8}{40}$ = 100 Ω cm $\kappa = \frac{1}{\rho}$ $= \frac{1}{100}$ = 10^{-2} S cm^{-1} $\Lambda_m = \frac{\kappa \times 1000}{C}$ $= \frac{10^{-2} \times 1000}{0.05}$ = 2×10^{2} S cm^{2} mol^{-1}	½ ½ ½ ½ ½ ½
24	(a) $5C_2O_4^{2-} + 2MnO_4^{-} + 16H^{+} \longrightarrow 2Mn^{2+} + 8H_2O + 10CO_2$ (b) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$ (c) $Cr_2O_7^{2-} + 8H^{+} + 3H_2S \rightarrow 2Cr^{3+} + 3S + 7H_2O$	1 1 1

25	(a)	
		½
	Hybridization: d^2sp^3	½
	Magnetic character: Diamagnetic.	½
	(b)	
		½
	Hybridization: sp^3	½
	Magnetic character: Diamagnetic.	½
26.	(a) (i) The stereoisomers related to each other as non-superimposable mirror images.	1
	(ii) A mixture containing dextro and laevo enantiomers in equal proportions.	1
	(b) C—Cl bond acquires a partial double bond character due to resonance / the carbon atom of benzene attached to halogen is sp^2-hybridised / Explanation through resonating structures.	1
27	(A)	
	(a) The carbonyl group of aldehydes and ketones is reduced to CH_2 group on treatment with hydrazine followed by heating with sodium or potassium hydroxide in high boiling solvent such as ethylene glycol	½
		½
	(b) Chromyl chloride oxidises methyl group of toluene to a chromium complex, which on hydrolysis gives corresponding benzaldehyde.	½
		½
	(c) Aldehydes which do not have α-hydrogen atom, undergo self-oxidation and reduction reaction on heating with concentrated alkali gives salt of carboxylic acid and alcohol	½
	 (Or any other example)	½
	OR	
27	(B)	
	(a) A = CH_3COCl (b) CH_3CHO (c) $CH_3CH{=}NNH_2$	½ x 3

	(b) A = CH_3CHO (b) $CH_3CH(OH)CH_2CHO$ (c) $CH_3CH=CHCHO$	½ x 3
28	(a) The oxide linkage between two monosaccharides. (b) Hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as invert sugar. (c) Carbohydrates that yield two to ten monosaccharide units, on hydrolysis.	1 1 1
	SECTION D	
29	(a) • When external pressure is larger than the osmotic pressure, then the movement of solvent is from solution to solvent side through semi permeable membrane. / The direction of osmosis can be reversed if a pressure larger than the osmotic pressure is applied to the solution side. • Cellulose acetate / Or any other suitable example. (b) (i) RBC swells up / Cells swell and may even burst due to endo-osmosis. **OR** (ii) 1 M KCl, i = 2 / KCl dissociates into ions, whereas urea does not dissociate. (c) It depends upon the number of solute particles in the solution.	1 1 1 ½ ½ 1
30	(a)  / Award full marks if attempted because of printing error. (b) Due to resonance in aniline the lone pair of electrons are less available while they are easily available in methyl amine. (c) (i) $NH_3 < (CH_3)_3N < CH_3NH_2 < (CH_3)_2NH$ OR (ii) A mixture of primary, secondary and tertiary amines and also a quaternary ammonium salt is formed.	2 1 1
	SECTION E	
31	(a) But-2-enal (b) On heating with NaOH + I_2, propanone gives yellow ppt. Of iodoform (CHI_3) whereas propanal does not. (Or any other suitable chemical test) (c) (i)  (ii) $CH_3CH_2OH \xrightarrow{PCC} CH_3CHO \xrightarrow[2.\ H_3O^+]{1.\ CH_3MgBr} CH_3CH(OH)CH_3$	1 1 1 1

	(iii)  (Or any other correct method)	1
	OR	
31	(B) (a)  (b)  (c)  (d)  (e) CH_3COCl / Anhy. $AlCl_3$ or $(CH_3CO)_2O$/ Anhy. $AlCl_3$	1 × 5= 5
32	(A) (a) $E^o_{cell}= E^o_{cathode}-E^o_{anode}$ $= - 2.87\ - 1.5$ V $=$ **- 4.37 V** $\triangle G^0 = - nF E^o_{cell}$ $= -6 \times 96500 \times (-4.37)$ $=$ 2530.230 kJ/mol Reaction is non-spontaneous. (b) Yes, the tarnish can be removed. Aluminium has more negative standard electrode potential than silver so will reduce silver sulphide to silver, tarnish will be removed. **/** $3\ Ag^+ + Al \longrightarrow 3\ Ag + Al^{3+}$ $E^o_{cell}= E^o_{cathode}-E^o_{anode}$ $= - 0.71\ -(-1.66)$ V $=$ 0.95 V This indicates that the reaction is feasible and tarnish can be removed.	 ½ ½ 1 1 1 1

	OR	
32	(B) (a) (i) Potential difference between two electrodes of a galvanic cell. (ii) The galvanic cell in which combustion energy of fuels is directly converted into electrical energy. b) n =2 $E^o_{cell} = E^o_{cathode} - E^o_{anode}$ $= -0.40 - (-0.76)$ V $=$ **0.36 V** $E_{Cell} = E^o_{celi} - \frac{0.059}{2} \log \left[\frac{Zn^{2+}}{Cd^{2+}}\right]$ $= [0.36] - \frac{0.059}{2} \log \frac{0.1}{0.01}$ $= (0 \cdot 36 - 0 \cdot 0295)$ = **0·3305 V** (Deduct ½ mark for no or incorrect unit)	1 1 1 1 1
33	**(A) A =** CH_3CH_2OH / Ethanol / Ethyl alcohol, B = CH_3CHO / Ethanal / Acetaldehyde, C = CHI_3 / Iodoform / Triiodomethane, D = $CH_3CH_2O\ CH_2\ CH_3$ / Ethoxyethane / Diethyl ether, E = CH_3CH_2I / Ethyl iodide / Iodoethane.  	½ x 5 ½ x 5
	OR	
33	(B) (a) (i)  (ii)  $3\ CH_3{-}CH{=}CH_2 + (H{-}BH_2)_2 \longrightarrow (CH_3{-}CH_2{-}CH_2)_3B \xrightarrow{H_2O,\ 3H_2O_2,\ \bar{O}H} 3CH_3{-}CH_2{-}CH_2{-}OH$ (iii)	1 1 1

	 $CH_3-\underset{CH_3}{\overset{CH_3}{C}}-\ddot{\underset{..}{O}}^{-}\overset{+}{Na} + CH_3-Cl \longrightarrow CH_3-\underset{..}{\ddot{O}}-\underset{CH_3}{\overset{CH_3}{C}}-CH_3 + NaCl$ (b) On heating with NaOH + I_2, Butan-2-ol gives yellow ppt. Of iodoform (CHI_3) whereas Butan-1-ol does not. (Or any other suitable chemical test) (c) Ethanol < Water < Phenol.	1 1

Series : W4YXZ

SET ~ 1

रोल नं.
Roll No.

प्रश्न-पत्र कोड
Q.P. Code **56/4/1**

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें।
Candidates must write the Q.P. Code on the title page of the answer-book.

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं।
Please check that this question paper contains **23** printed pages.

(II) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें।
Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(III) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं।
Please check that this question paper contains **33** questions.

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें।**
Please write down the Serial Number of the question in the answer-book at the given place before attempting it.

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है। प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा। 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे।
15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

#

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

*निर्धारित समय : **3** घण्टे*
*Time allowed : **3** hours*

*अधिकतम अंक : **70***
*Maximum Marks : **70***

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains* ***33*** *questions.* ***All*** *questions are* ***compulsory****.*

(ii) *This question paper is divided into* ***five*** *sections –* ***Section A, B, C, D*** *and* ***E****.*

(iii) ***Section A*** *– questions number* ***1*** *to* ***16*** *are multiple choice type questions. Each question carries* ***1*** *mark.*

(iv) ***Section B*** *– questions number* ***17*** *to* ***21*** *are very short answer type questions. Each question carries* ***2*** *marks.*

(v) ***Section C*** *– questions number* ***22*** *to* ***28*** *are short answer type questions. Each question carries* ***3*** *marks.*

(vi) ***Section D*** *– questions number* ***29*** *and* ***30*** *are case-based questions. Each question carries* ***4*** *marks.*

(vii) ***Section E*** *– questions number* ***31*** *to* ***33*** *are long answer type questions. Each question carries* ***5*** *marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculator is* ***not*** *allowed.*

SECTION A

Questions no. ***1*** *to* ***16*** *are Multiple Choice type Questions, carrying* ***1*** *mark each.* *16×1=16*

1. In an electrochemical cell, the following reaction takes place :

$$2Cu^{+}(aq) + Zn(s) \rightarrow 2Cu(s) + Zn^{2+}(aq)$$

$$E^{\circ}_{cell} = 1{\cdot}28\ V$$

As the reaction progresses, what will happen to the overall voltage of the cell ?

(A) Voltage will remain constant.

(B) It will decrease as $[Zn^{2+}]$ increases.

(C) It will increase as $[Cu^{+}]$ increases.

(D) It will increase as $[Zn^{2+}]$ increases.

2. Out of Fe^{3+}, Sc^{3+}, Cr^{3+} and Co^{3+} ions, the one which is colourless in aqueous solution is :

(A) Sc^{3+} (B) Fe^{3+}

(C) Cr^{3+} (D) Co^{3+}

[Atomic number : Fe = 26, Sc = 21, Cr = 24, Co = 27]

3. Hoffmann Bromamide degradation reaction is given by :

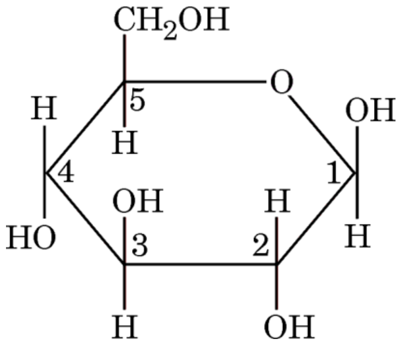
(A) $ArNO_2$

(B) $ArNH_2$

(C) $ArCONH_2$

(D) $ArCH_2NH_2$

4. In the Haworth structure of the following carbohydrate, various carbon atoms have been numbered. The anomeric carbon is numbered as :



(A) 1

(B) 2

(C) 3

(D) 5

5. The value of Henry's constant K_H is :

(A) greater for gases with higher solubility

(B) greater for gases with lower solubility

(C) constant for all gases

(D) not related to the solubility of gases

6. Out of the following statements, the ***incorrect*** statement is :

(A) La is actually an element of transition series.

(B) Zr and Hf have almost identical atomic radii because of lanthanoid contraction.

(C) Ionic radius decreases from La^{3+} to Lu^{3+} ion.

(D) Lanthanoids are radioactive in nature.

7. Out of 2-Bromobutane, 1-Bromobutane, 2-Bromopropane and 1-Bromopropane, the molecule which is chiral in nature is :

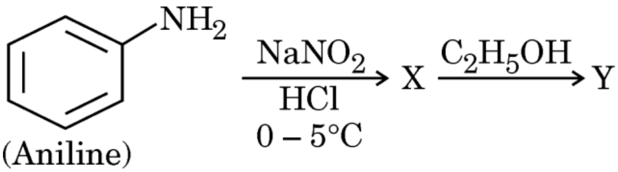
(A) 2-Bromobutane

(B) 1-Bromobutane

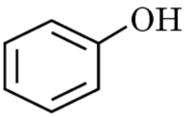
(C) 2-Bromopropane

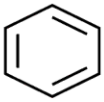
(D) 1-Bromopropane

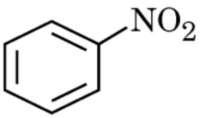
8. In the given reaction sequence, the structure of Y would be :

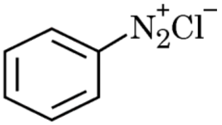


(Aniline)

(A) 

(B) 

(C) 

(D) 

9. The product of the oxidation of I^- with MnO_4^- in alkaline medium is :

(A) IO_4^-

(B) I_2

(C) IO^-

(D) IO_3^-

10. Polyhalogen compounds have wide application in industries and agriculture. DDT is also a very important polyhalogen compound. It is a :

(A) greenhouse gas

(B) fertilizer

(C) biodegradable insecticide

(D) non-biodegradable insecticide

11. What amount of electric charge is required for the reduction of 1 mole of MnO_4^- into Mn^{2+} ?

(A) 1 F (B) 5 F

(C) 4 F (D) 6 F

12. Alkenes are formed by heating alcohols with conc. H_2SO_4. The first step in the reaction is :

(A) formation of carbocation

(B) formation of ester

(C) protonation of alcohol molecule

(D) elimination of water

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* Electrolysis of aqueous NaCl gives H_2 at cathode and Cl_2 at anode.

Reason (R) : Chlorine has higher oxidation potential than H_2O.

14. *Assertion (A) :* Cuprous salts are diamagnetic.

Reason (R) : Cuprous ion has completely filled 3d-orbitals.

15. *Assertion (A) :* n-Butyl chloride has higher boiling point than n-Butyl bromide.

Reason (R) : C – Cl bond is more polar than C – Br bond.

16. *Assertion (A) :* Acetanilide is less basic than aniline.

Reason (R) : Acetylation of aniline results in decrease of electron density on nitrogen.

SECTION B

17. (a) Reactant 'A' underwent a decomposition reaction. The concentration of 'A' was measured periodically and recorded in the table given below :

Time/Hours	[A]/M
0	0·40
1	0·20
2	0·10
3	0·05

Based on the above data, predict the order of the reaction and write the expression for the rate law. *2*

OR

(b) The reaction between H_2 (g) and I_2 (g) was carried out in a sealed isothermal container. The rate law for the reaction was found to be :

$$\text{Rate} = k[H_2]\,[I_2]$$

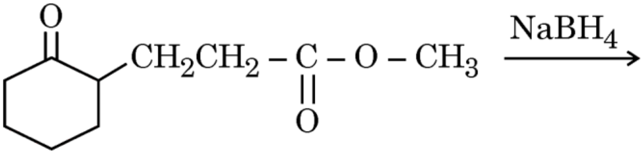
If 1 mole of H_2 (g) was added to the reaction chamber and the temperature was kept constant, then predict the change in rate of the reaction and the rate constant. *2*

18. $PtCl_4 \cdot 2KCl$ doesn't give precipitate of AgCl with $AgNO_3$ solution. Write the structural formula and IUPAC name of the complex. *2*

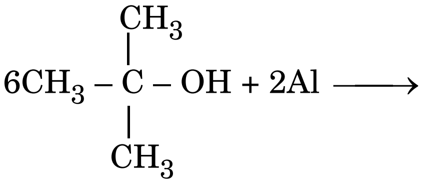
19. Define fuel cell. Give two advantages of fuel cell over ordinary cell. *2*

20. Write the structures of the main products of the following reactions : *2*

(a)



(b)



$$6CH_3-\overset{\overset{\large CH_3}{|}}{\underset{\underset{\large CH_3}{|}}{C}}-OH + 2Al \longrightarrow$$

21. What is meant by essential amino acids ? Why are amino acids amphoteric in nature ? *2*

SECTION C

22. (a) Account for the following : *3*

(i) Allyl chloride is hydrolysed more readily than n-propyl chloride.

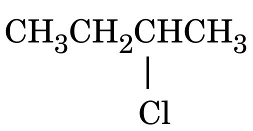
(ii) Isocyanides are formed when alkyl halides are treated with silver cyanide.

(iii) Methyl chloride reacts faster with $\bar{O}H$ ion in S_N2 reaction than t-butyl chloride.

OR

(b) Complete the following reactions by writing the structural formulae of 'A' and 'B' : *3*

(i) $CH_3CH = CH_2 \xrightarrow[\text{Peroxide}]{\text{HBr}} \text{'A'} \xrightarrow{\text{aq. KOH}} \text{'B'}$

(ii) 

$\underset{\displaystyle \overset{|}{Cl}}{CH_3CH_2CHCH_3} \xrightarrow[\Delta]{\text{alc. KOH}} \text{'A'} \xrightarrow{\text{HBr}} \text{'B'}$

(iii) $\text{'A'} \xrightarrow{\text{Mg}} CH_3CH_2MgCl \xrightarrow[H^+]{H_2O} \text{'B'}$ (Main product)

23. Calculate the cell voltage of the voltaic cell which is set up by joining following half-cells at 25°C : *3*

Al/Al^{3+} (0·001 M) and Ni/Ni^{2+} (0·1 M)

Given : $E^o_{Ni^{2+}/Ni} = -0{\cdot}25$ V, $E^o_{Al^{3+}/Al} = -1{\cdot}66$ V

24. Give explanation for each of the following observations : *3*

(a) With the same d-orbital configuration (d^4), Mn^{3+} ion is an oxidising agent whereas Cr^{2+} ion is a reducing agent.

(b) Actinoid contraction is greater from element to element than that among lanthanoids.

(c) Transition metals form large number of interstitial compounds with H, B, C and N.

25. An aqueous solution of NaOH was made and its molar mass from the measurement of osmotic pressure at 27°C was found to be 25 g mol^{-1}. Calculate the percentage dissociation of NaOH in this solution. *3*

[Atomic mass : Na = 23 u, O = 16 u, H = 1 u]

26. Arrange the following compounds as asked : *3*

(a) in decreasing order of pK_b values

$C_2H_5NH_2$, $(C_2H_5)_2NH$, $C_6H_5NHCH_3$, $C_6H_5NH_2$

(b) increasing order of boiling point

C_2H_5OH, $C_2H_5NH_2$, $(CH_3)_2NH$

(c) increasing order of solubility in water

$C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$

27. An aromatic compound 'A' with molecular formula C_8H_8O gives positive 2,4-DNP test. It gives yellow precipitate. of compound 'B' on treatment with sodium hypoiodite. Compound 'A' does not react with Tollen's or Fehling's reagent; on drastic oxidation with $KMnO_4$ it forms a carboxylic acid 'C'. Elucidate the structures of A, B and C. Also give their IUPAC names. *3*

28. (a) Can sodium ethoxide and t-butyl chloride be used for the preparation of t-butyl ethyl ether ? Give suitable explanation. Justify your answer by suggesting the appropriate starting material required for preparation of t-butyl ethyl ether. *2*

(b) Give the IUPAC name of above mentioned ether. *1*

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. According to the generally accepted definition of the ideal solution there are equal interaction forces acting between molecules belonging to the same or different species. (This is equivalent to the statement that the activity of the components equals the concentration.) Strictly speaking, this condition is fulfilled only in exceptional cases for mixtures (optical isomers, isotopic mixtures of an element, hydrocarbon mixtures). It is still usual to talk about ideal solutions as limiting cases in reality since very dilute solutions behave ideally with respect to the solvent. This view is further supported by the fact that Raoult's law empirically found for describing the behaviour of the solvent in dilute solutions can be deduced thermodynamically via the assumption of ideal behaviour of the solvent.

Answer the following questions :

(a) Give one example of miscible liquid pair which shows negative deviation from Raoult's law. What is the reason for such deviation ? *2*

(b) (i) State Raoult's law for a solution containing volatile components. *1*

OR

(b) (ii) Raoult's law is a special case of Henry's law. Comment. *1*

(c) Write two characteristics of an ideal solution. *1*

30. Ribose and 2-deoxyribose have an important role in biology. Among the most important derivatives are those with phosphate groups attached at the 5 position. Mono-, di- and tri-phosphate forms are important, as well as 3-5 cyclic monophosphates. Purines and pyrimidines form an important class of compounds with ribose and deoxyribose. When these purine and pyrimidine derivatives are coupled to a ribose sugar, they are called nucleosides.

Answer the following questions :

(a) What products would be formed when DNA is hydrolysed ? How is DNA different from RNA with reference to a structure ? *2*

(b) Differentiate between nucleotide and nucleoside. *1*

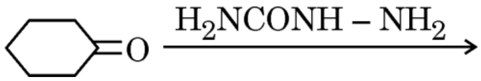
(c) (i) Mention two important functions of nucleic acid. *1*

OR

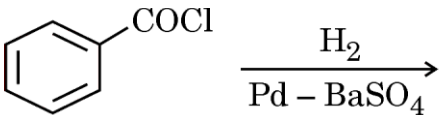
(c) (ii) Name the linkage which joins two nucleotides. Name the base that is found in nucleotide of RNA but not in DNA. *1*

SECTION E

31. (a) (i) Complete the following reactions by writing the structure of the main products :

(I)  1

(II) $(CH_3)_2Cd + 2CH_3COCl \longrightarrow$ 1

(III)  1

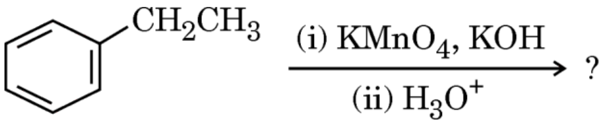
(ii) Give simple chemical test to distinguish between the following pairs of compounds :

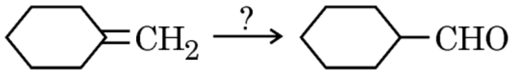
(I) Ethyl benzoate and benzoic acid 1

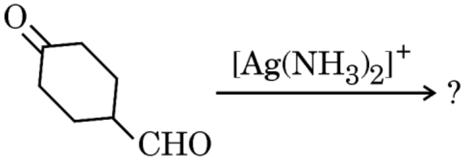
(II) Propanal and propanone 1

OR

(b) (i) Complete each synthesis by giving missing starting material, reagent or products :

(I)  1

(II)  1

(III)  1

(ii) Carry out the following conversions :

(I) Benzaldehyde to Benzophenone 1

(II) Benzaldehyde to 3-phenyl propanol 1

32. (a) (i) Give reasons :

(I) $[Ni(CO)_4]$ is diamagnetic whereas $[NiCl_4]^{2-}$ is paramagnetic. [Atomic number : Ni = 28] *1*

(II) CO is a stronger complexing agent than NH_3. *1*

(III) The trans isomer of complex $[Co(en)_2Cl_2]^+$ is optically inactive. *1*

(ii) Using Crystal Field theory, write the number of unpaired electrons in octahedral complexes of Fe^{3+} in the presence of : *2*

(I) Strong field ligand

(II) Weak field ligand

[Atomic number : Fe = 26]

OR

(b) (i) Name the type of isomerism exhibited by the following compounds. Also draw their corresponding isomers.

(I) $[Co(NH_3)_6]\ [Cr(CN)_6]$ *1*

(II) $[Co(en)_3]^{3+}$ *1*

(III) $[Co(NH_3)_3(NO_2)_3]$ *1*

(ii) Differentiate between weak field and strong field ligands. How does the strength of the ligand influence the spin of the complex ? *2*

33. (a) (i) The initial concentration of N_2O_5 in the first order reaction :

$$N_2O_5\ (g) \rightarrow 2NO_2\ (g) + \frac{1}{2} O_2\ (g)$$

was $1{\cdot}2 \times 10^{-2}$ mol L^{-1}. The concentration of N_2O_5 after 60 minutes was $0{\cdot}2 \times 10^{-2}$ mol L^{-1}. Calculate the rate constant of the reaction at 318 K. *3*

[log 6 = 0·778]

(ii) Account for the following :

(I) We cannot determine the order of a reaction by taking into consideration the balanced chemical equation. *1*

(II) A bimolecular reaction may become kinetically of first order under a specified condition. *1*

OR

(b) (i) The rate of the chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate activation energy (E_a). *3*

$$[2{\cdot}303\ R = 19{\cdot}15\ JK^{-1}\ mol^{-1},\ \log 2 = 0{\cdot}3]$$

(ii) For a reaction :

$$2H_2O_2 \xrightarrow{I^-} 2H_2O + O_2$$

the proposed mechanism is as given below :

(I) $H_2O_2 + I^- \longrightarrow H_2O + IO^-$ (slow)

(II) $H_2O_2 + IO^- \longrightarrow H_2O + I^- + O_2$ (fast)

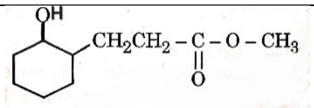
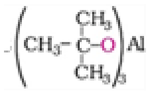
(1) Write rate law for the reaction.

(2) Write the overall order and molecularity of the reaction. *2*

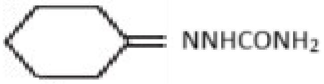
MARKING SCHEME 2024-25

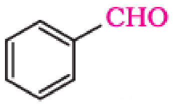
CHEMISTRY (Theory)- 043

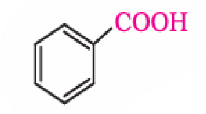
QP CODE 56/4/1 **MM: 70**

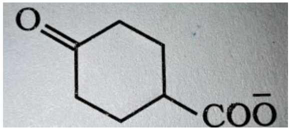
Q.No	Value points	Mark
	SECTION A	
1	**(B)**	**1**
2	**(A)**	**1**
3	**(C)**	**1**
4	**(A)**	**1**
5	**(B)**	**1**
6	**(D)**	**1**
7	**(A)**	**1**
8	**(B)**	**1**
9	**(D)**	**1**
10	**(D)**	**1**
11	**(B)**	**1**
12	**(C)**	**1**
13	**(C)**	**1**
14	**(A)**	**1**
15	**(D)**	**1**
16	**(A)**	**1**
	SECTION B	
17	Order of the reaction =1 / First Rate =k[A]	1 1
	OR	
17	Rate of the reaction will increase. Rate constant remains same.	1 1
18	Structural formula: $K_2[PtCl_6]$ IUPAC Name: Potassium hexachloridoplatinate(IV)	1 1
19	Galvanic cell which converts the energy of combustion of fuels directly into electrical energy. Advantages 1.High efficiency 2.Pollution free (or any other two correct advantages)	1 ½ x2=1
20	(a)  (b) 	1 1
21	- Amino-acids which cannot be synthesized in the body and must be obtained through diet. - In zwitter ionic form, amino-acids react both with acids and bases./ Due to the presence of both carboxylic group and amino group.	1 1
	SECTION C	
22(a)	(i) Greater stability of allylic carbocation due to resonance. (ii)Being covalent in nature, only nitrogen is free to donate electron pair in AgCN. (iii)Less sterically hindered carbon in Methyl chloride/ greater steric hinderance on tertiary carbon of t-butyl chloride.	1 1 1
	OR	
22(b)	(i) A =$CH_3CH_2CH_2Br$ B = $CH_3CH_2CH_2OH$ (ii) A = $CH_3CH=CHCH_3$ B= $CH_3CH_2CH(Br)CH_3$	½ x 6=3

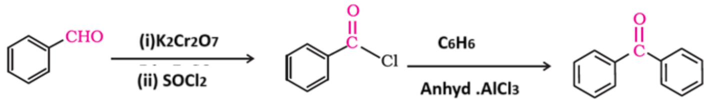
	(iii)A = CH_3CH_2Cl B= CH_3CH_3	
23	$2Al + 3Ni^{2+} \rightarrow 2Al^{3+} + 3Ni$ $E°cell=E°_{Ni^{2+}/Ni} - E°_{Al^{3+}/Al}$; $E°cell=-0.25-(-1.66)=1.41V$ n=6 $E_{cell}=E°_{cell}-\frac{2.303RT}{nF}\log\frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$ $E_{cell}=1.41-\frac{0.059}{6}\log\frac{[0.001]^2}{[0.1]^3}$ $E_{cell}=1.41-\frac{0.059}{6}\log\frac{[10]^{-6}}{[10]^{-3}}$ $E_{cell}=1.41-\frac{0.059}{6}\log 10^{-3}$ $E_{cell}=1.41-(-0.0295)$ $E_{cell}=1.41+0.0295$ $E_{cell}=1.439V/1.44V$ (Deduct ½ mark for no or incorrect unit)	½ ½ 1 1
24	(a)Change from Mn^{3+} to Mn^{2+} results in extra stable half filled d^5 configuration. Cr^{2+} is reducing as its configuration changes from d^4 to d^3 which is stable half filled t_{2g}^3 configuration. (b)Due to poorer shielding offered by 5f electrons than 4f. (c)H, B, C and N atoms being small in size get trapped inside the crystal lattices of transition metals.	½ ½ 1 1
25	i=Normal molar mass/Abnormal molar mass i=40/25 =1.6 α= i-1/n-1 $=\frac{1.6-1}{1}$ =0.6 x100 =60% (Any other suitable method)	½ 1 ½ 1
26.	(a)$C_6H_5NH_2 > C_6H_5NHCH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$ (b) $(CH_3)_2NH < C_2H_5NH_2 < C_2H_5OH$ (c) $C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2$	1 1 1
27	A: $C_6H_5COCH_3$ Acetophenone B : CHI_3 Triiodomethane C : C_6H_5COOH Benzoic acid	½ , ½ ½ , ½ ½ , ½
28	(a)No Sodium ethoxide is a strong nucleophile as well as a strong base so elimination reaction of t-butyl chloride predominates over substitution. Chloroethane and Sod.tert-butoxide / C_2H_5Cl and $(CH_3)_3CONa$ (b)2-Ethoxy-2-methylpropane	½ ½ ½ + ½ 1
	SECTION D	
29	(a)Chloroform and Acetone (or Any other correct example) A-B interactions are stronger than A-A and B-B interaction. (b)(i) For any solution the partial vapour pressure of each volatile component is directly proportional to its mole fraction. OR (b)(ii) $p = p^0 x_i$; $p = K_H x$ When $p^0 = K_H$ p α χ for both. (c) The enthalpy of mixing of the pure components in the ideal solution is Zero/$\Delta_{mix}H=0$. The Volume of mixing of the pure components in the ideal solution is Zero. /$\Delta_{mix}V=0$ (or any other two suitable characteristics)	1 1 1 1 ½ + ½

<table>
<tr><td>30</td><td>(a)2-Deoxyribose, Phosphoric acid, Nitrogenous base.
<table><tr><th>DNA</th><th>RNA</th></tr><tr><td>1.Double stranded helix</td><td>Single stranded helix</td></tr></table>(or any other suitable structural difference)
(b)
<table><tr><th>Nucleotide</th><th>Nucleoside</th></tr><tr><td>1.Pentose sugar+ Nitrogenous base + Phosphate</td><td>1.Pentose sugar+ Nitrogenous base</td></tr></table>(c)
(i) To preserve genetic information and Protein synthesis
OR
(c)(ii)Phosphodiester linkage
Uracil</td><td>1
1
1
1
½ + ½</td></tr>
<tr><td></td><td>SECTION E</td><td></td></tr>
<tr><td>31</td><td>(a)(i) (I)


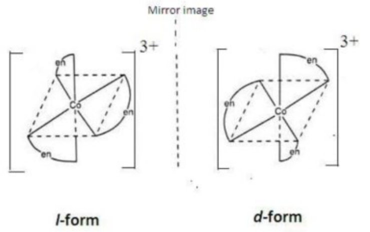
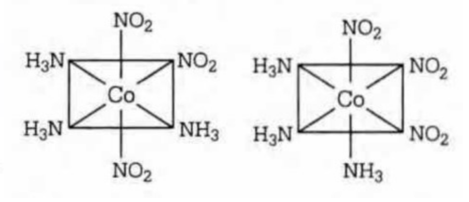
(II) CH_3COCH_3
(III) 

(ii) (I)Benzoic acid with Sodium bicarbonate gives brisk effervescence. No reaction with Ethyl benzoate
(ii)Propanal, when heated with ammoniacal solution of silver nitrate (Tollens' reagent) gives silver mirror. No reaction with propanone
(or any other suitable chemical test)</td><td>1
1
1
1
1</td></tr>
<tr><td></td><td>OR</td><td></td></tr>
<tr><td>31</td><td>(b)(i)(I)


(II)1.$(BH_3)_2$, 2.H_2O_2/OH^- , 3.PCC
(III)


(b)(ii)
(I)


(II) $C_6H_5CHO \xrightarrow{CH_3CHO,\ dil\ NaOH\ ,\Delta} C_6H_5CH{=}CHCHO \xrightarrow{H_2/Ni} C_6H_5CH_2CH_2CH_2OH$
(Or any other suitable method)</td><td>1
1
1
1
1</td></tr>
<tr><td>32</td><td>(a)(i)
(I)CO being a strong field ligand, causes pairing of electrons therefore, there is no unpaired electron.</td><td>1</td></tr>
</table>

	Whereas Cl^- is a weak field ligand, does not cause pairing, therefore presence of unpaired electrons. (II) CO can form both sigma (σ) and pi (π)bond with central metal atom/Metal to ligand bonding creates synergic effect between CO and the Metal. (III) Mirror images are superimposable/ Presence of plane of symmetry. (ii) (I)$\Delta_O > P$, causes pairing of electrons, therefore 1 unpaired electron (II) $\Delta_O < P$, No pairing of electrons therefore 5 unpaired electrons	1 1 1 1
	OR	
32	(b)(i) (I)Coordination Isomerism / $[Cr(NH_3)_6]\ [Co(CN)_6]$ (II)Optical Isomerism /  (III)Geometrical isomerism /  (ii) Weak field ligands produce weak field and leads to small splitting of d-orbitals whereas strong field ligands produce strong field leading to large splitting of d-orbitals. Strong field ligands cause pairing of electrons/a smaller number of unpaired electrons hence produces low spin complexes and weak field ligands causes no pairing of electrons/ a greater number of unpaired electrons hence produces high spin complexes.	½ , ½ ½ , ½ ½ , ½ 1 1
33	(a) (i) $k = \frac{2.303}{t}\ \log\ \frac{[R]_0}{[R]}$ $k = \frac{2.303}{60}\ \log \frac{1.2\ x\ 10^{-2}}{0.2\ x\ 10^{-2}}$ $= \frac{2.303}{60}\ \log 6$ $= \frac{2.303}{60}\ x\ 0.778$ k= 2.98 x 10^{-2} min^{-1} / 0.0298 min^{-1} (Deduct ½ mark for incorrect or no unit.) (ii) (I) Order is determined experimentally. (II) If one of the reactants is taken in excess.	1 1 1 1 1
	OR	
33	(b)(i) $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$	1

	log $\frac{2k_1}{k_1} = \frac{E_a}{19{\cdot}15}\left[\frac{1}{298} - \frac{1}{308}\right]$	1
	$0{\cdot}3 = \frac{\mathrm{E_a}}{19{\cdot}15}\left[\frac{10}{298\times308}\right]$	
	$\mathrm{E_a} = \frac{0{\cdot}3\times19{\cdot}15\times298\times308}{10}$	
	E_a= 52729 $\mathrm{Jmol^{-1}}$ or 52.729 $\mathrm{kJmol^{-1}}$ (Deduct ½ mark for incorrect or no unit.)	1
	(ii)	
	(1). Rate= k[H_2O_2] [I^-]	1
	(2) Overall order : 2/ Second	½
	Molecularity : 2 / Bimolecular	½

Series : WYXZ5

SET ~ 1

प्रश्न-पत्र कोड
Q.P. Code **56/5/1**

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें।
Candidates must write the Q.P. Code on the title page of the answer-book.

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं।
Please check that this question paper contains **23** printed pages.

(II) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें।
Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(III) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं।
Please check that this question paper contains **33** questions.

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें।**
Please write down the Serial Number of the question in the answer-book at the given place before attempting it.

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है। प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा। 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे।
15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

#

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

*निर्धारित समय : **3** घण्टे*
*Time allowed : **3** hours*

*अधिकतम अंक : **70***
*Maximum Marks : **70***

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains* ***33*** *questions.* ***All*** *questions are* ***compulsory****.*

(ii) *This question paper is divided into* ***five*** *sections –* ***Section A, B, C, D*** *and* ***E****.*

(iii) ***Section A*** *– questions number* ***1*** *to* ***16*** *are multiple choice type questions. Each question carries* ***1*** *mark.*

(iv) ***Section B*** *– questions number* ***17*** *to* ***21*** *are very short answer type questions. Each question carries* ***2*** *marks.*

(v) ***Section C*** *– questions number* ***22*** *to* ***28*** *are short answer type questions. Each question carries* ***3*** *marks.*

(vi) ***Section D*** *– questions number* ***29*** *and* ***30*** *are case-based questions. Each question carries* ***4*** *marks.*

(vii) ***Section E*** *– questions number* ***31*** *to* ***33*** *are long answer type questions. Each question carries* ***5*** *marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculator is* ***not*** *allowed.*

SECTION A

Questions no. ***1*** *to* ***16*** *are Multiple Choice type Questions, carrying* ***1*** *mark each.* *16×1=16*

1. The role of a catalyst is to change :

(A) equilibrium constant

(B) enthalpy of reaction

(C) Gibbs energy of reaction

(D) activation energy of reaction

2. Which of the following molecules is chiral in nature ?

(A) 1-chloropropane (B) 2-chloropropane

(C) 1-chlorobutane (D) 2-chlorobutane

3. CH_3CH_2OH can be converted to CH_3CHO by :

(A) catalytic hydrogenation

(B) treatment with $LiAlH_4$

(C) treatment with PCC

(D) treatment with $KMnO_4$

4. The IUPAC name for $CH_3 - CH_2 - N(CH_3) - CH_2 - CH_2 - CH_3$ is :

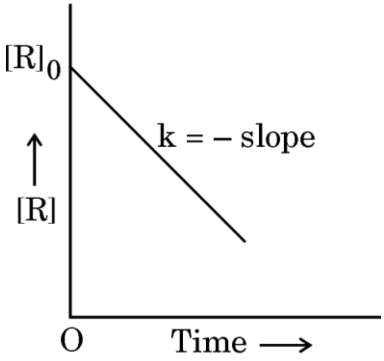
(A) N-methylpentan-2-amine

(B) N-ethyl-N-methylpropan-1-amine

(C) N,N-diethylpropan-1-amine

(D) N,N-dimethylpropan-1-amine

5. A plot between concentration of reactant [R] and time 't' is shown below. Which of the given order of reaction is indicated by the graph ?



(A) Third order (B) Second order

(C) First order (D) Zero order

6. The treatment of ethyl bromide with alcoholic silver nitrite gives :

(A) ethyl nitrite (B) nitroethane

(C) nitromethane (D) ethene

7. Which of the following aqueous solutions will have the highest freezing point ?

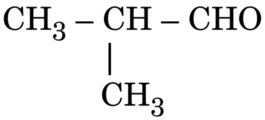
(A) 1·0 M KCl

(B) 1·0 M Na_2SO_4

(C) 1·0 M Glucose

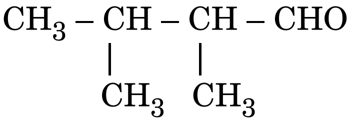
(D) 1·0 M $AlCl_3$

8. Which of the following aldehydes will undergo Cannizzaro reaction ?

(A) 
$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CHO$

(B) $(CH_3)_3C\ CHO$

(C) CH_3-CH_2-CHO

(D) 
$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CHO$

9. In which of the following groups are both ions coloured in aqueous solution ?

I. Cu^+ II. Ti^{4+} III. Co^{2+} IV. Fe^{2+}

[Atomic number : Cu = 29, Ti = 22, Co = 27, Fe = 26]

(A) I and II (B) II and III

(C) III and IV (D) I and IV

10. CH_3CH_2CHO and CH_3CH_2COOH can be distinguished by :

(A) Sodium bicarbonate test

(B) Hinsberg test

(C) Iodoform test

(D) Lucas test

11. Match the type of cell given in Column I with their use given in Column II.

	Column I		*Column II*
i.	Lead storage cell	a.	Wall clock
ii.	Mercury cell	b.	Apollo Space Programme
iii.	Dry cell	c.	Wrist watch
iv.	Fuel cell	d.	Inverter

(A) i-a, ii-b, iii-c, iv-d (B) i-d, ii-c, iii-a, iv-b

(C) i-c, ii-d, iii-b, iv-a (D) i-b, ii-a, iii-d, iv-c

12. While doing qualitative analysis in chemistry lab, Abhishek added yellow coloured potassium chromate solution into a test tube. He was surprised to see the colour of the solution changing immediately to orange. He realised that the test tube was not clean and contained a few drops of some liquid. Which of the following substances will be the most likely liquid to be present in the test tube before adding potassium chromate solution ?

(A) Sodium hydrogen carbonate solution

(B) Methyl orange solution

(C) Sodium hydroxide solution

(D) HCl solution

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* For measuring resistance of an ionic solution an AC source is used.

Reason (R) : Concentration of ionic solution will change if DC source is used.

14. *Assertion (A) :* Henry's law constant (K_H) decreases with increase in temperature.

Reason (R) : As the temperature increases, solubility of gases in liquids decreases.

15. *Assertion (A) :* The solubility of aldehydes and ketones in water decreases with increase in size of the alkyl group.

Reason (R) : Aldehydes and ketones have dipole-dipole interaction.

16. *Assertion (A) :* The boiling points of alkyl halides decrease in the order RI > RBr > RCl > RF.

Reason (R) : The van der Waals forces of attraction decrease in the order RI > RBr > RCl > RF.

SECTION B

17. (a) Calculate the elevation of boiling point of a solution when 3 g of $CaCl_2$ (Molar mass = 111 g mol^{-1}) was dissolved in 260 g of water, assuming that $CaCl_2$ undergoes complete dissociation. (K_b for water = 0·52 K kg mol^{-1}) *2*

OR

(b) Liquids 'X' and 'Y' form an ideal solution. The vapour pressure of pure 'X' and pure 'Y' are 120 mm Hg and 160 mm Hg respectively. Calculate the vapour pressure of the solution containing equal moles of 'X' and 'Y'. *2*

18.

Concentration of KCl solution in mol / L	*Conductivity at 298·15 K in S cm^{-1}*	*Molar Conductivity at 298·15 K in S cm^2 mol^{-1}*
1·000	0·1113	111·3
0·100	0·0129	129·0
0·010	0·00141	141·0

Based on the data given above, give plausible reason for the variation of conductivity and molar conductivity with concentration. *2*

19. (a) Write the rate law expression for the reaction $2HI \rightarrow H_2 + I_2$, if the order of the reaction is zero. *1*

(b) What is the effect of temperature on the rate of reaction ? Write a mathematical expression for the same. *1*

20. Explain the mechanism of acid catalysed hydration of ethene. *2*

21. (a) How can acetaldehyde be prepared from acetyl chloride ? *1*

(b) Propanal is more reactive than propanone towards nucleophilic addition reaction. Give reason. *1*

SECTION C

22. (a) Shweta mixed two liquids A and B of 10 mL each. After mixing, the volume of the solution was found to be 20·2 mL.

(i) Why was there a volume change after mixing the liquids ? *1*

(ii) Will there be an increase or decrease of temperature after mixing ? *1*

(iii) Give one example for this type of solution. *1*

OR

(b) (i) How does sprinkling of salt help in clearing the snow covered roads in hilly areas ? *1*

(ii) What happens when red blood cells are kept in 0·5% (mass/vol) NaCl solution ? Justify your answer. *1*

(iii) Write an application of reverse osmosis. *1*

23. For the reaction A + B → Products, the following initial rates were obtained at various initial concentrations of reactants :

Sl. No.	*[A] / mol L^{-1}*	*[B] / mol L^{-1}*	*Initial rate / mol L^{-1} s^{-1}*
1	0·1	0·1	0·05
2	0·2	0·1	0·10
3	0·1	0·2	0·05

Determine the order of the reaction with respect to A and B and overall order of the reaction. *3*

24. (a) What is meant by crystal field splitting energy ? For a d^4 ion, write the configuration if (i) $\Delta_o < P$, and (ii) $\Delta_o > P$.

(b) Explain why in tetrahedral coordination entities, low spin configurations are rarely observed. *3*

25. Account for the following :

(a) The C – Cl bond length in chlorobenzene is shorter than that in methyl chloride. *1*

(b) Grignard reagents should be prepared under anhydrous conditions. *1*

(c) In case of optically active alkyl halides, S_N1 reactions are accompanied by racemisation. *1*

26. (a) Arrange the following compounds in the increasing order of their acidic strength : *1*

3,5-dinitrophenol, 4-methylphenol, phenol, 2,4,6-trinitrophenol

(b) What happens when : (write equations) *2*

(i) Phenol is distilled with Zn dust ?

(ii) Anisole is treated with HBr ?

27. An organic compound 'A' (molecular formula C_8H_8O) gives 2,4-DNP test. It does not give Tollen's test, but gives a yellow precipitate 'B' with NaOH and I_2. On drastic oxidation, it gives a carboxylic acid 'C' with formula $C_7H_6O_2$. Identify 'A', 'B', 'C' and write the reactions involved. *3*

28. (a) Name the type of linkage responsible for the formation of proteins from α-amino acids. *1*

(b) Write any two differences between DNA and RNA. *2*

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. Carbohydrates are polyhydroxy aldehydes or ketones that represent enormous structural diversity in terms of the arrangement of atoms in space, resulting in hundreds of stereoisomers. Although the chemical properties of most stereoisomers may not be very different, their metabolic rate and utilization in biological systems is significantly different and known to influence the overall carbohydrate metabolism. Structural variants, which arise due to a different arrangement of atoms in three-dimensional space are known as stereoisomers. The number of stereoisomers can be theoretically estimated by using the formula 2n, where 'n' is the number of stereocenters or asymmetric (chiral) carbon atoms in a molecule. Out of these stereoisomers, there are some structures, which are mirror images of each other, and they are referred to as enantiomers.

Answer the following questions :

(a) Give chemical reactions to show the presence of an aldehydic group and straight chain in glucose. *2*

(b) (i) Define anomers. *1*

OR

(b) (ii) Draw the structure of β-D-Glucopyranose. *1*

(c) Sucrose is known as invert sugar. Explain. *1*

30. Werner's coordination theory in 1893 was the first attempt to explain the bonding in coordination complexes. It must be remembered that this theory was put forward before the electron had been discovered by J.J. Thomson in 1897, and before the electronic theory of valency. Werner did not have any of the modern instrumental techniques and all his studies were made using simple experimental techniques. Werner was able to explain the nature of bonding in complexes and he concluded that in complexes, the metal shows two different sorts of valency : primary and secondary. Primary valences are normally ionisable whereas secondary valences are non ionisable.

Answer the following questions :

(a) One mole of $CrCl_3 . 4H_2O$ precipitates one mole of AgCl when treated with excess of $AgNO_3$ solution. Write (i) the structural formula of the complex, and (ii) the secondary valency of Cr. *2*

(b) What is the difference between a complex and a double salt ? *1*

(c) (i) Arrange the following complexes in the increasing order of conductivity of their solution : *1*

$[Cr(NH_3)_3Cl_3]$, $[Cr(NH_3)_6]Cl_3$, $[Cr(NH_3)_5Cl]Cl_2$

OR

(c) (ii) Write two differences between primary and secondary valences in coordination compounds. *1*

SECTION E

31. (a) (i) For a galvanic cell, the following half reactions are given. Decide, which will remain as reduction reaction and which will be reversed to become an oxidation reaction. Give reason for your answer. *2*

(I) $Cr^{3+} + 3e^- \rightarrow Cr(s);\ E^\circ = -0{\cdot}74\ V$

(II) $Fe^{2+} + 2e^- \rightarrow Fe(s);\ E^\circ = -0{\cdot}44\ V$

(ii) Represent the cell in which the following reaction takes place : *3*

$Mg(s) + 2Ag^+\ (0{\cdot}001\ M) \rightarrow Mg^{2+}\ (0{\cdot}100\ M) + 2Ag(s)$

Calculate E_{cell} if $E^\circ_{cell} = 3{\cdot}17$ V. (log 10 = 1)

OR

(b) (i) State Kohlrausch's law. Give any two applications of it. *2*

(ii) $\Lambda^\circ_m NH_4Cl$, $\Lambda^\circ_m NaOH$ and $\Lambda^\circ_m NaCl$ are 129·8, 217·4, and $108{\cdot}9\ S\ cm^2\ mol^{-1}$ respectively. Molar conductivity of 1×10^{-2} M solution of NH_4OH is $9{\cdot}33\ S\ cm^2\ mol^{-1}$. Calculate the degree of dissociation (α) of NH_4OH solution at this concentration. *3*

32. (a) (i) In a chemistry practical class, the teacher gave his students an amine 'X' having molecular formula C_2H_7N, and asked the students to identify the type of amine. One of the students, Neeta, observed that it reacts with $C_6H_5SO_2Cl$, to give a compound which dissolves in NaOH solution. Can you help Neeta to identify the compound 'X' ? *1*

(ii) Arrange the following in the increasing order of their pK_b value in aqueous phase : *1*

$$C_6H_5NH_2,\ (CH_3)_2NH,\ NH_3,\ CH_3NH_2,\ (CH_3)_3N$$

(iii) Aniline on nitration gives considerable amount of meta product along with ortho and para products. Why ? *1*

(iv) Convert aniline to : *2*

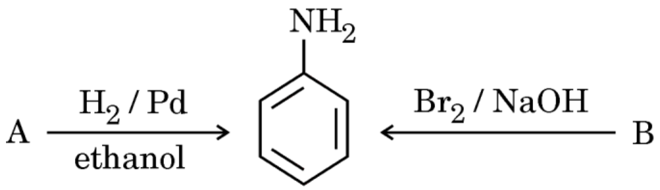
(I) p-bromoaniline

(II) phenol

OR

(b) (i) Arun heated a mixture of ethylamine and $CHCl_3$ with ethanolic KOH, which forms a foul smelling gas. Write the chemical equation involved. *1*

(ii) Identify A and B in the following reactions : *2*



(iii) Convert aniline to : *2*

(I) benzene

(II) sulphanilic acid

33. (a) (i) When pyrolusite ore is fused with KOH, in presence of air, a dark green coloured product ‘A’ is obtained which changes to purple coloured compound ‘B’ in acidic medium.

(I) Write the formulae of ‘A’ and ‘B’.

(II) Write the ionic equation for the reaction when compound ‘B’ reacts with Fe^{2+} in acidic medium. *2*

(ii) Give reasons : *3*

(I) Ce^{4+} in aqueous solution is a good oxidising agent.

(II) The actinoid contraction is greater from element to element than lanthanoid contraction.

(III) $E^{\circ}_{Zn^{2+}/Zn}$ value is more negative than expected, whereas $E^{\circ}_{Cu^{2+}/Cu}$ is positive.

OR

(b) (i) While studying the periodic properties, Arti came across an abnormal behaviour in the atomic size of Hf. She found that, even though Hf is placed below Zr in the same group, both have almost similar atomic sizes.

(I) Which phenomenon is responsible for the above behaviour ? Define it.

(II) Mention any other consequence of the above phenomenon. *2*

(ii) Give reasons for the following : *3*

(I) Transition metals exhibit catalytic properties.

(II) Transition metals have high enthalpy of atomisation.

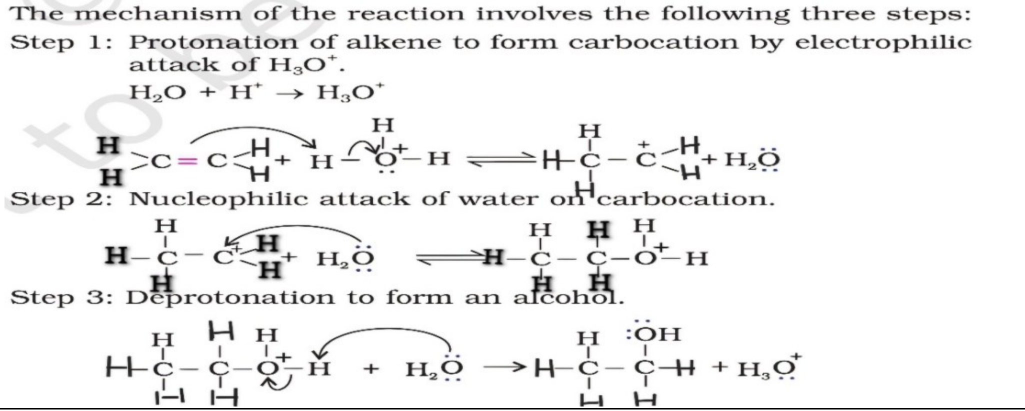
(III) Sc is a transition element, while Zn is not.

Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

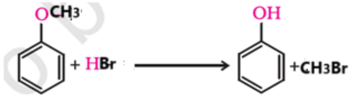
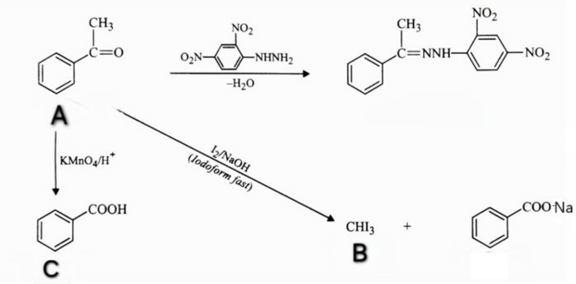
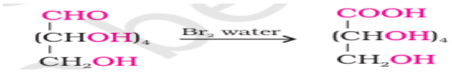
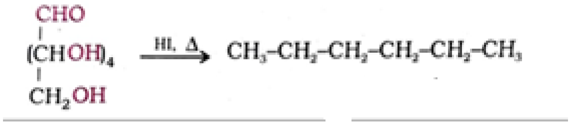
MARKING SCHEME 2024-25
CHEMISTRY(Theory)-043

QP Code 56/5/1 **MM: 70**

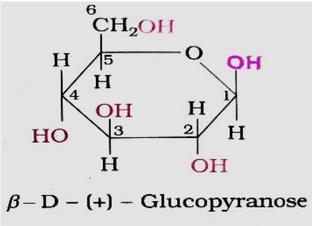
Q.No	Value Points	Mark
	SECTION A	
1	(D)	1
2	(D)	1
3	(C)	1
4	(B)	1
5	(D)	1
6	(B)	1
7	(C)	1
8	(B)	1
9	(C)	1
10	(A)	1
11	(B)	1
12	(D)	1
13	(A)	1
14	(D)	1
15	(B)	1
16	(A)	1
	SECTI(ON B	
17	$\Delta T_b = iK_b\, m$ $\Delta T_b = i\ \frac{K_b \times 1000 \times w_2}{M_2 \times w_1}$ i=3 $\Delta T_b = \frac{3\times 0{\cdot}52 \times 3\text{x } 1000}{111 \text{ x } 260}$ =0.162K	 ½ ½ ½ ½
	OR	
17	Given $n_X = n_Y$ $\chi_X = \chi_Y = 0.5$ $P_T = p_X{}^0 x_X + p_Y{}^0 x_Y$ / $p_{\text{total}} = x_1\, p_1{}^0 + x_2\, p_2{}^0$ = 120 x 0.5 +160 x 0.5 =60 +80 =140mm Hg	 ½ 1 ½
18	Conductivity decreases with decrease in concentration Due to decrease in number of current carrying ions per unit volume. Molar conductivity increases with decrease in concentration Due to decrease in inter-ionic attraction or increase in dissociation or increase in number of ions.	½ ½ ½ ½
19	(a) Rate=k$[HI]^0$ =k (b) Increases with increase in temperature k =A $e^{-Ea/RT}$ / lnk = lnA - Ea/RT	1 ½ ½

20	 The mechanism of the reaction involves the following three steps: Step 1: Protonation of alkene to form carbocation by electrophilic attack of H_3O^+. $H_2O + H^+ \rightarrow H_3O^+$ Step 2: Nucleophilic attack of water on carbocation. Step 3: Deprotonation to form an alcohol.	½ ½ 1
21	(a)Acetyl chloride is hydrogenated over catalyst, palladium-barium sulphate to prepare acetaldehyde / $CH_3COCl \xrightarrow[Pd-BaSO_4]{H_2} CH_3CHO$ (b)Due to less steric hinderance and greater electrophilicity of carbonyl carbon in propanal than propanone. / Due to more steric hinderance and less electrophilicity of carbonyl carbon in propanone than propanal	1 1
	SECTION C	
22	(a) (i) The solution is non ideal, shows positive deviation from Raoult's law / A-B interactions are weaker than A-A and B-B interactions (ii)Decrease in temperature (iii) Ethanol and acetone (or any other suitable example)	1 1 1
	OR	
22	(b) (i)Salt lowers the freezing point of water and prevents formation of ice and hence its easy to clean. (ii)-Red blood cells swell up -As the solution is hypotonic, water will flow into the cell/ As the solution is hypotonic, endosmosis occurs. (iii) Desalination of sea water	1 ½ ½ 1
23	Rate=$k[A]^x[B]^y$ Eq.1 Rate$_1$=$k(0.1)^x(0.1)^y$=5.0×10^{-2} Eq.2 Rate$_2$=$k(0.2)^x(0.1)^y$=1.0×10^{-1} Eq.3 Rate$_3$=$k(0.1)^x(0.2)^y$=5.0×10^{-2} $\frac{0.1}{0.5} = \frac{k \times 0.2^x \times 0.1^y}{k \times 0.1^x \times 0.1^y}$ Hence x=1 $\frac{0.05}{0.05} = \frac{k \times 0.1^x \times 0.2^y}{k \times 0.1^x \times 0.1^y}$ Hence y= 0 Rate=$k[A]^1[B]^0$ Overall order=1	1 1 1
24	(a)The difference of energy between the two sets of d-orbitals t_2g and eg due to the presence of ligands in a definite geometry. / The energy required to split the degenerate d-orbitals into two sets of orbitals. (i) $t^3_{2g}\,e^1_g$ (ii) $t^4_{2g}\,e^0_g$ (b)Orbital splitting energy is not sufficiently large for causing pairing of electrons	1 ½ ½ 1

<table>
<tr><td>25</td><td>(a)Due to resonance in chlorobenzene leading to partial double bond character of C-Cl bond but there is no resonance in CH_3Cl / sp^2 hybridised carbon atom having shorter bond length between C-Cl in chlorobenzene than sp^3 hybridized carbon in methyl chloride.
(b)Grignard reagent react with water to form corresponding hydrocarbon
(c)Due to the formation of planar carbocation, nucleophile may attack from either side of carbocation.</td><td>1
1
1</td></tr>
<tr><td>26</td><td>(a) 4-methylphenol < Phenol < 3,5-dinitrophenol < 2,4,6-trinitrophenol
(b)
(i)


(ii)

 </td><td>1
1
1</td></tr>
<tr><td>27</td><td>A=Acetophenone/$C_6H_5COCH_3$
B= Iodoform/CHI_3,
C=Benzoic acid/C_6H_5COOH

 </td><td>½
½
½
½ x 3</td></tr>
<tr><td>28</td><td>(a) Peptide linkage
(b)
<table><tr><th>DNA</th><th>RNA</th></tr><tr><td>Double stranded</td><td>Single stranded</td></tr><tr><td>Sugar is deoxyribose</td><td>Sugar is ribose</td></tr><tr><td>Thymine base is present</td><td>Uracil base is present</td></tr><tr><td>It replicates</td><td>It does not replicate</td></tr></table>(or any two suitable differences)</td><td>1
1+1</td></tr>
<tr><td></td><td>SECTION D</td><td></td></tr>
<tr><td>29</td><td>(a)

$\mathrm{CHO(CHOH)_4CH_2OH} \xrightarrow{Br_2\ water} \mathrm{COOH(CHOH)_4CH_2OH}$

$\mathrm{CHO(CHOH)_4CH_2OH} \xrightarrow{HI,\ \Delta} CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_3$
(b)(i)Cyclic structures of glucose differ only in configuration of -OH group at C_1. / Stereoisomers which differ in configuration of -OH group at C_1 or C_2
OR</td><td>1
1
1</td></tr>
</table>

(b)(ii)



β – D – (+) – Glucopyranose 1

(c)Hydrolysis of dextrorotatory sucrose brings a change in the sign of rotation or inverts the optical rotation from dextro to laevo. The product of hydrolysis is invert sugar. 1

30 (a)

(i) $[Cr(H_2O)_4Cl_2]Cl$ 1

(ii) 6 1

(b) Double salts dissociate into simple ions while complex compounds do not dissociate completely into ions when dissolved in water. (Or any other suitable difference) 1

(c)

(i) $[Cr(NH_3)_3Cl_3] < [Cr(NH_3)_5Cl]Cl_2 < [Cr(NH_3)_6]Cl_3$ 1

OR

(c)(ii)

Primary Valency	Secondary Valency
1.Ionisable	1. Non-ionisable
2.Satisfied by negative ions	2. Satisfied by negative ions or neutral molecules

(or any other two suitable differences) ½+½

SECTION E

31 (a)

(i) **(II)** will remain as reduction reaction / (II) ½

(I) will be reversed to become an oxidation reaction ½

Due to low reduction potential of Cr 1

(ii) Cell representation $Mg(s)/Mg^{2+}(aq,0.100M)||Ag^+(aq,0.001M)/Ag(s)$ 1

n=2

$$\text{Ecell} = \text{E°cell} - \frac{2.303RT}{nF}\log\frac{[Mg^{2+}]}{[Ag^+]^2}$$ ½

$$= 3.17 - \frac{0.059}{2}\log\frac{0.100}{(0.001)^2}$$

$$= 3.17 - \frac{0.059}{2}\log 10^5$$ 1

$$= 3.17 - 0.0295 \times 5$$

$$= 3.17 - 0.1475$$

$$= 3.0225 \text{ V or } 3.02 \text{ V}$$ ½

OR

31 (b)(i)Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte. 1

To determine -1. Limiting molar conductivity of an electrolyte. ½

2.Dissociation constant of a weak electrolyte ½

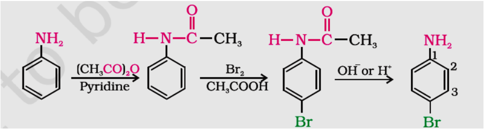
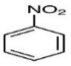
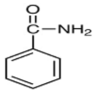
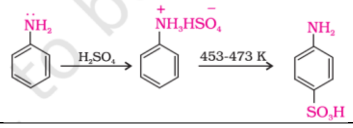
(or any other two suitable applications)

(ii)$\Lambda°mNH_4OH = \Lambda°mNH_4Cl + \Lambda°mNaOH - \Lambda°mNaCl$ ½

$= 129.8 + 217.4 - 108.9$

$= 238.3 \ Scm^2mol^{-1}$ 1

$\alpha = \frac{\Lambda m^c}{\Lambda° m}$ ½

	$= \frac{9.33}{238.3}$ $=0.039$ /3.9%	1
32	(a)(i) Amine ‘X’ react with $C_6H_5SO_2Cl$ to give a compound ,soluble in NaOH so amine ‘X’ is primary amine, $CH_3CH_2NH_2$/Ethanamine/Ethyl amine (ii) $(CH_3)_2NH < CH_3NH_2 < (CH_3)_3N < NH_3 < C_6H_5NH_2$ (iii) In the strongly acidic medium, aniline is protonated to anilinium ion, which is meta-directing. (iv)(I)  (II) $C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{(0\text{-}5°C)} C_6H_5N_2^+Cl^- \xrightarrow{H_2O,\ 283K} C_6H_5OH$	½ +½ 1 1 1 1
	OR	
32	(b)(i) $CH_3CH_2NH_2 + CHCl_3 + 3KOH(EtOH) \xrightarrow{\Delta} C_2H_5NC + 3KCl + 3H_2O$ (ii)A =  B =  (iii) (I) $C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{(0\text{-}5°C)} C_6H_5N_2^+Cl^- \xrightarrow{CH_3CH_2OH} C_6H_6$ (II) 	1 1 1 1 1
33	(a)(i) (I) A - K_2MnO_4 B- $KMnO_4$ (II) $MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5\,Fe^{3+} + 4H_2O$ (ii) (I) Gets reduced to +3 common oxidation state. (II) Due to poorer shielding offered by 5f electrons than 4f. (III) Due to completely filled d- subshell (d^{10}) in zinc whereas in Cu, due to high enthalpy of atomization and low enthalpy of hydration.	½ +½ 1 1 1 1
	OR	
33	(b)(i) (I) Lanthanoid contraction. The steady decrease in atomic and ionic radii in lanthanoid series. (II) Decrease in basic character from left to right in lanthanoid series. (any other correct consequence)	½ ½ 1

	(ii) (I)They have the ability to exhibit variable oxidation states/ tendency to form complex compounds/ large surface area. (II) Due to involvement of (n-1) d and ns electrons which results in strong metallic bond and strong interatomic bonding. (III) Sc has incompletely filled d orbital ($3d^1$) in its ground state whereas Zn has completely filled d orbital ($3d^{10}$) in ground state as well as in its oxidized state.	1 1 1

Series : WYXZ6

SET ~ 1

प्रश्न-पत्र कोड
Q.P. Code **56/6/1**

रोल नं.
Roll No.

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें।
Candidates must write the Q.P. Code on the title page of the answer-book.

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं।
Please check that this question paper contains **23** printed pages.

(II) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें।
Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(III) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं।
Please check that this question paper contains **33** questions.

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें।**
Please write down the Serial Number of the question in the answer-book at the given place before attempting it.

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है। प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा। 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे।
15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

\#

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

*निर्धारित समय : **3** घण्टे* — *अधिकतम अंक : **70***

*Time allowed : **3** hours* — *Maximum Marks : **70***

General Instructions :

Read the following instructions carefully and follow them :

- *(i)* *This question paper contains* ***33*** *questions.* ***All*** *questions are* ***compulsory****.*
- *(ii)* *This question paper is divided into* ***five*** *sections –* ***Section A****,* ***B****,* ***C****,* ***D*** *and* ***E****.*
- *(iii)* ***Section A*** *– questions number* ***1*** *to* ***16*** *are multiple choice type questions. Each question carries* ***1*** *mark.*
- *(iv)* ***Section B*** *– questions number* ***17*** *to* ***21*** *are very short answer type questions. Each question carries* ***2*** *marks.*
- *(v)* ***Section C*** *– questions number* ***22*** *to* ***28*** *are short answer type questions. Each question carries* ***3*** *marks.*
- *(vi)* ***Section D*** *– questions number* ***29*** *and* ***30*** *are case-based questions. Each question carries* ***4*** *marks.*
- *(vii)* ***Section E*** *– questions number* ***31*** *to* ***33*** *are long answer type questions. Each question carries* ***5*** *marks.*
- *(viii)* *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.*
- *(ix)* *Kindly note that there is a separate question paper for Visually Impaired candidates.*
- *(x)* *Use of calculator is* ***not*** *allowed.*

SECTION A

Questions no. ***1*** *to* ***16*** *are Multiple Choice type Questions, carrying* ***1*** *mark each.* *16×1=16*

1. Williamson synthesis of preparing unsymmetrical ether is :

(A) S_N1 reaction

(B) S_N2 reaction

(C) Electrophilic addition reaction

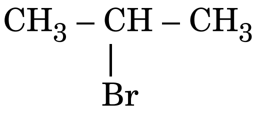
(D) Elimination reaction

2. Which of the following compounds would be hydrolysed by aqueous KOH most easily ?

(A) $CH_2 = CH - Br$

(B) $CH_3 - CH_2 - Br$

(C)



$CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$

(D) $CH_2 = CH - CH_2 - Br$

3. According to Werner's theory of coordination compounds :

(A) Primary valences are ionisable.

(B) Secondary valences are ionisable.

(C) Both primary and secondary valences are non-ionisable.

(D) Both primary and secondary valences are ionisable.

4. Which of the following complex ion is ***not*** optically active ?

(A) $[Co(ox)_3]^{3-}$

(B) *cis*-$[Co(en)_2Cl_2]^+$

(C) *trans*-$[Co(en)_2Cl_2]^+$

(D) $[Co(en)_3]^{3+}$

5. Which of the following is the softest metal ?

(A) Zn

(B) Sc

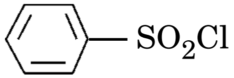
(C) Cu

(D) Fe

6. In the Hinsberg's method for separation of primary, secondary and tertiary amines, the reagent used is :

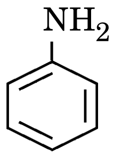
(A) Nitrous acid

(B) $CHCl_3$ + aq. NaOH

(C) 

(D) $HCl / ZnCl_2$

7. Which one of the following amines gives an alcohol on reaction with HNO_2 ?

(A) 

(B) $C_2H_5NH_2$

(C) $(C_2H_5)_2NH$

(D) $(C_2H_5)_3N$

8. The freezing point of one molal KCl solution, assuming KCl to be completely dissociated in water, is : (K_f for water = 1·86 K kg mol^{-1})

(A) – 3·72°C

(B) + 3·72°C

(C) – 1·86°C

(D) + 2·72°C

9. A solution of acetone in ethanol :

(A) obeys Raoult's law.

(B) forms an ideal solution.

(C) shows a positive deviation from Raoult's law.

(D) shows a negative deviation from Raoult's law.

10. Which of the following cell converts the energy of combustion of fuel into electrical energy ?

(A) Mercury cell

(B) Fuel cell

(C) Dry cell

(D) Lead storage cell

11. The unit of rate and rate constant are same for a :

(A) First order reaction

(B) Second order reaction

(C) Zero order reaction

(D) Third order reaction

12. Pyranose ring of glucose is formed due to the reaction between :

(A) C_1 and C_3

(B) C_1 and C_5

(C) C_1 and C_4

(D) C_1 and C_2

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* Actinoids show wide range of oxidation states.
Reason (R) : Actinoids are radioactive in nature.

14. *Assertion (A) :* Hydrolysis of an ester follows first order kinetics.
Reason (R) : The concentration of water does not get altered much during the reaction.

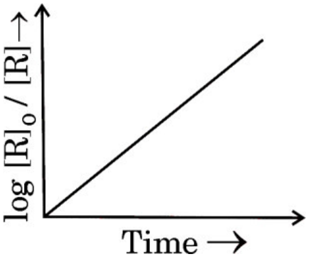
15. *Assertion(A):* Boiling point of $(CH_3)_3N$ is higher than that of $CH_3CH_2CH_2NH_2$.
Reason (R) : Hydrogen bonding is more extensive in $CH_3CH_2CH_2NH_2$.

16. *Assertion (A) :* Phenol is strongly acidic as compared to ethanol.
Reason (R) : Phenoxide ion is more stable than ethoxide ion.

SECTION B

17. State Henry's law. Why are aquatic species more comfortable in cold water as compared to warm water ? *2*

18. Observe the graph in the given figure and answer the following questions : *1+1=2*



(a) Predict the order of reaction.

(b) What is the slope of the curve ?

19. (a) Write IUPAC names of the following coordination compounds : *1+1=2*

(i) $[CoCl_2(en)_2]SO_4$

(ii) $K_3[Fe(C_2O_4)_3]$

OR

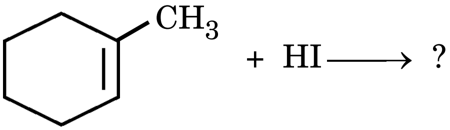
(b) Differentiate between : *1+1=2*

(i) Double salt and Complex compound

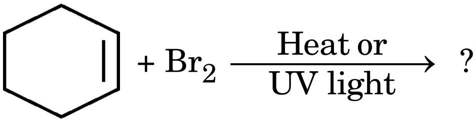
(ii) Didentate ligand and Ambidentate ligand

20. Draw the structures of major monohalo products in each of the following reactions : *1+1=2*

(a)



(b)



21. How do you explain the following ? *1+1=2*

(a) Presence of an aldehydic group in glucose.

(b) Presence of five – OH groups in glucose.

SECTION C

22. Vapour pressure of pure water at 298 K is 24·8 mm Hg. Calculate the lowering in vapour pressure of an aqueous solution which freezes at – 0·3°C. (K_f of water = 1·86 K kg mol^{-1}) *3*

23. The rate of a reaction :

$A + B \longrightarrow \text{product}$

is given below as a function of different initial concentrations of A and B.

Experiment	[A] / mol L^{-1}	[B] / mol L^{-1}	Initial Rate/mol L^{-1} min^{-1}
1	0·01	0·01	5×10^{-3}
2	0·02	0·01	1×10^{-2}
3	0·01	0·02	5×10^{-3}

Calculate the order of the reaction with respect to A and B. Determine the rate constant of the reaction. *3*

24. Give reasons for the following : *3×1=3*

(a) The pH of aqueous NaCl increases when it is electrolysed.

(b) Unlike dry cell, mercury cell has a constant cell potential through its lifetime.

(c) Conductivity of solution decreases with dilution.

25. (a) Answer the following about the complexes *3×1=3*

$[FeF_6]^{3-}$ and $[Fe(CN)_6]^{4-}$:

(i) Write the hybridization involved in each case.

(ii) Which of them is the outer orbital complex and which one is the inner orbital complex ?

(iii) Compare their magnetic behaviour.

[Atomic number : Fe = 26]

OR

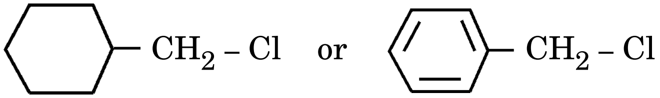
(b) (i) What happens to the colour of complex $[Ti(H_2O)_6]^{3+}$ when heated gradually ?

(ii) Write the electronic configuration for d^5 ion if $\Delta_o < P$.

(iii) Write the hybridization and magnetic behaviour of the complex $[Ni(CO)_4]$.

[Atomic number : Ni = 28] *3×1=3*

26. Write any two differences between S_N1 and S_N2 reactions. Which of the following compounds would undergo S_N1 reaction faster and why ? *3*



27. A compound (A) with molecular formula C_4H_5N on reduction with DIBAL-H followed by hydrolysis, gives a compound (B). Compound (B) gives positive Tollens' test but does not give iodoform test. Compound (B) can also be obtained when ethanal is treated with dilute NaOH followed by heating. Identify (A) and (B). Write the reactions of (A) with DIBAL-H followed by hydrolysis. *3*

28. How will you obtain the following from aniline ? Give chemical equations only. *3×1=3*

(a) Sulphanilic acid

(b) Phenylisocyanide

(c) Acetanilide

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. Alcohols undergo a number of reactions involving the cleavage of C – OH bond. However, phenols do not undergo reactions involving the cleavage of C – OH bond. Alcohols are weaker acids than water. Alcohols react with halogen acids to form the corresponding haloalkanes. Phenols are stronger acids than alcohols. A characteristic feature of phenols is that they undergo electrophilic substitution reactions such as halogenation, nitration, etc. Since – OH group is a strong activating group, phenol gives trisubstituted products during halogenation, nitration, etc.

(a) What happens when phenol is treated with the following ? *2*

(i) Br_2 water (ii) Conc. HNO_3

(b) (i) Write the mechanism of alcohol reacting as nucleophile in a reaction with $\overset{\oplus}{CH_3}$. *1*

OR

(b) (ii) Why do phenols not undergo reactions involving cleavage of C – OH bond ? *1*

(c) How can you distinguish between Butan-1-ol and 2-Methylpropan-2-ol by using HCl in the presence of anhydrous $ZnCl_2$? *1*

30. The α-amino acids are the building blocks of proteins. All α-amino acids exist as zwitter ion due to which they show amphoteric behaviour. All amino acids are joined through peptide bond. Proteins are broadly classified as globular proteins and fibrous proteins. Globular proteins are water soluble, whereas fibrous proteins are not. The complete structure of protein is discussed at four different levels i.e. primary, secondary, tertiary and quaternary structures. Protein loses its biological activity in denatured form.

(a) Define the following : *2*

(i) Peptide linkage (ii) Denatured protein

(b) Why do amino acids show amphoteric behaviour ? *1*

(c) (i) How can you differentiate between Fibrous protein and Globular protein ? *1*

OR

(c) (ii) Write the names of two different secondary structures of proteins. *1*

SECTION E

31. (a) (i) Calculate E_{cell} of a galvanic cell in which the following reaction takes place at 25°C :

$$Zn(s) + Pb^{2+}(0{\cdot}02\ M) \longrightarrow Zn^{2+}(0{\cdot}1\ M) + Pb(s)$$

[Given : $E^{\circ}_{Zn^{2+}/Zn} = -0{\cdot}76\ V$, $E^{\circ}_{Pb^{2+}/Pb} = -0{\cdot}13\ V$;

log 2 = 0·3010, log 4 = 0·6021, log 5 = 0·6990].

(ii) State Faraday's first law of electrolysis. How much electricity, in terms of Faraday, is required to reduce one mol of MnO_4^- to Mn^{2+} ion ? *3+2=5*

OR

(b) (i) The resistance of a conductivity cell containing 0·001 M KCl solution at 298 K is 1000 ohm. What is the cell constant if conductivity of 0·001 M KCl solution at 298 K is $0{\cdot}125 \times 10^{-3}\ S\ cm^{-1}$?

(ii) Calculate the $E_{Mg^{2+}/Mg}$ potential for the following half cell at 25°C :

$Mg/Mg^{2+}\ (1 \times 10^{-4}\ M)$; $E^{\circ}_{Mg^{2+}/Mg} = +2{\cdot}36\ V$

[Given : log 10 = 1]

(iii) What is the effect of temperature on the electrical conductance of metallic conductor ? *2+2+1=5*

32. (a) (i) Account for the following :

(I) Orange colour of $Cr_2O_7^{2-}$ ion changes to yellow when treated with an alkali.

(II) Zn, Cd and Hg are non-transition elements.

(III) E° value for Mn^{3+}/Mn^{2+} couple is highly positive (+1·57 V) as compared to Cr^{3+}/Cr^{2+}.

(ii) What happens when :

(I) Manganate ion undergoes disproportionation reaction in acidic medium ?

(II) $KMnO_4$ is heated ? *3+2=5*

OR

(b) Answer the following questions : *5×1=5*

(i) What is 'Misch metal' ? Give its one use.

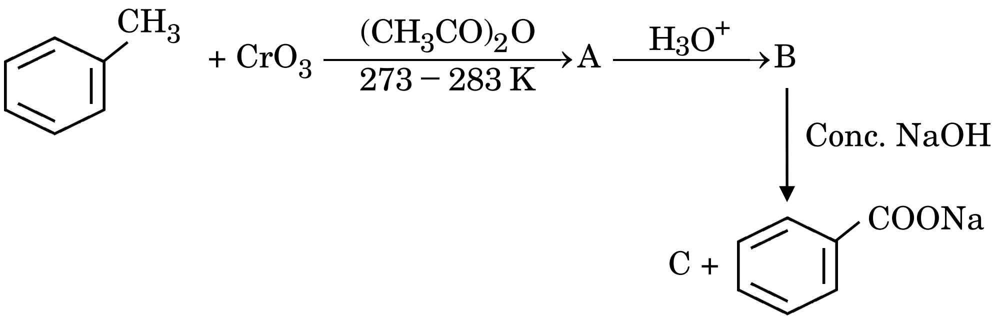
(ii) Write the formula of an oxoanion of chromium in which it shows the oxidation state equal to its group number.

(iii) Why does Vanadium pentoxide (V_2O_5) act as a catalyst ?

(iv) Why do transition elements have high enthalpies of atomisation ?

(v) How do you prepare $Na_2Cr_2O_7$ from Na_2CrO_4 ?

33. (a) (i) Identify A, B and C in the following reactions :



(ii) Give reasons for the following :

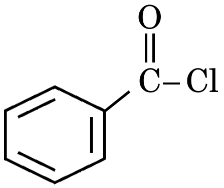
(I) Carboxylic acids do not give the characteristic reactions of carbonyl group.

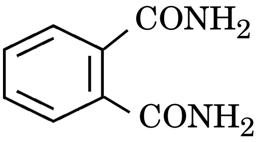
(II) Ethanoic acid is a stronger acid than ethanol. *3+2=5*

OR

(b) (i) Write the product(s) in the following reactions :

(I) $2CH_3COOH \xrightarrow[\text{heat}]{P_4O_{10}}$

(II)  + $(CH_3)_2Cd \rightarrow$

(III)  $\xrightarrow{\text{strong heating}}$

(ii) Write the reaction involved in the following reactions :

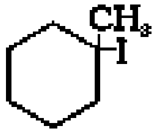
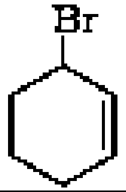
(I) Wolff-Kishner Reduction

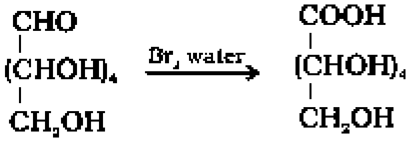
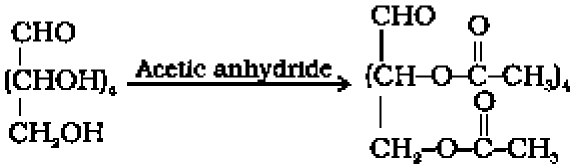
(II) Decarboxylation Reaction *3+2=5*

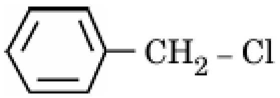
MARKING SCHEME 2024-25

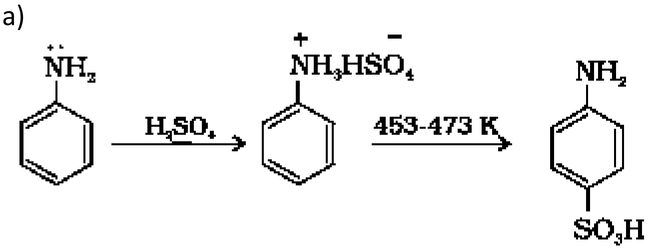
CHEMISTRY (Theory)- 043

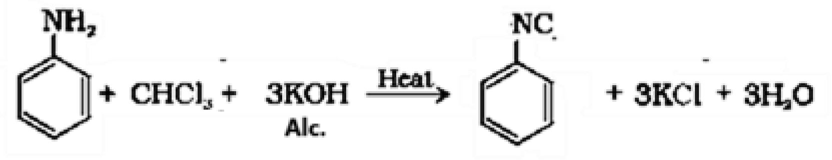
QP CODE 56/6/1 **MM: 70**

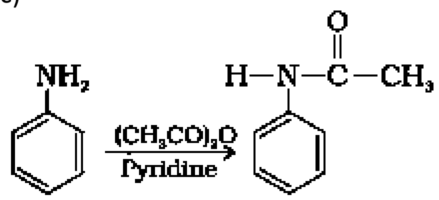
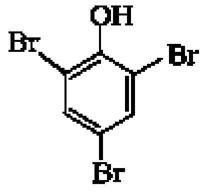
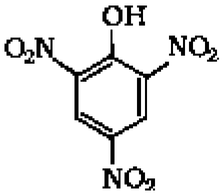
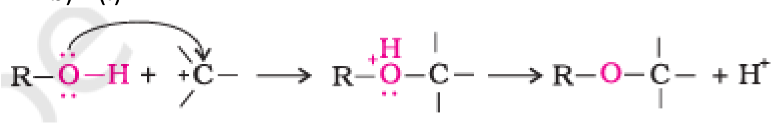
Q.No	Value points	Mark
	SECTION A	1
1	B	1
2	D	1
3	A	1
4	C	1
5	A	1
6	C	1
7	B	1
8	A	1
9	C	1
10	B	1
11	C	1
12	B	1
13	B	1
14	A	1
15	D	1
16	A	1
	SECTION B	
17	• At a constant temperature, the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas present above the surface of liquid or solution/ the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution • Because the solubility of oxygen increases with decrease in temperature/ Because of low solubility of O_2 in warm water.	1 1
18	a) First order b) Slope= k/ 2.303	1 1
19	a) i) Dichloridobis(ethane-1,2-diamine)cobalt(IV) sulphate ii) Potassium trioxalatoferrate(III)	1 1
	OR	
19	b) i) Double salts dissociate into simple ions while complex compounds do not dissociate completely into ions when dissolved in water. (Or any other suitable difference) ii) When a ligand binds through two donor atoms is called a didentate ligand while a unidentate ligand which has two different donor atoms and either of the two ligates in the complex is called ambidentate ligand.	1 1
20	a)  b) 	1 1

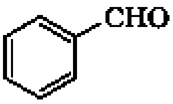
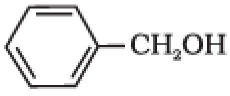
21	a) Glucose gets oxidised to six carbon carboxylic acid (gluconic acid) on reaction with a mild oxidising agent like bromine water. This indicates the presence as an aldehydic group /  $CHO-(CHOH)_4-CH_2OH \xrightarrow{Br_2\text{ water}} COOH-(CHOH)_4-CH_2OH$ b) Acetylation of glucose with acetic anhydride gives glucose pentaacetate which confirms the presence of five –OH groups /  $CHO-(CHOH)_4-CH_2OH \xrightarrow{\text{Acetic anhydride}} CHO-(CH-O-\overset{O}{\overset{\parallel}{C}}-CH_3)_4-CH_2-O-\overset{O}{\overset{\parallel}{C}}-CH_3$	1 1
	SECTION C	
22	$\Delta T_f = K_f\ m$ m= $\Delta T_f / K_f$ m= 0.3/1.86 = 0.16m m = $\frac{x_2 \text{ X } 1000}{M_A}$ $x_2 = \frac{0.16 \text{ X } 18}{1000}$ = 2.88 X 10^{-3} $\frac{p_1^0 - p_1}{p_1^0} = x_2$ $\frac{24.8 - p_1}{24.8}$ = 2.88 X 10^{-3} $p_1^0 - p_1 = x_2\ p_1^0$ = 2.88 X 10^{-3} × 24.8 mm Hg = 0.07 mm Hg	½ ½ ½ ½ ½ ½
23	Rate = k [A]^p [B]^q $5 \cdot 0 \times 10^{-3}$= k [0.01]^p [0.01]^q………Eq 1 $1 \cdot 0 \times 10^{-2}$= k [0.02]^p [0.01]^q………Eq 2 $5 \cdot 0 \times 10^{-3}$= k [0.01]^p [0.02]^q………Eq 3 On Comparing (eq1) and (eq3) 1= $(2)^q$ q = 0 On Comparing (eq1) and (eq2) $(2)^1 = (2)^p$ p = 1 Order w·r·t A = 1	1 1

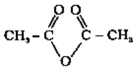
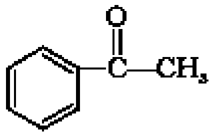
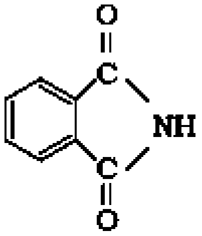
<table>
<tr><td></td><td>Order w·r·t B= 0
From eq 1
$5{\cdot}0 \times 10^{-3}$= k [0.01]^1 [0.01]^0
k =0.5 min^{-1}</td><td>½
½</td></tr>
<tr><td>24</td><td>a) Because of the formation of NaOH / Due to the formation of OH$^-$ ions.
b) Because the overall reaction does not involve any ion in solution whose concentration can change during its life time.
c) Because the number of ions per unit volume that carry current in a solution decreases.</td><td>1
1
1</td></tr>
<tr><td>25</td><td>a) $[FeF_6]^{3-}$ -sp^3d^2
$[Fe(CN)_6]^{4-}$ - d^2sp^3
b) $[FeF_6]^{3-}$ -outer orbital complex
$[Fe(CN)_6]^{4-}$ - inner orbital complex
c) $[FeF_6]^{3-}$ - paramagnetic
$[Fe(CN)_6]^{4-}$ -diamagnetic</td><td>½+½
½+½
½+½</td></tr>
<tr><td></td><td>OR</td><td></td></tr>
<tr><td>25</td><td>a) It becomes colourless/ colour slowly fades away
b) $t_{2g}^3e_g^2$
c) sp^3, diamagnetic</td><td>1
1
½+½</td></tr>
<tr><td>26.</td><td>
<table>
<tr><th></th><th>S_N1</th><th>S_N2</th></tr>
<tr><td>1</td><td>Unimolecular</td><td>Bimolecular</td></tr>
<tr><td>2</td><td>It follows first order kinetics</td><td>It follows second order kinetics</td></tr>
<tr><td>3</td><td>Retention of configuration</td><td>Inversion of configuration</td></tr>
<tr><td>4.</td><td>Racemisation occurs</td><td>No racemisation is seen</td></tr>
<tr><td>5.</td><td>Takes place through formation of carbocation</td><td>Takes place through formation of transition state</td></tr>
<tr><td>6.</td><td>Occurs in polar protic solvent</td><td>Occurs in polar aprotic solvent</td></tr>
<tr><td>7.</td><td>Rate is independent of the concentration of the nucleophile.</td><td>Rate is dependent on the concentration of the nucleophile.</td></tr>
</table>
(Any TWO)


, because of the stability of benzyl carbocation</td><td>1+1
½+½</td></tr>
<tr><td>27</td><td>A= $CH_3CH=CHCN$ / But-2-ene nitrile
B= $CH_3CH=CHCHO$ / But-2-enal
$CH_3CH=CHCN \xrightarrow[2.\ H_2O]{1.\ DIBAL\text{-}H} CH_3CH=CHCHO$</td><td>1
1
1</td></tr>
<tr><td>28</td><td>a)


b)

</td><td>1 X3</td></tr>
</table>

	c) 	
	SECTION D	
29	a) i)  / 2,4,6-Tribromophenol is formed	1
	ii)  / 2,4,6-Trinitrophenol / Picric acid is formed.	1
	b) (i) 	1
	OR b)(ii) due to sp^2 hybridisation leading to shorter bond length / Due to resonance leading to partial double bond character of C-OH bond	1
	c) 2-Methylpropan-2-ol gives turbidity immediately whereas butan-1-ol does not react.	1
30	a) (i) A linkage which joins amino acids through -CO-NH- bond	1
	(ii) When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, it loses its biological activity.	1
	b) Due to zwitter ion formation which can react with both acids and bases./ Due to the presence of both carboxylic group and amino group.	1
	c) (i) Fibrous protein: parallel polypeptide chain structure / insoluble in water Globular protein: spherical polypeptide chain structure/ soluble in water **(Any one difference)**	1
	OR c) (ii) α-helix and β-pleated sheet	½ + ½
	SECTION E	
31	(a) (i) $E_{Cell} = (E^o{}_c - E^o{}_a) - \frac{0\cdot059}{2} log \left[\frac{Zn^{2+}}{Pb^{2+}}\right]$	1
	$= [(-\ 0 \cdot 13) - (-0 \cdot 76)] - \frac{0\cdot059}{2} log \frac{0\cdot1}{0\cdot02}$ = 0.63 – 0.0295 log 5 =0.63-0.0295 X 0.699 = 0.63-0.02	1
	= 0.61V (Deduct ½ mark for no or incorrect unit)	1

	(ii) The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte. 5F	1 1
	OR	
31	(b) (i) $k = G^*/R$ $G^* = k \text{ X } R = 0.125 \text{ X } 10^{-3} \text{ X } 1000$ $= 0.125\ cm^{-1}$ (ii) $E_{Mg^{2+}/Mg} = E^0_{Mg^{2+}/Mg} - \frac{0{\cdot}059}{2}\log\frac{1}{[Mg^{2+}]}$ $= 2.36\ V - \frac{0{\cdot}059}{2}\log\frac{1}{10^{-4}}$ $= 2.36 - 0{\cdot}0295 \text{ X } 4 \log 10$ $= 2.242\ V$ (iii) It decreases with increase in temperature	½ 1 ½ 1 ½ ½ 1
32	(a) (i) (I) Due to formation of chromate /CrO_4^{2-} ion (II) Due to completely filled d-orbitals in ground state as well as oxidised state. (III) Because Mn^{2+} is more stable due to stable $3d^5$ configuration whereas Cr^{3+} is more stable due to stable t_{2g}^3 configuration. (ii) (I) it changes to permanaganate ion / MnO_4^- is formed / $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$ (II) Potassium manganate/ K_2MnO_4 is formed / $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$	1 1 1 1 1
	OR	
32.	(b) i) • An alloy of lanthanoid / an alloy of lanthanoid and iron with traces of S, C, Ca and Al. • used in making bullets/shells/ lighter flint ii) CrO_4^{2-}/ $Cr_2O_7^{2-}$ iii) variable oxidation state of vanadium / large surface area /Complex formation iv) Because of large number of unpaired electrons in their atoms they have stronger interatomic interaction or strong metallic bonding v) by acidification of Na_2CrO_4/ $2Na_2CrO_4 + 2\ H^+ \rightarrow Na_2Cr_2O_7 + 2\ Na^+ + H_2O$	½ +½ 1 1 1 1
33	**(a) (i)** **A=**  **B=**  C=  (ii) (I) Because carbon of carboxyl group is less electrophilic due to resonance with -OH group. (II) Because ethanoate ion is more stable than ethoxide ion due to resonance.	1 1 1 1 1

	OR	
33	(b) i) (I)  / $(CH_3CO)_2O$ (II)  (III)  (ii) (I)  (II) $R\text{-}COONa \xrightarrow[Heat]{NaOH \,\&\, CaO} R\text{-}H + Na_2CO_3$	1 1 1 1 1

Series : WYXZ7

SET ~ 1

रोल नं.
Roll No.

प्रश्न-पत्र कोड
Q.P. Code **56/7/1**

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें।
Candidates must write the Q.P. Code on the title page of the answer-book.

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **23** हैं।
Please check that this question paper contains **23** printed pages.

(II) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें।
Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(III) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **33** प्रश्न हैं।
Please check that this question paper contains **33** questions.

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें।**
Please write down the Serial Number of the question in the answer-book at the given place before attempting it.

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है। प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा। 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे।
15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period.

#

रसायन विज्ञान (सैद्धान्तिक)
CHEMISTRY (Theory)

*निर्धारित समय : **3** घण्टे*
*Time allowed : **3** hours*

*अधिकतम अंक : **70***
*Maximum Marks : **70***

General Instructions :

Read the following instructions carefully and follow them :

(i) *This question paper contains **33** questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** sections – **Section A, B, C, D** and **E**.*

(iii) ***Section A** – questions number **1** to **16** are multiple choice type questions. Each question carries **1** mark.*

(iv) ***Section B** – questions number **17** to **21** are very short answer type questions. Each question carries **2** marks.*

(v) ***Section C** – questions number **22** to **28** are short answer type questions. Each question carries **3** marks.*

(vi) ***Section D** – questions number **29** and **30** are case-based questions. Each question carries **4** marks.*

(vii) ***Section E** – questions number **31** to **33** are long answer type questions. Each question carries **5** marks.*

(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.*

(ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*

(x) *Use of calculator is **not** allowed.*

SECTION A

*Questions no. **1** to **16** are Multiple Choice type Questions, carrying **1** mark each.* *16×1=16*

1. Which of the following transition metal ion is ***not*** coloured ?

(A) Cu^+

(B) Ni^{2+}

(C) Co^{2+}

(D) V^{3+}

2. Which of the following solutions will have the highest boiling point in water ?

(A) 1% KCl

(B) 1% glucose

(C) 1% urea

(D) 1% $CaCl_2$

3. During electrolysis of dilute H_2SO_4, using platinum electrodes, the gas evolved at the anode is :

(A) H_2 gas

(B) O_2 gas

(C) SO_2 gas

(D) SO_3 gas

4. The activation energy (E_a) of a reaction can be determined from the slope of which of the following plots ?

(A) $ln\ k$ vs. T

(B) $\frac{ln\ k}{T}$ vs. T

(C) $ln\ k$ vs. $\frac{1}{T}$

(D) $\frac{T}{ln\ k}$ vs. $\frac{1}{T}$

5. Which of the following represents the fraction of molecules with energies equal to or greater than E_a ?

(A) $\frac{-E_a}{RT}$

(B) $e^{-E_a/RT}$

(C) $e^{+E_a/RT}$

(D) $\frac{+E_a}{RT}$

6. The number of moles of AgCl precipitated when excess $AgNO_3$ solution is mixed with one mole of $[Co(NH_3)_3Cl_3]$ is :

(A) 0

(B) 1

(C) 2

(D) 3

7. Which of the following haloalkanes react with aqueous KOH most rapidly by S_N1 reaction ?

(A) 2-Chlorobutane

(B) 1-Bromobutane

(C) 2-Bromo-2-Methylpropane

(D) 2,2-Dimethyl-1-Chloropropane

8. The reaction

$$R - OH + Na \longrightarrow RO^{-}Na^{+} + \frac{1}{2}H_2\,(g)$$

suggests that alcohols are :

(A) Acidic

(B) Basic

(C) Neutral

(D) Amphoteric

9. At low temperature, phenol reacts with Br_2 in CS_2 to form :

(A) 2,4,6-tribromophenol

(B) *p*-bromophenol

(C) *o*-and *p*-bromophenol

(D) 2,4-dibromophenol

10. When alkyl iodide is treated with large excess of ammonia, the major product obtained is :

(A) Tertiary amine

(B) Quaternary ammonium salt

(C) Secondary amine

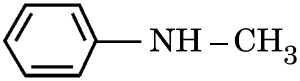
(D) Primary amine

11. An amine 'X' reacts with Hinsberg reagent and the product obtained is soluble in alkali. The amine 'X' is :

(A) $CH_3 - NH_2$

(B) $(CH_3)_2NH$

(C) $(CH_3)_3N$

(D) 

12. α-helix structure refers to :

(A) primary structure of protein

(B) secondary structure of protein

(C) tertiary structure of protein

(D) quaternary structure of protein

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

13. *Assertion (A) :* A mixture of *o*-nitrophenol and *p*-nitrophenol can be separated by steam distillation.

Reason (R) : *o*-nitrophenol is steam volatile due to intermolecular hydrogen bonding.

14. *Assertion (A) :* Cooking time is reduced in pressure cooker.

Reason (R) : Boiling point of water inside the pressure cooker is elevated.

15. *Assertion (A) :* Actinoids show irregularities in their electronic configurations.

Reason (R) : Actinoids are radioactive in nature.

16. *Assertion (A) :* Vitamin K can be stored in our body.

Reason (R) : Vitamin K is a water soluble vitamin.

SECTION B

17. What is meant by positive deviation from Raoult's law ? Give an example. What type of azeotrope is formed by positive deviation ? *2*

18. State a condition under which a bimolecular reaction is kinetically first order reaction. Give an example. For which type of reactions, do order and molecularity have the same value ? *2*

19. (a) Write the IUPAC name of the complex $[Pt(en)_2Cl_2]^{2+}$. Draw the structure of geometrical isomer of this complex which is optically inactive. *2*

OR

(b) (i) Write the formula of the following coordination compound :

Pentaamminecarbonatocobalt(III)chloride

(ii) Write the IUPAC name of the linkage isomer of the complex $[Co(NH_3)_5(NO_2)]Cl_2$. *1+1=2*

20. Why are haloarenes less reactive towards nucleophilic substitution reaction ? How does the presence of nitro ($-NO_2$) group at ortho- and para-positions in haloarenes increase the reactivity towards nucleophilic substitution reaction ? *2*

21. The two strands in DNA are not identical but complementary. Explain. What products would be formed when DNA is hydrolysed ? *2*

SECTION C

22. 0·3 g of acetic acid (Molar mass = 60 g mol^{-1}) dissolved in 30 g of benzene shows a depression in freezing point equal to 0·45°C. Calculate the percentage association of acid if it forms a dimer in the solution. *3*

(Given : K_f for benzene = 5·12 K kg mol^{-1})

23. (a) Write the name of the cell which is generally used in inverters. Write the reactions taking place at anode and cathode of this cell, when it is in use. *3*

OR

(b) Explain why electrolysis of an aqueous solution of NaCl gives H_2 gas at cathode and Cl_2 gas at anode ? Write overall reaction. *3*

(Given : $E^\circ_{Na^+/Na} = -2{\cdot}71$ V, $E^\circ_{H_2O/H_2} = -0{\cdot}83$ V,

$E^\circ_{Cl_2/2Cl^-} = +1{\cdot}36$ V, $E^\circ_{H^+/O_2/H_2O} = +1{\cdot}23$ V)

24. The following data were obtained during the first order thermal decomposition of N_2O_5 (g) at constant volume : *3*

$$2N_2O_5(g) \longrightarrow 2N_2O_4(g) + O_2(g)$$

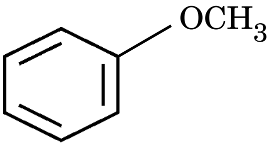
S.No.	Time/s	Total Pressure/atm
1	0	0·5
2	100	0·625

Calculate rate constant.

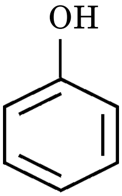
[Given : log 2 = 0·3010, log 10 = 1]

25. A compound (A) with molecular formula C_4H_9I which is a primary alkyl halide, reacts with alcoholic KOH to give compound (B). Compound (B) reacts with HI to give (C) which is an isomer of (A). When (A) reacts with Na metal in the presence of dry ether, it gives a compound (D), C_8H_{18}, which is different from the compound formed when n-butyl iodide reacts with sodium. Write the structures of (A), (B), (C) and (D). Write the chemical equation when compound (A) is reacted with alcoholic KOH. *3*

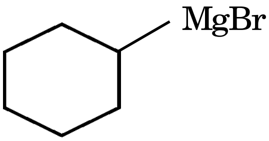
26. Write structure of the products of the following reactions : *3×1=3*

(a) 

+ HI $\longrightarrow$

(b) 

+ conc. $HNO_3 \longrightarrow$

(c) 

+ HCHO $\xrightarrow{H^+/H_2O}$

27. Give reasons for the following : *3×1=3*

(a) Benzoic acid does not undergo Friedel-Crafts reaction.

(b) HCHO is more reactive than CH_3CHO towards addition of HCN.

(c) Vinyl group directly attached with carboxylic acid should decrease the acidity of corresponding carboxylic acid due to resonance, but on the contrary it increases the acidity.

28. Write the reaction of D-Glucose with the following : *3×1=3*

(a) HCN (b) Br_2 water (c) $(CH_3CO)_2O$

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. The Crystal Field Theory (CFT) of coordination compounds is based on the effect of different crystal fields (provided by the ligands taken as point charges) on the degeneracy of d-orbital energies of the central metal atom/ion. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields. In tetrahedral coordination entity formation, the d-orbital splitting is smaller as compared to the octahedral entity.

Answer the following questions :

(a) On the basis of CFT, explain why $[Ti(H_2O)_6]Cl_3$ complex is coloured ? What happens on heating the complex $[Ti(H_2O)_6]Cl_3$? Give reason. *2*

[Atomic no. : Ti = 22]

(b) (i) What is crystal field splitting energy ? *1*

OR

(b) (ii) On the basis of Δ_o and P (pairing energy), how can you differentiate between a strong field ligand and a weak field ligand ? *1*

(c) Why are low spin tetrahedral complexes rarely observed ? *1*

30. Amines are usually formed from amides, imides, halides, nitro compounds, etc. They exhibit hydrogen bonding which influences their physical properties. In alkyl amines, a combination of electron releasing, steric and H-bonding factors influence the stability of the substituted ammonium cations in protic polar solvents and thus affect the basic nature of amines. Alkyl amines are found to be stronger bases than ammonia. Amines being basic in nature, react with acids to form salts. Aryldiazonium salts, undergo replacement of the diazonium group with a variety of nucleophiles to produce aryl halides, cyanides, phenols and arenes.

Answer the following questions :

(a) How can you convert the following ? *2*

(i) Ethanoic acid to methanamine

(ii) Propanenitrile to 1-aminopropane

(b) Why is pK_b value of aniline more than that of methylamine ? *1*

(c) (i) Arrange the following in increasing order of their basic strength in aqueous solution : *1*

$$CH_3 - NH_2, \quad (CH_3)_2NH, \quad (CH_3)_3N$$

OR

(c) (ii) Give the structures of A and B in the following reaction : *1*

$$C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow[273\,K]{HNO_2} B$$

SECTION E

31. (a) (i) Account for the following :

(I) The $E^\circ_{Mn^{2+}/Mn}$ value for manganese is highly negative, whereas $E^\circ_{Mn^{3+}/Mn^{2+}}$ is highly positive. *1*

(II) Actinoids show wide range of oxidation states. *1*

(III) Transition metals have high melting points. *1*

(ii) Complete the following ionic equations :

(I) $5SO_3^{2-} + 2MnO_4^- + 6H^+ \longrightarrow$ *1*

(II) $2MnO_4^- + H_2O + I^- \longrightarrow$ *1*

OR

(b) Answer the following questions : *5×1=5*

(i) Name two elements of 3d series for which the third ionisation enthalpies are quite high.

(ii) Out of $KMnO_4$ and K_2MnO_4, which one is paramagnetic and why ?

(iii) Write any one consequence of lanthanoid contraction.

(iv) How do you prepare potassium manganate from pyrolusite ore ?

(v) Why is the ability of oxygen more than fluorine to stabilise higher oxidation states of transition metals ?

32. (a) (i) An organic compound (X) having molecular formula $C_5H_{10}O$ can show various properties depending on its structures. Draw each of the structures if it :

(I) shows Cannizzaro reaction. *1*

(II) reduces Tollens' reagent and has a chiral carbon. *1*

(III) gives positive iodoform test. *1*

(ii) Write the reaction involved in the following : *2*

(I) Clemmensen reduction

(II) Etard reaction

OR

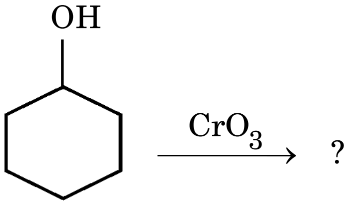
(b) Answer the following questions : *5×1=5*

(i) Draw structure of the methyl hemiacetal of methanal.

(ii) There are two – NH_2 groups in semicarbazide. However only one is involved in the formation of semicarbazones. Give reason.

(iii) How will you convert ethanol to 3-hydroxybutanal ?

(iv) Complete the following equation :



(v) Write the final product formed when phthalic acid is treated with NH_3 followed by strong heating.

33. (a) (i) Calculate the emf of the following cell at 25°C : *3*

$Zn(s) | Zn^{2+} (0.1\ M) || H^+ (0.01\ M) | H_2(g)\ (1\ bar), Pt(s)$

[Given : $E^\circ_{Zn^{2+}/Zn} = -0.76\ V$, $E^\circ_{2H^+/H_2} = 0.00\ V$, $\log 10 = 1$]

(ii) State Faraday's second law of electrolysis. How much electricity is required in terms of Faraday for the reduction of 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+} ? *2*

OR

(b) Answer the following questions :

(i) The conductivity of 0·20 M solution of KCl is $2.48 \times 10^{-2}\ S\ cm^{-1}$. Calculate its molar conductivity and degree of dissociation (α).

[Given : $\lambda^\circ_{(K^+)} = 73.5\ S\ cm^2\ mol^{-1}$

$\lambda^\circ_{(Cl^-)} = 76.5\ S\ cm^2\ mol^{-1}$]

(ii) Calculate $\Delta_r G^\circ$ of the following cell :

$$Mg(s) + Cu^{2+}(aq) \longrightarrow Mg^{2+}(aq) + Cu(s)$$

[Given : $E^\circ_{Mg^{2+}/Mg} = -2.37\ V$, $E^\circ_{Cu^{2+}/Cu} = +0.34\ V$

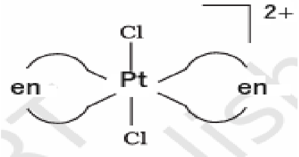
$1\ F = 96500\ C\ mol^{-1}$]

(iii) What type of cell is mercury cell ? Why is it more advantageous than dry cell ? *2+2+1=5*

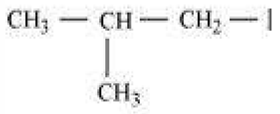
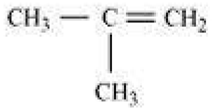
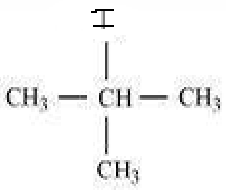
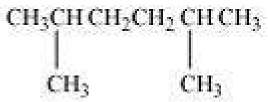
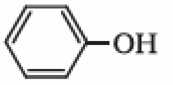
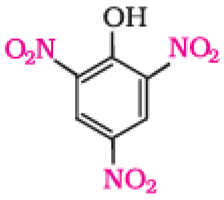
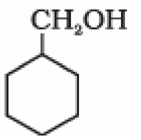
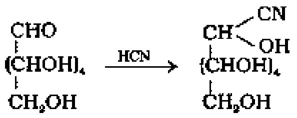
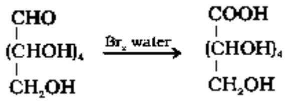
MARKING SCHEME 2024-25

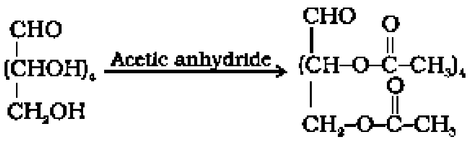
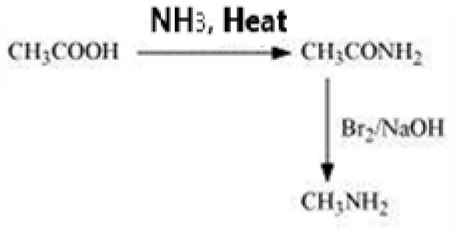
CHEMISTRY (Theory)- 043

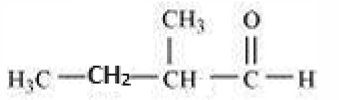
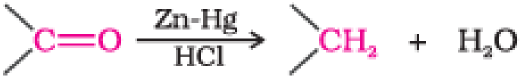
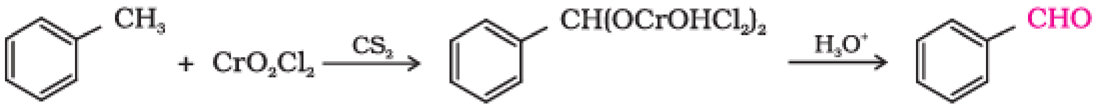
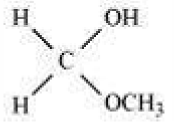
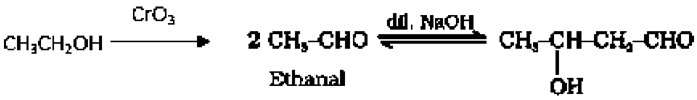
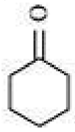
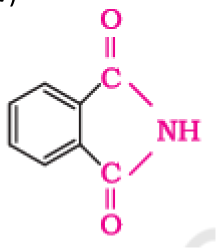
QP CODE 56/7/1 **MM: 70**

Q.No	Value points	Mark
	SECTION A	
1	**A**	**1**
2	**D**	**1**
3	**B**	**1**
4	**C**	**1**
5	**B**	**1**
6	**A**	**1**
7	**C**	**1**
8	**A**	**1**
9	**C**	**1**
10	**D**	**1**
11	**A**	**1**
12	**B**	**1**
13	**C**	**1**
14	**A**	**1**
15	**B**	**1**
16	**C**	**1**
	SECTION B	
17	When vapour pressure of the solution is higher than expected from the ideal behaviour. Example : ethanol and acetone/ carbon disulphide and acetone (or any other suitable example) Minimum boiling azeotrope	1 ½ ½
18	When one of the reactant is present in excess Hydrolysis of an ester/ sucrose (or any other suitable example) For elementary reaction, which takes place in a single step.	1 ½ ½
19	a) Dichloridobis(ethane-1,2-diamine)platinum(IV) ion 	1 1
	OR	
19	i) $[Co(NH_3)_5(CO_3)]Cl$ ii) Pentaamminenitrito-O-cobalt(III) chloride	1 1
20	-Because C—X bond acquires a partial double bond character due to resonance/ sp^2 hybridized carbon of C-X bond leading to shorter bond length (Or any other suitable reason). -Nitro group withdraws the electron density from the benzene ring and thus facilitates the attack of the nucleophile on haloarene / $-NO_2$ group being electron withdrawing stabilises the intermediate carbanion.	1 1
21	Because the hydrogen bonds are formed between specific pairs of bases 2-deoxyribose sugar , base and phosphoric acid	1 1

	SECTION C	
22	$\Delta T_f = iK_f m$ $\Delta T_f = i\text{X}\frac{K_f \times w_2 \times 1000}{M_2 \times w_1}$ $0.45 = \frac{i\ X\ 5.12\ X\ 0.3\ X\ 1000}{60\ X\ 30}$ $i = 0.527$ $\alpha = \frac{i-1}{1/n-1}$ $\alpha = \frac{0.527-1}{1/2-1}$ (n=2) α= 0.946 or 94.6% (Or any other suitable method)	½ 1 ½ ½ ½
23	(a) Lead storage battery Anode: $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$ Cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$	1 1 1
	OR	
23	(b)Because at cathode the reaction with higher value of E° is preferred and therefore, the reduction of H_2O to H_2 gas is preferred whereas at anode water should get oxidised in preference to Cl^- (aq), however, on account of overpotential of oxygen, oxidation of Cl^- to Cl_2 gas is preferred. $NaCl(aq) + H_2O(l) \rightarrow Na^+(aq) + OH^-(aq) + ½H_2(g) + ½Cl_2(g)$	1 1 1
24	$\begin{array}{llll} & 2N_2O_5(g) \rightarrow & 2N_2O_4(g) + & O_2(g) \\ \text{Start } t = 0 & P_i \text{ atm} & 0 \text{ atm} & 0 \text{ atm} \\ \text{At time } t & (P_i - 2x) \text{ atm} & 2x \text{ atm} & x \text{ atm} \end{array}$ $P_t = P_i - 2x + 2x + x = P_i + x$ $x = = P_t - P_i$ $p_A = P_i - 2x$ $= P_i - 2(P_t - P_i)$ $= 3P_i - 2P_t$ $k = \frac{2.303}{t} \log \frac{p_i}{p_A}$ Where pi=0.5 atm, $p_A = 3p_i - 2p_t$ $= (3X\ 0.5) - (2x0.625)$ $= 0.25 atm$ $k = \frac{2.303}{100s} \log \frac{0.5 atm}{0.25\ atm}$ $= \frac{2.303}{100s} \times 0.3010$ $= 6.93\ X\ 10^{-3}\ s^{-1}$	1 1 1

25	A=  $CH_3-CH(CH_3)-CH_2-I$ B=  $CH_3-C(CH_3)=CH_2$ C=  $CH_3-CHI(CH_3)-CH_3$ D=  $CH_3CH(CH_3)CH_2CH_2CH(CH_3)CH_3$  + KI + H2O $CH_3-CH(CH_3)-CH_2-I \xrightarrow{KOH(alc)/\Delta} CH_3-C(CH_3)=CH_2$ + KI + H_2O	½ ½ ½ ½ 1
26	a) CH_3I +  b)  c) 	1 1 1
27	a) Because the carboxyl group is deactivating and the catalyst aluminium chloride (Lewis acid) gets bonded to the carboxyl group.(forms salt) b) Because carbonyl carbon of HCHO is more electrophilic than CH_3CHO/ due to +I effect of methyl group/ steric effect of methyl group, CH_3CHO is less reactive. c) Because of greater electronegativity of sp^2 hybridised carbon to which carboxyl carbon is attached.	1 1 1
28	a)  b) 	1 1

	c) 	1
	SECTION D	
29	a) Due to presence of one unpaired electron in t_{2g} which gets excited to e_g / Due to excitation energy $t_{2g}{}^{1} \rightarrow e_g{}^{1}$, it gives colour. (d-d transition) When heated, water is lost therefore crystal field splitting does not occur and it becomes colourless. b) The energy required to split the degenerate d-orbitals into two sets of orbitals (t_2g and e_g). /The difference of energy between the two sets of d-orbitals t_2g and eg due to the presence of ligands in a definite geometry . **OR** b) (ii) $\Delta_o < P$, weak filed ligand $\Delta_o > P$, strong field ligand c) Because the orbital splitting energies are not sufficiently large for forcing pairing / Due to low crystal field splitting energy.	1 1 1 ½ + ½ 1
30	a) (i)  (ii) $CH_3\text{-}CH_2\text{-}C{\equiv}N \xrightarrow{H_2/Pt} CH_3\text{-}CH_2\text{-}CH_2\text{-}NH_2$ (or by any other method) **b)** Aniline undergoes resonance and as a result the electrons on the N-atom are less available for donation. **c)** (i) $(CH_3)_3N < CH_3NH_2 < (CH_3)_2NH$ OR c) (ii) A= $C_6H_5NH_2$; B= =$C_6H_5N_2{}^{+}Cl$	1 1 1 1 ½ + ½
	SECTION E	
31	(a) (i) (I) Because Mn^{2+} is more stable than Mn^{3+} due to extra stable half-filled d^5 configuration. (II) Due to comparable energies of 5f, 6d and 7s orbitals (III) Due to the involvement of greater number of electrons from (n-1)d in addition to the ns electrons in the inter-atomic metallic bonding. (ii) (I) $5SO_3^{2-} + 2MnO_4^{-} + 6H^{+} \longrightarrow 2Mn^{2+} + 3H_2O + 5SO_4^{2-}$ (II) $2MnO_4^{-} + H_2O + I^{-} \longrightarrow 2MnO_2 + 2OH^{-} + IO_3^{-}$	1 1 1 1 1
	OR	
31	b) (i) Mn, Zn, Ni, Cu (any two) (ii) K_2MnO_4, due to presence of one unpaired electron (iii) Similar radii of 4d and 5d series elements/ similar properties/ difficulty in separation of lanthanoids (or any other relevant consequence)	½ , ½ ½ , ½ 1

	(iv) It is prepared by fusion of MnO_2 with an alkali metal hydroxide and an oxidising agent / $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$ (v) because of the ability of oxygen to form multiple bonds with metal	1 1
32	(a) (i) (I) $(CH_3)_3C\text{-}CHO$ (II)  $H_3C-CH_2-\underset{}{\overset{CH_3}{\overset{\vert}{CH}}}-\overset{O}{\overset{\Vert}{C}}-H$ (III) $CH_3\text{-}CO\text{-}CH_2CH_2CH_3$ (ii) (I)  (II) 	1 1 1 1 1
	OR	
32.	(b) i)  ii) Because semicarbazide undergoes resonance involving only one of the two - NH_2 groups, which is attached directly to the carbonyl-carbon atom. iii)  iv)  v) 	1 1 1 1 1
33	**(a) (i)** $E_{Cell} = (E^o{}_c - E^o{}_a) - \frac{0.059}{2}\log\frac{[Zn^{2+}]}{[H^+]^2}$	1

	$= [(0) - (-0\cdot76)] - \frac{0\cdot059}{2} log \frac{0\cdot1}{(0\cdot01).^2}$ = 0.76 - 0.0295 log 10^3 = 0.76 – 0.0885 = 0.6715 V or 0.67 V (Deduct ½ mark for no or incorrect unit) (ii) The amounts of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weights. 6F	1 1 1 1
	OR	
33	(b) (i) $\Lambda_m = \frac{K}{C} \times 1000$ $\Lambda_m = \frac{2.48 \times 10^{-2}}{0.2} \times 1000$ $= 124 \text{ S cm}^2 \text{ mol}^{-1}$ $\Lambda_m^\circ = \lambda^\circ_{K^+} + \lambda^\circ_{Cl^-}$ $= 73.5 + 76.5$ $= 150 \text{ S cm}^2 \text{ mol}^{-1}$ $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$ $= \frac{124}{150}$ $= 0.827$ (ii) $E^0_{cell} = E^0_{cathode} - E^0_{anode}$ $= 0.34 - (-2.37)$ $= 2.71V$ $\Delta_r G^0 = -nFE^0_{cell}$ $= -2 \text{ X } 96500 \text{ X } 2.71$ $= -523030 \text{ Jmol}^{-1}$ or $-523.03 \text{ kJmol}^{-1}$ (iii) Primary cell Maintains constant potential throughout its usage/ longer lifespan	½ ½ ½ ½ ½ ½ ½ ½ ½ ½