

Series HFG1E/3



SET-3

प्रश्न-पत्र कोड
Q.P. Code

56/3/3

रोल नं.

Roll No.

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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. $18 \times 1 = 18$

1. Kohlrausch gave the following relation for strong electrolyte :

$$\Lambda = \Lambda_{\circ} - A\sqrt{C}$$

Which of the following equality holds true ?

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



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2. Which of the following belongs to the class of alkyl halides ?
- (a) $\text{CH}_2 = \text{CH} - \text{Cl}$
- (b) $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{Cl}$
- (c) $\text{CH}_2 = \text{CH} - \underset{\text{Cl}}{\text{CH}} - \text{CH}_3$
- (d) $\text{CH} \equiv \text{C} - \text{CH}_2 - \text{Cl}$
3. 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.
4. For the conversion of propene into 1-propanol, which of the following reagents and conditions should be used ?
- (a) Conc. H_2SO_4 ; H_2O and heat
- (b) B_2H_6 ; $\text{H}_2\text{O}_2 / \text{OH}^-$
- (c) Dilute H_2SO_4
- (d) $\text{H}_2\text{O} / \text{H}^+$
5. Which of the following reagents would one choose to transform CH_3COCl into acetone ?
- (a) $(\text{CH}_3)_2\text{Cd}$ (b) CH_3MgBr
- (c) CH_3Cl (d) $(\text{CH}_3\text{O})_2\text{Mg}$
6. The reaction of ammonia with a large excess of methyl chloride will yield mainly :
- (a) methylamine
- (b) dimethylamine
- (c) tetramethylammonium chloride
- (d) trimethylamine



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7. In the ring structure of glucose, the anomeric carbon is :
- (a) C-2 (b) C-3
(c) C-4 (d) C-1
8. Deficiency of Vitamin B causes :
- (a) rickets
(b) muscular weakness
(c) scurvy
(d) beri-beri
9. The cathode reaction during the charging of a lead storage battery leads to the :
- (a) formation of PbSO_4
(b) reduction of Pb^{2+} to Pb^{4+}
(c) formation of PbO_2 and Pb
(d) deposition of Pb at the anode
10. Which one of the following pairs will **not** form an ideal solution ?
- (a) Benzene and Toluene
(b) Nitric acid and Water
(c) Hexane and Heptane
(d) Ethyl chloride and Ethyl bromide
11. The half-life of a reaction is doubled when the initial concentration is doubled. The order of the reaction is :
- (a) 1 (b) 2
(c) 4 (d) 0
12. Which of the following ions has the maximum number of unpaired d-electrons ?
- (a) Fe^{3+} (b) V^{3+}
(c) Ti^{3+} (d) Sc^{3+}

[Atomic number : Fe = 26, V = 23, Ti = 22, Sc = 21]



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13. Which of the following is a polydentate ligand ?
- (a) NH_3
 - (b) $\text{H}_2\text{N} - \text{CH}_2 - \text{CH}_2 - \text{NH}_2$
 - (c) EDTA^{4-}
 - (d) $\text{C}_2\text{O}_4^{2-}$
14. Which of the following coordination compounds exhibits linkage isomerism ?
- (a) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
 - (b) $[\text{Co}(\text{NH}_3)_5(\text{CO}_3)]\text{Cl}$
 - (c) $[\text{Co}(\text{NH}_3)_5\text{NO}_2](\text{NO}_3)_2$
 - (d) $[\text{Co}(\text{en})_3]\text{Cl}_3$

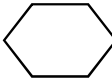
For Questions number 15 to 18, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (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)* : Nucleophilic substitution of iodoethane is easier than chloroethane.
- Reason (R)*: Bond energy of C – Cl bond is less than C – I bond.
16. *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.



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17. *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.
18. *Assertion (A):* Fe^{2+} acts as a reducing agent.
Reason (R): Fe^{3+} state is stable due to $3d^5$ configuration.

SECTION B

19. Give the structures and IUPAC name of the products expected from the following reactions : 2×1=2
- (a) Reaction of methanal with -MgBr followed by hydrolysis.
- (b) Reaction of phenol with Br_2 (aq).
20. The half-life of a first order reaction is 60 minutes. How long will it take to consume 90% of the reactant ? 2
[Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 10 = 1$]
21. Write the chemical equation involved in the following reactions : 2
- (a) Carbylamine reaction
- (b) Gabriel phthalimide synthesis
22. What type of deviation from Raoult's law is shown by a mixture of ethanol and acetone ? Give reason. 2
23. (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



24. (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 : $E^\circ_{X^{2+}/X} = -2.36 \text{ V}$

$$E^\circ_{Y^{2+}/Y} = -0.14 \text{ V}$$

$$E^\circ_{Fe^{2+}/Fe} = -0.44 \text{ V}$$

25. Give reasons : 2×1=2

- (a) Formic acid is a stronger acid than acetic acid.
(b) Alpha (α)-Hydrogens of aldehydes and ketones are acidic.

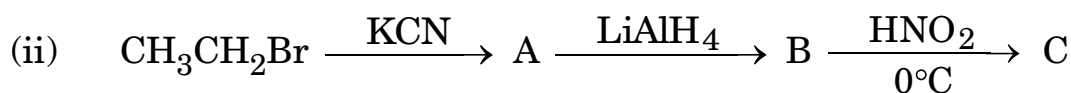
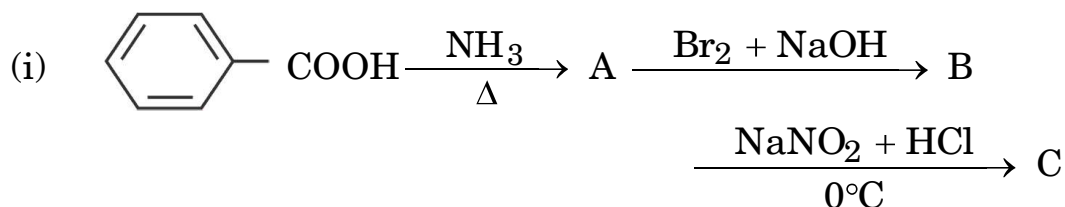
SECTION C

26. The rate of a reaction doubles when temperature changes from 27°C to 37°C . Calculate energy of activation for the reaction.
($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$) 3
(Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$)

27. 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

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



OR



(b) How will you convert the following :

3×1=3

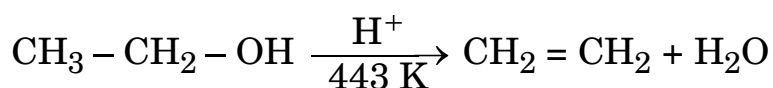
- (i) Aniline to p-bromoaniline
- (ii) Ethanoic acid to methanamine
- (iii) Butanenitrile to 1-aminobutane

29. 0.3 g of acetic acid ($M = 60 \text{ g mol}^{-1}$) 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 = $5.12 \text{ K kg mol}^{-1}$)

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



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

3

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_N^1 and S_N^2 on the basis of their kinetic properties. Chirality has a profound role in understanding the S_N^1 and S_N^2 mechanism.

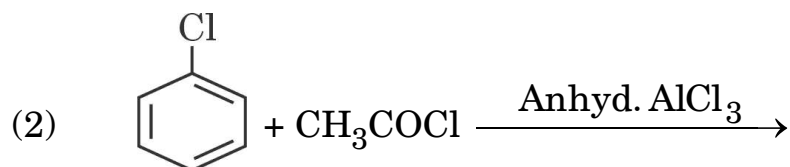
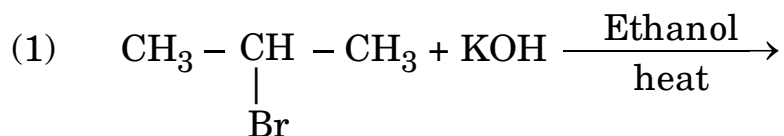


Answer the following questions :

- (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_N^1 reaction with 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



- 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 $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ 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 $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]\text{Cl}$. 1
- (iii) Using Valence Bond Theory, predict the geometry and magnetic nature of :
- (1) $[\text{Ni}(\text{CO})_4]$
- (2) $[\text{Fe}(\text{CN})_6]^{3-}$
- [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) $[\text{Co}(\text{NH}_3)_6]^{3+}$ is an inner orbital complex whereas $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is an outer orbital complex.
- [Atomic number : Co = 27, Ni = 28]

SECTION E

- 33.** (a) (i) An organic compound (X) having molecular formula $\text{C}_5\text{H}_{10}\text{O}$ 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 :

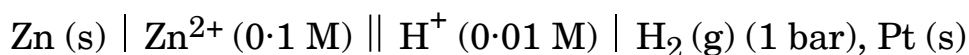
(1) $\text{O}_2\text{N} - \text{CH}_2 - \text{COOH}$, $\text{F} - \text{CH}_2 - \text{COOH}$, $\text{CN} - \text{CH}_2\text{COOH}$
(Acidic character)

(2) Ethanal, Propanal, Butanone, Propanone

(Reactivity in nucleophilic addition reactions)

3+2=5

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



[Given : $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$, $E^\circ_{\text{H}^+/\text{H}_2} = 0.00 \text{ V}$, $\log 10 = 1$]

(b) State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution ?

3+2=5



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

- (1) Transition metals form complex compounds.
- (2) The $E^\circ_{\text{Mn}^{2+}/\text{Mn}}$ value for manganese is highly negative whereas $E^\circ_{\text{Mn}^{3+}/\text{Mn}^{2+}}$ is highly positive.
- (3) Cu^+ ion is unstable in aqueous solution.

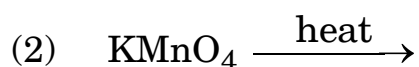
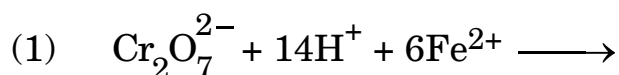
(ii) Write the equations involved in the preparation of KMnO_4 from Pyrolusite ore (MnO_2). 3+2=5

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 :



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

