

Series HFG1E/2



SET-3

प्रश्न-पत्र कोड
Q.P. Code 56/2/3

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 (सैद्धांतिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे

Time allowed : 3 hours

अधिकतम अंक : 70

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.



56/2/3

245 C

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P.T.O.

General Instructions :

Read the following instructions very carefully and follow them :

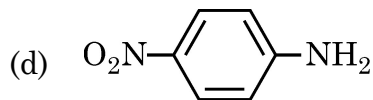
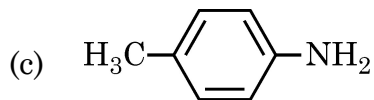
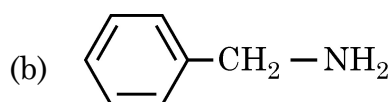
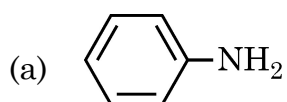
- (i) *This Question Paper contains 35 questions. All questions are compulsory.*
- (ii) *Question Paper is divided into FIVE sections – Section A, B, C, D and E.*
- (iii) *In section A – question number 1 to 18 are Multiple Choice (MCQ) type questions carrying 1 mark each.*
- (iv) *In section B – question 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. Auto oxidation of chloroform in air and sunlight produces a poisonous gas known as 1
- (a) Tear gas (b) Mustard gas
(c) Phosgene gas (d) Chlorine gas
2. Which of the following ligands is an ambidentate ligand ? 1
- (a) CO (b) NO₂
(c) NH₃ (d) H₂O



3. Among the following, which has the highest value of p^{K_b} ? 1



4. The slope in the plot of $\log \frac{[R]_0}{[R]}$ vs. time for a first order reaction is 1

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

(b) $+k$

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

(d) $-k$

5. When D-glucose reacts with HI, it forms 1

(a) Gluconic acid

(b) n-hexane

(c) Saccharic acid

(d) Iodohexane

6. Inversion of configuration occurs in 1

(a) S_N2 reaction

(b) S_N1 reaction

(c) Neither S_N2 nor S_N1 reaction

(d) S_N1 as well as S_N2 reaction

7. Solubility of gas in liquid decreases with increase in 1

(a) Pressure

(b) Temperature

(c) Volume

(d) Number of solute molecules



8. Which of the following relations is incorrect ? 1

(a) $R = \frac{1}{k} \left(\frac{l}{a} \right)$ (b) $G = k \left(\frac{a}{l} \right)$

(c) $G = k \left(\frac{l}{a} \right)$ (d) $\wedge_m = \frac{k}{c}$

9. The reagent that can be used to distinguish acetophenone and benzophenone is 1

- (a) 2, 4-dinitrophenyl hydrazine (b) aqueous NaHSO_3
(c) Fehling solution (d) I_2 and NaOH

10. Which of the following reactions are feasible ? 1

- (a) $\text{CH}_3\text{CH}_2\text{Br} + \text{Na}^+ \text{O}^- \text{C}(\text{CH}_3)_3 \rightarrow \text{CH}_3\text{CH}_2\text{O} - \text{C}(\text{CH}_3)_3$
(b) $(\text{CH}_3)_3\text{C} - \text{Cl} + \text{Na}^+ \text{O}^- \text{CH}_2\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{O} - \text{C}(\text{CH}_3)_3$
(c) Both (a) and (b)
(d) Neither (a) nor (b)

11. Which of the following compounds will undergo self-condensation in the presence of dilute NaOH solution ? 1

- (a) $\text{C}_6\text{H}_5\text{CHO}$ (b) $\text{CH}_3\text{CH}_2\text{CHO}$
(c) $(\text{CH}_3)_3\text{C} - \text{CHO}$ (d) $\text{H} - \text{CHO}$

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

(a) $\frac{+3}{2} \frac{d[\text{B}]}{dt}$ (b) $\frac{+2}{3} \frac{d[\text{B}]}{dt}$

(c) $\frac{+1}{3} \frac{d[\text{B}]}{dt}$ (d) $\frac{+1}{2} \frac{d[\text{B}]}{dt}$



13. Which of the following transition metals shows + 1 and + 2 oxidation states ? 1

- (a) Mn (b) Zn
(c) Sc (d) Cu

14. The formula of the complex Iron (III) hexacyanidoferrate (II) is : 1

- (a) $\text{Fe}_2 [\text{Fe}(\text{CN})_6]_3$ (b) $\text{Fe}_4 [\text{Fe}(\text{CN})_6]_3$
(c) $\text{Fe} [\text{Fe}(\text{CN})_6]$ (d) $\text{Fe}_3 [\text{Fe}(\text{CN})_6]_2$

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) :** The enthalpy of mixing $\Delta_{\text{mix}} H$ is equal to zero for an ideal solution. 1

Reason (R) : For an ideal solution the interaction between solute and solvent molecules is stronger than the interactions between solute-solute or solvent-solvent molecules.

16. **Assertion (A) :** Molar conductivity decreases with increase in concentration. 1

Reason (R) : When concentration approaches zero, the molar conductivity is known as limiting molar conductivity.

17. **Assertion (A) :** Transition metals show their highest oxidation state with oxygen. 1

Reason (R) : The ability of oxygen to form multiple bonds to metals.



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18. **Assertion (A)** : Chlorobenzene is resistant to nucleophilic substitution reaction at room temperature. 1

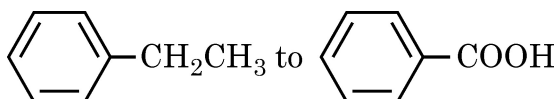
Reason (R) : C–Cl bond gets weaker due to resonance.

SECTION – B

19. What are nucleic acids ? Why two strands in DNA are not identical but are complementary ? 1 × 2

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

(a) CH_3COOH to CH_3COCH_3

(b) 

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

(a) Reimer-Tiemann reaction

(b) Acetylation of Salicylic acid

22. (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.

23. 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



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24. (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

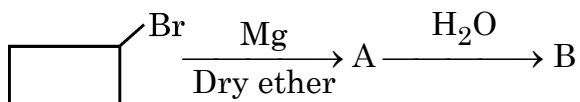
- (b) Define fuel cell with an example. What advantages do the fuel cells have over primary and secondary batteries ? 2
25. (a) Write the IUPAC names of the following : 2 × 1
- (i) $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$
- (ii) $\text{K}_2[\text{NiCl}_4]$

OR

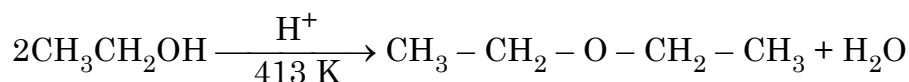
- (b) (i) What is a chelate complex ? Give one example.
- (ii) What are heteroleptic complexes ? Give one example. 2 × 1

SECTION – C

26. Answer any 3 of the following : 3 × 1
- (a) Which isomer of C_5H_{10} gives a single monochloro compound $\text{C}_5\text{H}_9\text{Cl}$ in bright sunlight ?
- (b) Arrange the following compounds in increasing order of reactivity towards $\text{S}_{\text{N}}2$ 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 :



27. (a) (i) Write the mechanism of the following reaction : 2 + 1



- (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 $\text{Na}_2\text{Cr}_2\text{O}_7/\text{H}^+$?
- (iii) $(\text{CH}_3)_3\text{C} - \text{OH}$ is heated with $\text{Cu}/573\text{ K}$?

Write chemical equation in support of your answer.

28. (a) Draw the geometrical isomers of $[\text{Co}(\text{en})_2\text{Cl}_2]^{2+}$. Which geometrical isomer of $[\text{Co}(\text{en})_2\text{Cl}_2]^{2+}$ is not optically active and why ? 2 + 1
- (b) Write the hybridisation and magnetic behaviour of $[\text{CoF}_6]^{3-}$.
- [Given : Atomic number of Co = 27]

29. 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.
[$R = 8.314\text{ J K}^{-1}\text{ mol}^{-1}$] 3
- [Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$]

30. When 19.5 g of $\text{F} - \text{CH}_2 - \text{COOH}$ (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 $\text{F} - \text{CH}_2 - \text{COOH}$.
[Given : K_f for water = $1.86\text{ K kg mol}^{-1}$] 3



SECTION – D

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

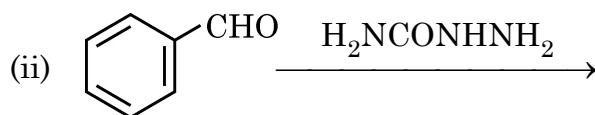
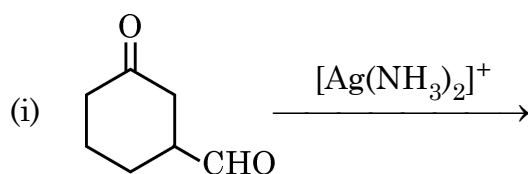
31. The carbon – oxygen double bond is polarised in aldehydes and ketones due to higher electronegativity of oxygen relative to carbon. Therefore they undergo nucleophilic addition reactions with a number of nucleophiles such as HCN, NaHSO₃, alcohols, ammonia derivatives and Grignard reagents. Aldehydes 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 CH₃MgBr :
- $\text{CH}_3\text{CHO}, (\text{CH}_3)_3\text{C} - \underset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{CH}_3, \text{CH}_3 - \underset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{CH}_3$
- (ii) Write a chemical test to distinguish between propanal and propanone. 2 × 1

OR

- (c) Write the main product in the following :



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 $\times$ 1

OR

- (c) Define the following as related to carbohydrates :
- (i) Anomers
- (ii) Glycosidic linkage 2 $\times$ 1

SECTION – E

33. (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.

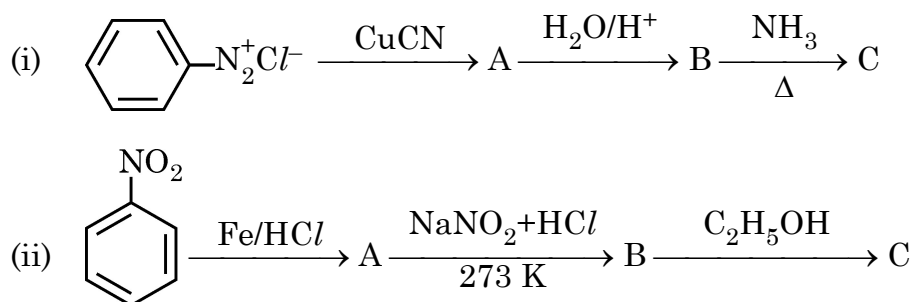


(II) Write the reaction involved in the following :

- (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**



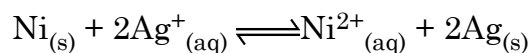
(II) Why aniline does not undergo Friedal-Crafts reaction ?

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



34. (a) Conductivity of $2 \times 10^{-3} \text{ M}$ methanoic acid is $8 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation if $\wedge_m^0$ for methanoic acid is $404 \text{ S cm}^2\text{mol}^{-1}$. **3 + 2**

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



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

$1\text{F} = 96500 \text{ C mol}^{-1}$.



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

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

(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 :

