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

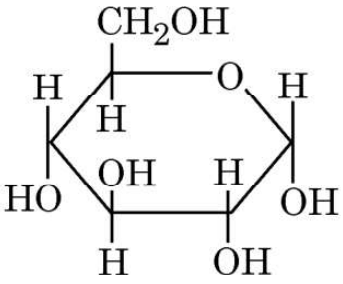
2. The half-life for a zero order reaction equals :

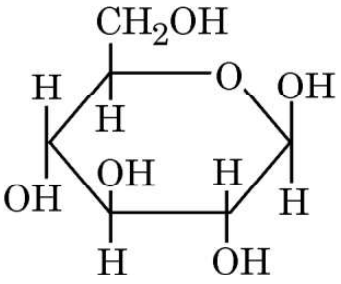
(a) $\frac{2k}{R}$ (b) $\frac{1}{2}\frac{k}{R^2}$

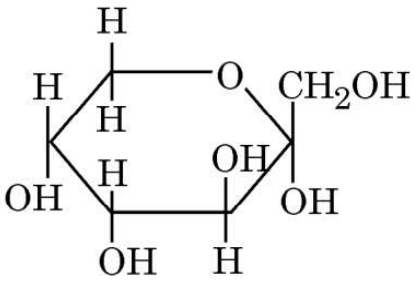
(c) $\frac{R^2}{2k}$ (d) $\frac{R}{2k}$

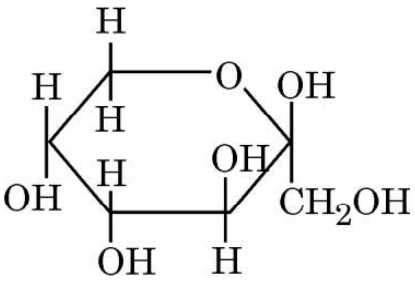
where R is the initial concentration.

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 :

$$\log k = 23{\cdot}6 - \frac{2 \times 10^4 K}{T}$$

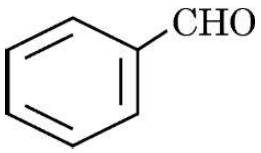
Calculate E_a for this reaction. *2*

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

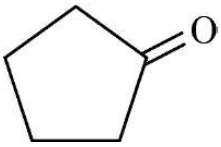
23. Write the mechanism of the following reaction : *2*

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

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*

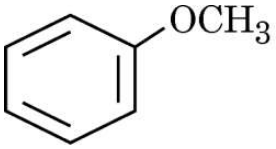
(a) $[Co(NH_3)_4Cl(NO_2)]Cl$

(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 = 0·0821 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*

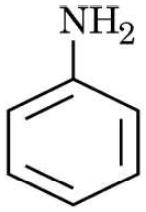
$C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$

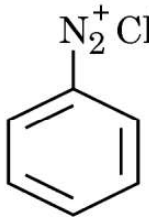
(ii) Aniline on nitration gives a substantial amount of m-nitroaniline, though amino group is o/p directing. Why ? *1*

(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)  + Br_2 (aq) $\longrightarrow$

(2)  $\xrightarrow[\text{(ii) } NaNO_2/Cu,\ \Delta]{\text{(i) } HBF_4}$

SECTION E

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

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

[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 $K_2Cr_2O_7$?

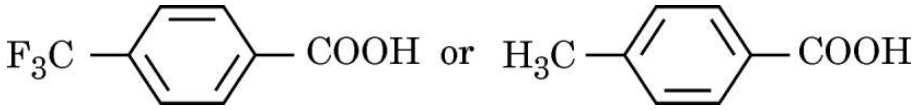
(iii) Why is Cu^+ not stable in aqueous solution ?

(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*