

Series : QSR5P



SET~1

प्रश्न-पत्र कोड

Q.P. Code

56/5/1

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.

नोट	NOTE
(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ 23 हैं।	(I) 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।	(II) 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।	(III) 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। []	(IV) 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।	(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 (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 :

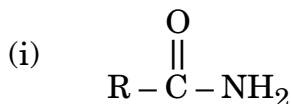
- (i) This question paper contains **33** questions. **All** questions are **compulsory**.
- (ii) This question paper is divided into **five** sections – **Section A, B, C, D and E**.
- (iii) **Section A** – questions number **1 to 16** are multiple choice type questions. Each question carries **1** 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. $16 \times 1 = 16$

1. Which of the reactions is used in the conversion of a ketone into hydrocarbon ?

(A) Reimer-Tiemann reaction	(B) Wolff-Kishner reduction
(C) Aldol condensation	(D) Stephen reaction
2. Which of the following reagents are used to prepare primary amines by Hoffmann bromamide degradation reaction ?



(ii) NaOH

(iii) Br₂

(iv) CHCl₃

(A) (i), (ii) and (iv)

(B) (i) and (iii)

(C) (i), (ii) and (iii)

(D) (i), (iii) and (iv)





3. The major product of carbylamine reaction is :
- (A) Carboxylic acid (B) Aldehyde
(C) Cyanide (D) Isocyanide
4. Actinoids show larger number of oxidation states :
- (A) because they are radioactive in nature
(B) because they have large atomic numbers
(C) because they have large atomic masses
(D) due to comparable energies of 5f, 6d and 7s orbitals
5. Consider the following reaction and identify A and B :
- $$\text{CH}_3\text{Cl} + \text{NaI} \xrightarrow{\text{dry acetone}} \text{A} + \text{B}$$
- (A) A = CH₃I, B = NaCl
(B) A = CH₃OH, B = NaCl
(C) A = CH₃CHO, B = NaCl
(D) A = C₂H₆, B = CH₃I
6. The correct formula of Hinsberg's reagent is :
- (A) C₆H₅COCl
(B) C₆H₅SO₂Cl
(C) C₆H₅CONHCH₃
(D) C₆H₅CH₂NH₂
7. Half-life (t_{1/2}) of a first order reaction is 1386 s. The value of rate constant is :
- (A) 0.5 × 10⁴ s⁻¹
(B) 5.0 × 10⁻⁴ s⁻¹
(C) 0.5 × 10⁻⁵ s⁻¹
(D) 0.5 × 10⁻² s⁻¹





8. Which of the following ligands forms a chelate complex ?
- (A) Ammonia
(B) Water
(C) NO_2^-
(D) Oxalate ion
9. Primary, secondary and tertiary alcohols can be distinguished by :
- (A) Lucas test
(B) Fehling's test
(C) Tollens' test
(D) Hinsberg's test
10. Consider the following compounds :
 $\text{C}_2\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$, $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$, NH_3 , $\text{C}_6\text{H}_5\text{NH}_2$
The correct increasing order of the above compounds on the basis of their basic strength is :
- (A) $\text{C}_6\text{H}_5\text{NH}_2 < \text{NH}_3 < \text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$
(B) $\text{NH}_3 < \text{C}_6\text{H}_5\text{NH}_2 < \text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$
(C) $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH} < \text{NH}_3 < \text{C}_6\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2$
(D) $\text{C}_2\text{H}_5\text{NH}_2 < \text{C}_6\text{H}_5\text{NH}_2 < \text{NH}_3 < \text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$
11. Identify the polysaccharide among the following :
- (A) Fructose (B) Maltose
(C) Glucose (D) Cellulose
12. The polypeptide chain in a protein has amino acids linked with each other in a specific sequence. This specific sequence of amino acids is called :
- (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) :* D (+) – Glucose is dextrorotatory in nature.

Reason (R) : (+) represents dextrorotatory nature and D represents the configuration.

14. *Assertion (A) :* Highest oxidation state of Mn is +7 in first series of transition elements.

Reason (R) : Transition metals exhibit variable oxidation states.

15. *Assertion (A) :* p-nitrophenol is more acidic than phenol.

Reason (R) : Nitro group is an electron-withdrawing group, it stabilises phenoxide ion by dispersal of negative charge.

16. *Assertion (A) :* All aliphatic aldehydes give a positive Fehling's test.

Reason (R) : Aliphatic aldehydes are reduced by Fehling's reagent.

SECTION B

17. (a) 1.00 molal aqueous solution of trichloroacetic acid is heated to its boiling point. Boiling point of this solution was found to be 100.18°C. Calculate the van't Hoff factor for trichloroacetic acid. (Given : K_b for water = 0.512 K kg mol⁻¹)

2

OR





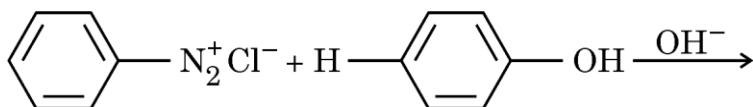
- (b) State Henry's law. Calculate the mole fraction of CO_2 in water at 298 K under 760 mm Hg.

(Given : K_H for CO_2 in H_2O at 298 K = 1.25×10^6 mm Hg) 2

18. (a) Name the cell which was used in the Apollo space programme for providing electrical power.

- (b) Define limiting molar conductivity. 1+1

19. (a) Complete the following equation :



- (b) How will you convert nitromethane to methyl isocyanide ? 1+1

20. (a) What are the products obtained on hydrolysis of sucrose ?

- (b) What are essential amino acids ? 1+1

21. (a) Write any two fat soluble vitamins.

- (b) How will you confirm the presence of five – OH groups in a glucose molecule, which are attached to different carbon atoms ? 1+1

SECTION C

22. Calculate emf of the following cell at 298 K : 3



(Given : $E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}$, $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$, $[\log 10 = 1]$)

23. (a) Define order of a reaction.

- (b) The rate for the following reaction is given by : $\text{A} + \text{B} \rightarrow \text{C}$

$$\text{Rate} = k[\text{A}][\text{B}]^2$$

- (i) How is the rate of reaction affected if we double the concentration of B ?

- (ii) Write the overall order of a reaction if 'A' is present in large excess. 1+2=3

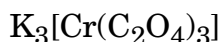




24. The rate of the chemical reaction doubles when the temperature is raised from 298 K to 308 K. Calculate activation energy (E_a) for this reaction assuming that it does not change with temperature. 3

(Given : $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$, $\log 2 = 0.30$)

25. (a) Write the IUPAC name of the following complex : 1



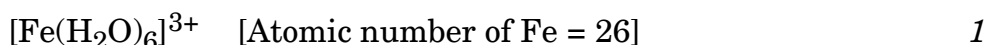
- (b) Differentiate between homoleptic complex and heterolyptic complex. 1

- (c) Which type of isomerism is exhibited by the following complex : 1



26. (a) A coordination compound $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ is mixed with excess of AgNO_3 solution, two moles of AgCl are precipitated per mole of the compound. Write the structural formula of the coordination compound. 1

- (b) Write the oxidation state and hybridisation of the central metal in the following complex :



- (c) Why is $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ coloured ? [Atomic number of Ni = 28] 1

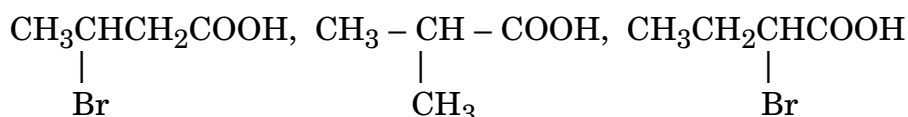
27. How do you convert the following ? 3

- (a) Acetophenone to Benzoic acid

- (b) Acetonitrile to Acetone

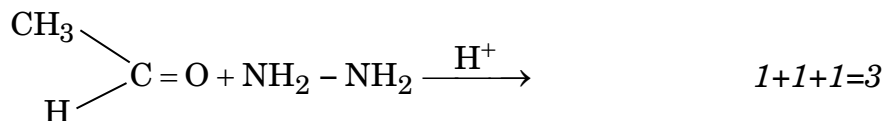
- (c) Benzoic acid to Benzene

28. (a) (i) Arrange the following compounds in increasing order of their acidic strengths :





- (ii) Why is CH_3CHO more reactive than acetone towards reaction with HCN ?
- (iii) Complete the equation :



OR

- (b) An organic compound with the molecular formula $\text{C}_8\text{H}_8\text{O}$ forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation it gives Benzene-1,2-dicarboxylic acid. Identify the compound and write the reactions of compound 2,4-DNP and when it undergoes Cannizzaro reaction.

3

SECTION D

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

- 29.** Ethers are prepared by the dehydration of alcohols in presence of protic acids at 413 K. Symmetrical and unsymmetrical ethers can also be prepared by Williamson synthesis. This reaction involves $\text{S}_{\text{N}}2$ attack of an alkoxide ion on primary alkyl halide. If a tertiary alkyl halide is used, elimination reaction occurs and an alkene is formed, no ether is formed. C – O bond in ethers are cleaved under drastic conditions with excess of HI. When unsymmetrical ethers react with HI, the alkyl halide is formed from smaller alkyl group. If one of the alkyl group is tertiary, the alkyl halide is formed from the tertiary alkyl group because tertiary alkyl carbocation is more stable than the primary carbocation. Cleavage of alkyl aryl ethers takes place at the alkyl-oxygen bond due to more stable aryl-oxygen bond. The order of reactivity of hydrogen halides is $\text{HI} > \text{HBr} > \text{HCl}$. Aromatic ethers undergo electrophilic substitution reactions. The alkoxy group attached to the aromatic ring activates the ring towards electrophilic substitution and directs the incoming group to ortho- and para-positions.

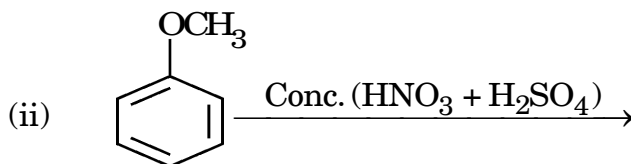
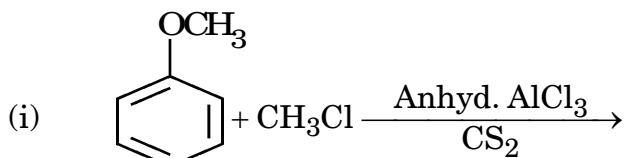




Answer the following questions :

(a) Complete the following equations :

2



(b) (i) Write the names of alkyl halide and sodium alkoxide used to prepare tert-butyl ethyl ether.

1

OR

(b) (ii) Anisole on reaction with HI gives phenol and $\text{CH}_3 - \text{I}$ and not methanol and iodobenzene. Justify the statement.

1

(c) Why is $\text{C} - \text{O} - \text{C}$ bond angle in ethers slightly greater than tetrahedral angle ?

1

30. Electrochemistry is the study of the relationship between chemical energy and electrical energy. Many spontaneously occurring chemical reactions liberate electrical energy. In electrolysis, electrical energy is converted directly into chemical energy. The product of an electrolytic reaction depends on the nature of the material being electrolysed and the type of electrode used. Oxidising and reducing species present in the electrolytic cell and their standard electrode potential too, affect the products of electrolysis. Electrolysis plays an important role in most people's daily lives, whether it is for the manufacturing of aluminium, electroplating of metals, or the synthesis of chemical compounds.

Michael Faraday was the first scientist who proposed two laws to explain the quantitative aspects of electrolysis, popularly known as Faraday's laws of electrolysis. Faraday's laws of electrolysis provide a basis for mathematical analysis of the mass deposited at electrodes and the amount of charge passed through them.

Faraday's laws are fundamental in various applications, including electroplating, metal extraction, battery technology and chemical synthesis. These laws also help in environmental monitoring and in various chemistry experiments.



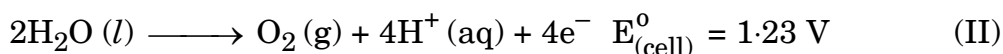
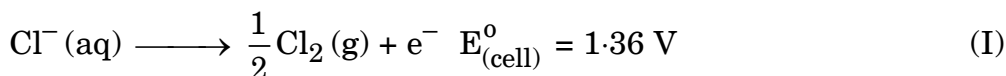


Answer the following questions :

- (a) Predict the products of electrolysis in each of the following : 2
- (i) An aqueous solution of CuCl_2 with platinum electrodes.
- (ii) A concentrated solution of H_2SO_4 with platinum electrodes.
- (b) (i) How much charge in faraday is required for the reduction of 1 mol of Ag^+ to Ag ? 1

OR

- (b) (ii) State Faraday's second law of electrolysis. 1
- (c) The following reactions occur at the anode during the electrolysis of aqueous sodium chloride solution :



Which reaction is feasible at the anode and why ? 1

SECTION E

31. (a) (i) Calculate the freezing point of a solution when 10.5 g of MgBr_2 was dissolved in 250 g of water, assuming MgBr_2 undergoes complete dissociation. 3
- (Given : Molar mass of $\text{MgBr}_2 = 184 \text{ g mol}^{-1}$,
 K_f for water = $1.86 \text{ K kg mol}^{-1}$)

- (ii) Write two differences between ideal and non-ideal solutions. 1+1

OR

- (b) (i) A solution is prepared by dissolving 0.025 g of potassium sulphate in 2 L of water at 27°C . Assuming potassium sulphate is completely dissociated, determine its osmotic pressure. 3
- (Given : $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$,
 Molar mass of $\text{K}_2\text{SO}_4 = 174 \text{ g mol}^{-1}$)
- (ii) What type of azeotrope will be formed by a solution of acetone and chloroform ? Give reason. 2



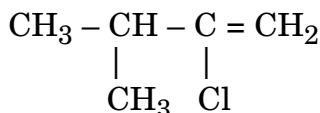


32. (a) (i) (I) Why do transition metals show variable oxidation states ? 1
- (II) Out of Mn^{2+} and Ti^{2+} which will be more paramagnetic and why ? [Atomic No. : Ti = 22, Mn = 25] 1
- (III) Which ion is the strongest oxidising agent in the options given below :
 Cr^{3+} , V^{3+} , Mn^{3+}
 Give reason. 1
 [Atomic No. : Cr = 24, V = 23, Mn = 25]
- (ii) Complete and balance the following equations : 1+1
- (I) $2\text{MnO}_2 + 4\text{KOH} + \text{O}_2 \longrightarrow$
- (II) $5\text{C}_2\text{O}_4^{2-} + 2\text{MnO}_4^- + 16\text{H}^+ \longrightarrow$

OR

- (b) (i) What is meant by lanthanoid contraction ?
- (ii) Why do transition metals form coloured compounds ?
- (iii) Why are $E_{\text{M}^{2+}/\text{M}}^0$ values for Mn and Zn more negative than expected ?
- (iv) Which is the most stable oxidation state of Cu and why ?
- (v) Why is Ce^{4+} in aqueous solution a good oxidising agent ? $5 \times 1 = 5$

33. (a) (i) (I) Which of the following is more reactive towards $\text{S}_{\text{N}}1$ reaction : 1
 2-Bromo-2-methylbutane or 1-Bromopentane
- (II) What type of halide is present in the following compound : 1



- (III) Why is chloroform stored in dark coloured bottles ? 1





(ii) Define the following terms :

1+1

(I) Ambident Nucleophiles

(II) Racemic mixture

OR

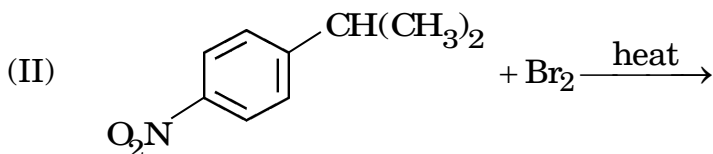
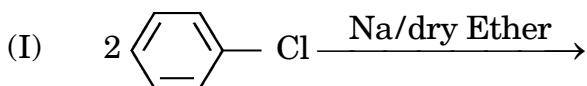
(b) (i) Answer the following :

(I) Which isomer of C_4H_9Br is most reactive towards S_N1 reaction ?

(II) Predict the alkene that would be formed by dehydrohalogenation of 1-Bromo-1-methylcyclohexane.

(III) Although chlorine shows strong $-I$ effect, yet it is ortho/para-directing in electrophilic aromatic substitution reactions. Why ?

(ii) Write the major product in the following reactions :



3+2

