



Series SQR1P/1



SET-1

प्रश्न-पत्र कोड
Q.P. Code

56/1/1

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

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

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

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

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

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का (V) 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

Please check that this question paper contains 27 printed pages.

Please check that this question paper contains 33 questions.

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 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.

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 calculators is **not** allowed.

SECTION A

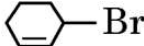
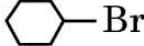
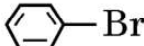
Questions no. **1** to **16** are Multiple Choice type Questions, carrying **1** mark each. $16 \times 1 = 16$

1. Which 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) $(\text{CH}_3)_2\text{CH} - \text{CH}_2\text{OH}$
 - (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
 - (C) $(\text{CH}_3)_3\text{C} - \text{OH}$
 - (D) $\text{CH}_3 - \text{CH}_2 - \underset{\text{OH}}{\underset{|}{\text{CH}}} - \text{CH}_3$



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 $X + 2Y \rightarrow P$, 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)  Br
- (B)  Br
- (C)  Br
- (D)  Br
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 $\frac{-E_a}{2.303 R}$ 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) $(\text{CH}_3)_3\text{C} - \text{OH} > (\text{CH}_3)_2\text{CH} - \text{OH} > \text{CH}_3\text{CH}_2 - \text{OH}$
(B) $(\text{CH}_3)_2\text{CH} - \text{OH} > \text{CH}_3\text{CH}_2 - \text{OH} > (\text{CH}_3)_3\text{C} - \text{OH}$
(C) $\text{CH}_3\text{CH}_2 - \text{OH} > (\text{CH}_3)_2\text{CH} - \text{OH} > (\text{CH}_3)_3\text{C} - \text{OH}$
(D) $(\text{CH}_3)_2\text{CH} - \text{OH} > (\text{CH}_3)_3\text{C} - \text{OH} > \text{CH}_3\text{CH}_2 - \text{OH}$
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.



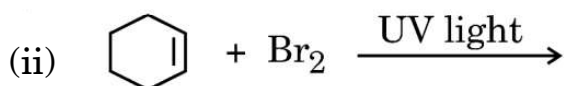
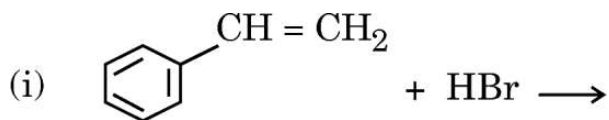
13. *Assertion (A)* : When NaCl is added to water a depression in freezing point is observed.
Reason (R) : NaCl undergoes dissociation in water.
14. *Assertion (A)* : Separation of Zr and Hf is difficult.
Reason (R) : Zr and Hf have similar radii due to lanthanoid contraction.
15. *Assertion (A)* : The 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.
($E^0_{Fe^{2+}/Fe} = -0.45$ 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



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

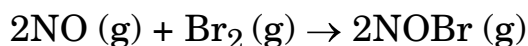
- (a) Butan-2-one is treated with Zn(Hg) and conc. HCl .
- (b) Two molecules of benzaldehyde are treated with conc. NaOH .

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 = $1.35 \times 10^{-2} \text{ ohm}^{-1}\text{cm}^{-1}$)



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



Expt. No.	[NO]/mol L ⁻¹	[Br ₂]/mol L ⁻¹	Initial Rate (mol L ⁻¹ s ⁻¹)
1	0.05	0.05	1.0×10^{-3}
2	0.05	0.15	3.0×10^{-3}
3	0.15	0.05	9.0×10^{-3}

- (a) What is the order with respect to NO and Br₂ in the reaction ?
(b) Calculate the rate constant (k).
(c) Determine the rate of reaction when concentration of NO and Br₂ are 0.4 M and 0.2 M, respectively. $1+1+1=3$

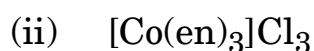
24. (a) Write the formula for the following coordination compound :

Potassium tetrahydroxidozincate (II)

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

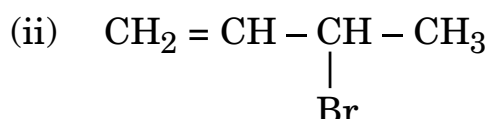


- (c) Identify the type of isomerism exhibited by the following complexes :



$$1+1+(\frac{1}{2}+\frac{1}{2})=3$$

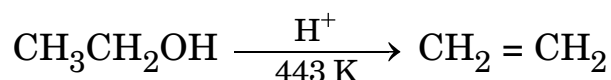
25. (a) Which of the following is an allylic halide ?



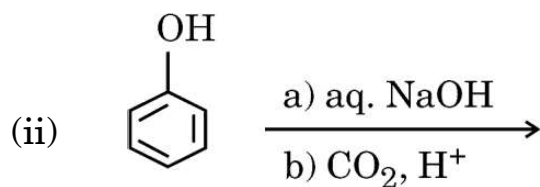
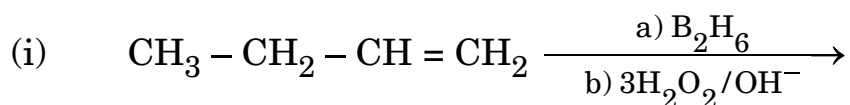


- (b) Out of chlorobenzene and 2,4,6-trinitrochlorobenzene, which is more reactive towards nucleophilic substitution and why ?
- (c) Which isomer of C_4H_9Cl has the lowest boiling point ? $3 \times 1 = 3$

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



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



$1 + 2 = 3$

27. Answer the following : (any **three**) $3 \times 1 = 3$

- (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 $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ on the basis of crystal field theory. 1
- (c) $[\text{Cr}(\text{NH}_3)_6]^{3+}$ is paramagnetic while $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic. Explain why. [Atomic No. : Cr = 24, Ni = 28] 2

OR

- (c) Explain why $[\text{Fe}(\text{CN})_6]^{3-}$ is an inner orbital complex, whereas $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ 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 $\text{H}_2\text{O} = 0.52 \text{ K kg mol}^{-1}$)

OR

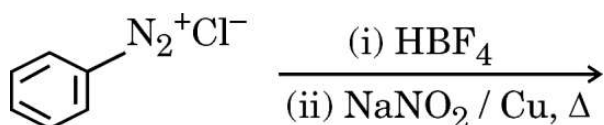
- (b) (i) The vapour pressures of A and B at 25°C are 75 mm Hg and 25 mm Hg, respectively. If A and B are mixed such that the mole fraction of A in the mixture is 0.4, then calculate the mole fraction of B in vapour phase.
- (ii) Define colligative property. Which colligative property is preferred for 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 : $5 \times 1 = 5$

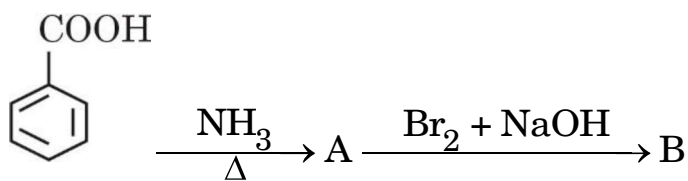
- (a) N,N-diethyl-benzenesulphonamide is insoluble in alkali. Give reason.
- (b) Aniline does not undergo Friedel-Crafts reaction. Why ?



- (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 :



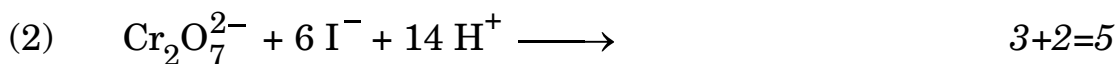
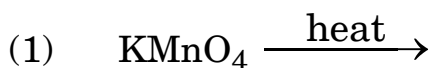
- (g) Write the structures of A and B in the following reaction :



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° value of Cu^{2+}/Cu is + 0.34 V.

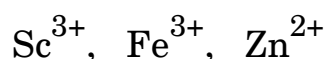
(ii) Complete and balance the following chemical equations :



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 ?



[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 ? $5 \times 1 = 5$

