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Your JEE Guide

MP Board Class XII · Chemistry

Sample Question Paper 6 · Session 2026-27

Time allowed: 3 hours **Maximum marks: 70**

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This is an original practice paper written to the MPBSE 2027 sample question paper pattern; it is not issued by MPBSE.

General instructions:

1. All questions are compulsory.
2. Questions 1 to 5 are objective questions (28 in all): choose the correct option, fill in the blanks, true/false, match the columns and answer in one word or sentence. Each sub-question carries 1 mark.
3. Questions 6 to 12 are very short answer questions of 2 marks each. Answer each in about 30 words.
4. Questions 13 to 16 are short answer questions of 3 marks each. Answer each in about 75 words.
5. Questions 17 to 20 are long answer questions of 4 marks each. Answer each in about 120 words.
6. Internal options are given in questions 13 to 20.
7. Draw neat and labelled diagrams wherever necessary.

1.	**(i)** *Choose the correct option and write it:* In a solution of a solid in benzene, the mole fraction of the solute is 0.2. The mole fraction of benzene is: (a) 0.2 (b) 1.2 (c) 0.8 (d) 0.5	1
	(ii) When aqueous $CuSO_4$ is electrolysed with copper electrodes: (a) oxygen is given off at the anode (b) copper dissolves at the anode and is deposited at the cathode (c) hydrogen is given off at the cathode (d) the concentration of Cu^{2+} falls steadily	1
	(iii) Radioactive decay follows the kinetics of a reaction of: (a) third order (b) second order (c) zero order (d) first order	1
	(iv) Which of the following is NOT a lanthanoid? (a) thorium (b) gadolinium (c) lutetium (d) cerium	1

	(v) Benzyl chloride reacts readily by the S_N1 mechanism because: (a) chlorine is strongly bonded to carbon (b) benzene is aliphatic (c) the benzyl carbocation is stabilised by resonance (d) it has no hydrogen atoms	1
	(vi) Ethanal is reduced to ethanol by: (a) $NaBH_4$ (b) $K_2Cr_2O_7$ (c) $KMnO_4$ (d) HNO_3	1
2.	**(i)** *Fill in the blanks:* A 10% (w/w) aqueous solution of glucose contains 10 g of glucose in _____ g of water.	1
	(ii) The relation between the standard Gibbs energy change and the standard emf of a cell is _____.	1
	(iii) The variation of the rate constant with temperature is given by the _____ equation.	1
	(iv) Copper(I) compounds are _____, because Cu^+ has the configuration $3d^{10}$.	1
	(v) Alcohols react with sodium metal to give off _____ gas.	1
	(vi) Starch consists of amylose and _____.	1
3.	**(i)** *Write True or False:* The molarity of a solution decreases slightly when its temperature rises.	1
	(ii) Galvanised iron is iron coated with tin.	1
	(iii) A catalyst is used up during a reaction.	1
	(iv) The actinoids show only the +3 oxidation state.	1
	(v) Ethoxyethane has a lower boiling point than butan-1-ol.	1
	(vi) Proteins are polymers of nucleotides.	1

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4. Match each reaction in column A with its type in column B: — 5

Column A	Column B
(i) $CH_3Br + OH^- \rightarrow CH_3OH + Br^-$	(a) elimination (dehydration)
(ii) $C_2H_5OH \rightarrow$ (conc. H_2SO_4, 443 K) $C_2H_4 + H_2O$	(b) aldol reaction
(iii) $CH_3CHO + HCN \rightarrow CH_3CH(OH)CN$	(c) electrophilic substitution
(iv) $C_6H_6 + HNO_3 \rightarrow$ (conc. H_2SO_4) $C_6H_5NO_2 + H_2O$	(d) nucleophilic substitution
(v) $2CH_3CHO \rightarrow$ (dil. NaOH) $CH_3CH(OH)CH_2CHO$	(e) nucleophilic addition

5. **(i)** *Answer in one word or one sentence:*
How does the solubility of a gas in a liquid change when the pressure of the gas is increased? — 1

(ii) Name the cell whose electrolyte is a moist paste of NH_4Cl and $ZnCl_2$. — 1

(iii) For which order of reaction is the half-life independent of the initial concentration? — 1

(iv) Write the IUPAC name of $[Ni(CN)_4]^{2-}$. — 1

(v) Which acid is present in the sting of an ant? — 1

6. Define the molal depression constant. Write its unit. — 2

7. How much electricity, in coulombs, is needed to reduce (a) 1 mol of Cu^{2+} to Cu, (b) 1 mol of Al^{3+} to Al? (F = 96500 C mol^{-1}) — 2

8. Write the units of the rate constant for zero-, first- and second-order reactions. — 2

9. Why are many transition metal ions paramagnetic? Which ion of the 3d series in its +2 or +3 state has the largest magnetic moment? — 2

10. Find the oxidation state and coordination number of the metal in $K_3[Co(C_2O_4)_3]$. — 2

11. Arrange CH_3Br, $(CH_3)_3CBr$, $(CH_3)_2CHBr$ and CH_3CH_2Br in decreasing order of reactivity by the S_N2 mechanism. Give a reason. — 2

12. Write the equations for the reactions of ethanol with (a) sodium, (b) ethanoic acid in the presence of concentrated H_2SO_4. — 2

13. 10 g of NaOH is dissolved in 90 g of water. Calculate (a) the mole fraction of NaOH, (b) the molality of the solution. (Na = 23, O = 16, H = 1) — 3

OR

What is a semipermeable membrane? Distinguish between isotonic, hypertonic and hypotonic solutions.

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14.	Draw graphs of molar conductivity against √c for a strong and a weak electrolyte, and explain their shapes. **OR** What are the products of electrolysis of aqueous $CuSO_4$ with (a) platinum electrodes, (b) copper electrodes? Write the anode reactions.	3
15.	Show that for a first-order reaction the time needed for 99.9% completion is about ten times its half-life. **OR** A reaction is second order in A. How does its rate change if [A] is (a) doubled, (b) halved? Write the unit of its rate constant.	3
16.	Write the formulae of: (a) hexaamminecobalt(III) sulphate, (b) potassium tetrachloridopalladate(II), (c) pentaamminenitrito-O-cobalt(III) chloride. **OR** The magnetic moment of $[MnBr_4]^{2-}$ is 5.9 BM. Predict the number of unpaired electrons, the hybridisation and the shape of the complex.	3
17.	Describe how the following vary across the 3d transition series and explain each: (a) oxidation states, (b) $E°(M^{2+}/M)$ values, (c) tendency to form complexes, (d) colour of compounds. **OR** Write the equations for the preparation of potassium permanganate from pyrolusite, and for its reaction with (a) Fe^{2+} ions, (b) iodide ions, in acid solution.	4
18.	Write equations for preparing haloalkanes (a) from propene by Markovnikov addition of HBr, (b) from propene by addition of HBr in the presence of a peroxide, (c) by the Finkelstein reaction, (d) by the Swarts reaction. **OR** Give reasons: (a) Haloalkanes are polar but only slightly soluble in water. (b) Haloalkanes readily undergo nucleophilic substitution. (c) Grignard reagents must be prepared in dry conditions. (d) Vinyl chloride is unreactive towards nucleophiles.	4
19.	Write one equation each for preparing aldehydes or ketones by: (a) oxidation of a secondary alcohol, (b) dehydrogenation of a primary alcohol, (c) ozonolysis of an alkene, (d) the Stephen reaction. **OR** Explain, with equations, (a) the Clemmensen reduction, (b) the Wolff–Kishner reduction, (c) the haloform reaction of propanone.	4

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20.	Explain why aniline is a weaker base than ethanamine. How do (a) a nitro group, (b) a methyl group at the para position affect the basicity of aniline? **OR** What are coupling reactions of diazonium salts? Give two examples. Why are arenediazonium salts more stable than alkyldiazonium salts?	4

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Answers and Marking Scheme

Marks for each step are shown in brackets. Any correct alternative method gets full credit.

Question 1

(i) **(c)** 0.8. *Working:* The mole fractions add up to 1.

(ii) **(b)** copper dissolves at the anode and is deposited at the cathode. *Working:* The copper anode is oxidised in preference to water.

(iii) **(d)** first order. *Working:* The rate is proportional to the number of nuclei present.

(iv) **(a)** thorium. *Working:* Thorium ($Z = 90$) is an actinoid.

(v) **(c)** the benzyl carbocation is stabilised by resonance. *Working:* The positive charge spreads over the ring.

(vi) **(a)** $NaBH_4$. *Working:* The others are oxidising agents.

Question 2

(i) 90.

(ii) $\Delta G^\circ = -nFE^\circ$.

(iii) Arrhenius.

(iv) colourless (white).

(v) hydrogen.

(vi) amylopectin.

Question 3

(i) True: the volume of the solution increases.

(ii) False: it is coated with zinc.

(iii) False: it is recovered unchanged at the end.

(iv) False: they show a range of oxidation states.

(v) True: ethers cannot form hydrogen bonds with one another.

(vi) False: they are polymers of α-amino acids.

4. (i) – (d) nucleophilic substitution; (ii) – (a) elimination (dehydration); (iii) – (e) nucleophilic addition; (iv) – (c) electrophilic substitution; (v) – (b) aldol reaction

Question 5

(i) It increases.

(ii) The dry (Leclanché) cell.

(iii) First order.

(iv) Tetracyanidonickelate(II) ion.

(v) Methanoic (formic) acid.

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6. The depression in freezing point produced when one mole of a non-volatile solute is dissolved in one kilogram of solvent ($K_f = \Delta T_f/m$) (1). Unit: K kg mol^{-1} (1).

7. (a) 2 F = 1.93×10^5 C (1). (b) 3 F = 2.895×10^5 C (1).

8. Zero order: mol L^{-1} s^{-1}; first order: s^{-1} (1). Second order: L mol^{-1} s^{-1} (1).

9. They have unpaired electrons in their d orbitals (1). Ions with the $3d^5$ configuration, such as Mn^{2+} and Fe^{3+}, with five unpaired electrons (5.92 BM) (1).

10. x + 3(–2) = –3, so x = +3 (1). Each oxalate is bidentate: coordination number 6 (1).

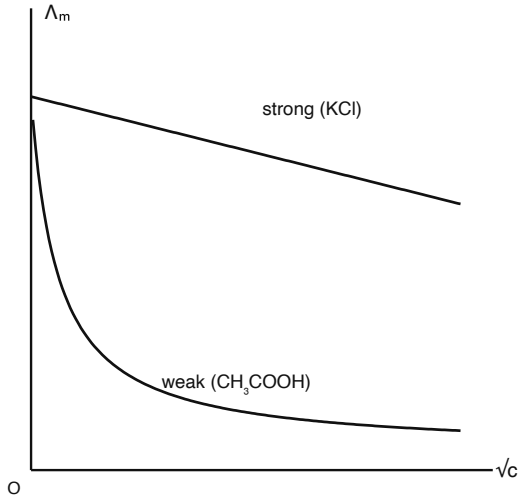
11. $CH_3Br > CH_3CH_2Br > (CH_3)_2CHBr > (CH_3)_3CBr$ (1). Bulky alkyl groups hinder the back-side attack of the nucleophile (1).

12. (a) $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$ (1). (b) $C_2H_5OH + CH_3COOH \rightleftharpoons CH_3COOC_2H_5 + H_2O$ (1).

13. Moles: NaOH 10/40 = 0.25, water 90/18 = 5.0 (1). (a) x(NaOH) = 0.25/5.25 ≈ 0.048 (1). (b) m = 0.25/0.090 ≈ 2.78 mol kg^{-1} (1).

OR A membrane that lets solvent molecules pass but not solute molecules (1). Isotonic solutions have the same osmotic pressure; a hypertonic solution has a higher, and a hypotonic solution a lower, osmotic pressure than the other solution (2).

14. Graphs (1):



For a strong electrolyte Λ_m falls slowly and linearly, because interionic attractions increase with concentration (1). For a weak electrolyte Λ_m falls steeply at low concentration, because its degree of ionisation falls sharply (1).

OR Cathode in both cases: $Cu^{2+} + 2e^- \rightarrow Cu$ (1). (a) Anode: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$; oxygen is given off (1). (b) Anode: $Cu \rightarrow Cu^{2+} + 2e^-$; the anode dissolves (1).

15. $t_{99.9} = \frac{2.303}{k} \log \frac{100}{0.1} = \frac{2.303 \times 3}{k}$ (1). $t_{1/2} = \frac{0.693}{k}$ (1). Ratio = 6.909/0.693 ≈ 10 (1).

OR (a) 2^2 = 4 times (1). (b) $(½)^2$ = one-quarter (1). L mol^{-1} s^{-1} (1).

16. (a) $[Co(NH_3)_6]_2(SO_4)_3$ (1). (b) $K_2[PdCl_4]$ (1). (c) $[Co(NH_3)_5(ONO)]Cl_2$ (1).

OR $\sqrt{(n(n+2))} = 5.9$ gives n = 5 (1). Mn^{2+} ($3d^5$) with the weak ligand Br^- keeps its five unpaired electrons, using 4s and 4p orbitals: sp^3 (1). Tetrahedral (1).

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17. (a) The number of oxidation states rises to a maximum at manganese (+2 to +7) and then falls, as d electrons pair up (1). (b) E° becomes generally less negative across the series, with irregularities (e.g. Mn, Ni, Zn) due to the stability of half-filled and filled d subshells; Cu alone is positive (1). (c) Small, highly charged ions with vacant d orbitals form many complexes (1). (d) Ions with partly filled d orbitals are coloured from d–d transitions; d^0 and d^{10} ions are colourless (1).

OR $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$; $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$ (2). (a) $MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$ (1). (b) $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$ (1).

18. (a) $CH_3CH{=}CH_2 + HBr \rightarrow CH_3CHBrCH_3$ (1). (b) $CH_3CH{=}CH_2 + HBr \rightarrow$ (peroxide) $CH_3CH_2CH_2Br$ (1). (c) $CH_3CH_2Br + NaI \rightarrow$ (dry acetone) $CH_3CH_2I + NaBr$ (1). (d) $CH_3Br + AgF \rightarrow CH_3F + AgBr$ (1).

OR (a) Less energy is released in forming new attractions with water than is needed to break hydrogen bonds in water (1). (b) The C–X bond is polar, so the carbon is electron-deficient and attracts nucleophiles (1). (c) They react with water to give alkanes (1). (d) Resonance gives the C–Cl bond partial double-bond character (1).

19. (a) $(CH_3)_2CHOH + [O] \rightarrow (K_2Cr_2O_7/H^+)\ CH_3COCH_3 + H_2O$ (1). (b) $CH_3CH_2OH \rightarrow$ (Cu, 573 K) $CH_3CHO + H_2$ (1). (c) $CH_3CH{=}CHCH_3 \rightarrow (O_3$, then $Zn/H_2O)\ 2CH_3CHO$ (1). (d) $CH_3CN + SnCl_2/HCl \rightarrow CH_3CH{=}NH \rightarrow (H_3O^+)\ CH_3CHO$ (1).

OR (a) $R_2C{=}O + 4[H] \rightarrow$ (Zn–Hg/conc. HCl) $R_2CH_2 + H_2O$ (1½). (b) $R_2C{=}O + NH_2NH_2 \rightarrow R_2C{=}NNH_2 \rightarrow$ (KOH/ethylene glycol, heat) $R_2CH_2 + N_2$ (1½). (c) $CH_3COCH_3 + 3I_2 + 4NaOH \rightarrow CH_3COONa + CHI_3 + 3NaI + 3H_2O$ (1).

20. In aniline the lone pair on nitrogen is delocalised into the ring by resonance and is less available for a proton; in ethanamine the ethyl group pushes electrons to nitrogen (2). (a) $–NO_2$ withdraws electrons, so p-nitroaniline is much weaker (1). (b) $–CH_3$ releases electrons, so p-toluidine is slightly stronger (1).

OR Reactions in which diazonium salts combine with phenols or aromatic amines to form azo compounds (–N=N–), which are coloured dyes (1). With phenol in alkali: p-hydroxyazobenzene (orange) (1). With aniline: p-aminoazobenzene (yellow) (1). The positive charge of the arenediazonium ion is spread over the ring by resonance (1).

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