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Your JEE Guide

MP Board Class XII · Chemistry

Sample Question Paper 1 · 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:* The unit of molar conductivity is: (a) Ω cm (b) mol L^{-1} (c) S cm^{-1} (d) S cm^2 mol^{-1}	1
	(ii) Which of the following 0.1 m aqueous solutions has the highest freezing point? (a) glucose (b) $AlCl_3$ (c) $CaCl_2$ (d) NaCl	1
	(iii) The oxidation state of manganese in $KMnO_4$ is: (a) +6 (b) +4 (c) +7 (d) +2	1
	(iv) Which of the following is a bidentate ligand? (a) Cl^- (b) ethane-1,2-diamine (c) NH_3 (d) H_2O	1
	(v) Phenol reacts with bromine water to give: (a) bromobenzene (b) p-bromophenol only (c) 2,4,6-tribromophenol (d) o-bromophenol only	1

	(vi) Glucose is an: (a) aldopentose (b) aldohexose (c) ketopentose (d) ketohexose	1
2.	**(i)** *Fill in the blanks:* A solution showing large positive deviation from Raoult's law forms a _____-boiling azeotrope.	1
	(ii) The time in which half of a reactant is used up is called the _____ of the reaction.	1
	(iii) The general outer electronic configuration of the d-block elements is _____.	1
	(iv) The IUPAC name of $CHCl_3$ is _____.	1
	(v) The functional group of aldehydes is _____.	1
	(vi) The sugar present in DNA is _____.	1
3.	**(i)** *Write True or False:* The molality of a solution changes with temperature.	1
	(ii) Zinc, cadmium and mercury are regarded as typical transition elements.	1
	(iii) The rate of most reactions increases with temperature.	1
	(iv) Phenol is more acidic than ethanol.	1
	(v) Tertiary amines react with Hinsberg's reagent.	1
	(vi) Sucrose is a reducing sugar.	1
4.	Match each named reaction in column A with its reactants in column B:	5

Column A	Column B
(i) Cannizzaro reaction	(a) sodium phenoxide and CO_2, then acid
(ii) Kolbe's reaction	(b) phenol, chloroform and NaOH
(iii) Reimer–Tiemann reaction	(c) a primary amine, chloroform and alcoholic KOH
(iv) Carbylamine reaction	(d) benzaldehyde and concentrated NaOH
(v) Clemmensen reduction	(e) a ketone with zinc amalgam and concentrated HCl

5.	**(i)** *Answer in one word or one sentence:* Name the cell commonly used in hearing aids and watches.	1
	(ii) Write the formula of tetraamminecopper(II) sulphate.	1

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	(iii) Name the polyhalogen compound once used as an anaesthetic.	1
	(iv) Name a reagent that oxidises ethanol to ethanal without forming ethanoic acid.	1
	(v) Name the base present in DNA but not in RNA.	1
6.	State Raoult's law for a solution of two volatile liquids and write its mathematical form.	2
7.	Calculate the standard emf of the cell Cu | Cu^{2+}(1 M) || Ag^{+}(1 M) | Ag. Which electrode is the cathode? ($E^\circ(Cu^{2+}/Cu)$ = +0.34 V, $E^\circ(Ag^{+}/Ag)$ = +0.80 V)	2
8.	Define the order of a reaction. Give one example of a zero-order reaction.	2
9.	What is lanthanoid contraction? What causes it?	2
10.	Write the IUPAC name of $[Ni(CO)_4]$, and state the hybridisation of nickel and the shape of the complex.	2
11.	How is phenol obtained from cumene? Write the equations.	2
12.	What are vitamins? Classify them on the basis of solubility, with one example of each class.	2
13.	5.0 g of urea (molar mass 60 g mol^{-1}) is dissolved in 250 g of water. Calculate the boiling point of the solution. (K_b for water = 0.52 K kg mol^{-1}, boiling point of water = 373.15 K) **OR** Define osmotic pressure. Calculate the osmotic pressure of a 0.20 M glucose solution at 300 K. (R = 0.0821 L atm K^{-1} mol^{-1})	3
14.	State Faraday's first law of electrolysis. Calculate the mass of silver deposited when a current of 0.50 A is passed through silver nitrate solution for 30 minutes. (Ag = 108, F = 96500 C mol^{-1}) **OR** State Kohlrausch's law of independent migration of ions. How is it used to find the limiting molar conductivity of a weak electrolyte such as acetic acid?	3
15.	Derive the integrated rate equation for a first-order reaction. **OR** The rate constant of a first-order reaction is 6.93×10^{-3} s^{-1}. Calculate its half-life and the time for 75% of the reaction to be completed.	3
16.	State three differences between the lanthanoids and the actinoids. **OR** Write the electronic configurations of Cr^{3+}, Mn^{2+} and Fe^{3+} and the number of unpaired electrons in each. (Atomic numbers: Cr 24, Mn 25, Fe 26)	3

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17.	State the main postulates of Werner's theory of coordination compounds. Using valence bond theory, explain the hybridisation and magnetic behaviour of $[Co(NH_3)_6]^{3+}$. **OR** Explain with one example each: (a) geometrical isomerism, (b) optical isomerism, (c) linkage isomerism, (d) ionisation isomerism in coordination compounds.	4
18.	Explain the S_N1 and S_N2 mechanisms of nucleophilic substitution in haloalkanes, giving one example of each and its stereochemical result. **OR** Describe three methods of preparing haloalkanes from alcohols. Why is thionyl chloride preferred?	4
19.	Write the equations for: (a) the Williamson synthesis of ethoxyethane, (b) Kolbe's reaction, (c) the Reimer–Tiemann reaction. (d) Why is phenol more acidic than ethanol? **OR** Explain, with equations: (a) aldol condensation, (b) the Cannizzaro reaction, (c) addition of HCN to ethanal, (d) Tollens' test.	4
20.	Write the equations for: (a) the Hoffmann bromamide degradation, (b) the Gabriel phthalimide synthesis, (c) the diazotisation of aniline. (d) Why are amines basic? **OR** Give two pieces of evidence for the open-chain structure of glucose and two that it cannot be explained by it. What are anomers?	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) **(d)** S cm² mol⁻¹. *Working:* $\Lambda_m = \kappa/c$.

(ii) **(a)** glucose. *Working:* Glucose does not ionise (i = 1), so its depression is the smallest.

(iii) **(c)** +7. *Working:* 1 + x − 8 = 0.

(iv) **(b)** ethane-1,2-diamine. *Working:* It binds through both nitrogen atoms.

(v) **(c)** 2,4,6-tribromophenol. *Working:* The –OH group strongly activates the ring, so all three ortho and para positions are substituted.

(vi) **(b)** aldohexose. *Working:* It has six carbons and an aldehyde group.

Question 2

(i) minimum.

(ii) half-life.

(iii) $(n-1)d^{1\text{-}10}\,ns^{1\text{-}2}$.

(iv) trichloromethane.

(v) –CHO.

(vi) 2-deoxyribose (β-D-2-deoxyribose).

Question 3

(i) False: it depends only on masses.

(ii) False: they have completely filled d orbitals.

(iii) True.

(iv) True: the phenoxide ion is stabilised by resonance.

(v) False: they have no hydrogen on nitrogen.

(vi) False.

4. (i) – (d) benzaldehyde and concentrated NaOH; (ii) – (a) sodium phenoxide and CO_2, then acid; (iii) – (b) phenol, chloroform and NaOH; (iv) – (c) a primary amine, chloroform and alcoholic KOH; (v) – (e) a ketone with zinc amalgam and concentrated HCl

Question 5

(i) The mercury cell.

(ii) $[Cu(NH_3)_4]SO_4$.

(iii) Chloroform ($CHCl_3$).

(iv) Pyridinium chlorochromate (PCC).

(v) Thymine.

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6. The partial vapour pressure of each component is directly proportional to its mole fraction in the solution (1). $p_A = p°_A x_A$, $p_B = p°_B x_B$, and $P = p_A + p_B$ (1).

7. $E° = E°_{cathode} - E°_{anode} = 0.80 - 0.34 = 0.46$ V (1). The silver electrode, where reduction occurs (1).

8. The sum of the powers of the concentration terms in the rate law (1). E.g. the decomposition of ammonia on a hot platinum surface at high pressure (1).

9. The steady decrease in the atomic and ionic radii of the lanthanoids with increasing atomic number (1). The 4f electrons shield the outer electrons poorly from the increasing nuclear charge (1).

10. Tetracarbonylnickel(0) (1). sp^3, tetrahedral (1).

11. Cumene is oxidised by air to cumene hydroperoxide, $C_6H_5C(CH_3)_2OOH$ (1). This is treated with dilute acid to give phenol and acetone (1).

12. Organic compounds needed in small amounts in the diet for growth and health (1). Fat-soluble, e.g. vitamin A; water-soluble, e.g. vitamin C (1).

13. Molality = (5.0/60)/0.250 = 0.333 mol kg^{-1} (1). $\Delta T_b = 0.52 \times 0.333 = 0.173$ K (1). Boiling point = 373.32 K (1).

OR The extra pressure that must be applied to a solution to stop the flow of solvent into it through a semipermeable membrane (1). $\pi = CRT$ (1) $= 0.20 \times 0.0821 \times 300 = 4.93$ atm (1).

14. The mass of a substance deposited at an electrode is proportional to the quantity of electricity passed (1). $Q = 0.50 \times 1800 = 900$ C (1). Mass $= 108 \times 900/96500 \approx 1.01$ g (1).

OR At infinite dilution, the molar conductivity of an electrolyte is the sum of the limiting molar conductivities of its cation and anion (1½). $\Lambda°(CH_3COOH) = \Lambda°(CH_3COONa) + \Lambda°(HCl) - \Lambda°(NaCl)$, all of which can be measured for strong electrolytes (1½).

15. For $R \rightarrow P$, $-d[R]/dt = k[R]$, so $d[R]/[R] = -k\,dt$ (1). Integrating, $\ln[R] = -kt + I$; at $t = 0$, $I = \ln[R]_0$ (1). $\ln([R]_0/[R]) = kt$, i.e. $k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$ (1).

OR $t_{½} = 0.693/k = 100$ s (1½). 75% completion is two half-lives = 200 s (1½).

16. Lanthanoids fill 4f orbitals, actinoids 5f (1). Actinoids show a wider range of oxidation states; lanthanoids mainly +3 (1). Actinoids are all radioactive and have a greater tendency to form complexes; most lanthanoids are not radioactive (1).

OR Cr^{3+}: $[Ar]3d^3$, three unpaired electrons (1). Mn^{2+}: $[Ar]3d^5$, five (1). Fe^{3+}: $[Ar]3d^5$, five (1).

17. Metals show primary valency (ionisable, satisfied by anions) and secondary valency (non-ionisable, satisfied by ligands, equal to the coordination number); the secondary valencies are directed in space, giving definite shapes (2). Co^{3+} is $3d^6$; NH_3 pairs the electrons, leaving two empty 3d orbitals for d^2sp^3 hybridisation: octahedral, inner-orbital and diamagnetic (2).

OR (a) Different arrangements of ligands in space, e.g. cis and trans $[Pt(NH_3)_2Cl_2]$ (1). (b) Non-superimposable mirror images, e.g. $[Co(en)_3]^{3+}$ (1). (c) An ambidentate ligand binding through different atoms, e.g. $-NO_2$ and $-ONO$ in $[Co(NH_3)_5(NO_2)]Cl_2$ (1). (d) Exchange of an ion between the coordination sphere and outside, e.g. $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$ (1).

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18. S_N2: a one-step reaction in which the nucleophile attacks from the side opposite the leaving group; rate = k[RX][Nu^-], e.g. $CH_3Cl + OH^- \rightarrow CH_3OH + Cl^-$ (1). The configuration is inverted (1). S_N1: the C–X bond breaks first to form a carbocation (slow step), which the nucleophile then attacks; rate = k[RX], e.g. $(CH_3)_3CBr$ with water (1). The planar carbocation is attacked from both sides, giving racemisation (1).

OR With hydrogen halides: $ROH + HCl \rightarrow (ZnCl_2)\ RCl + H_2O$ (1). With phosphorus halides: $3ROH + PCl_3 \rightarrow 3RCl + H_3PO_3$, or $ROH + PCl_5 \rightarrow RCl + POCl_3 + HCl$ (1). With thionyl chloride: $ROH + SOCl_2 \rightarrow RCl + SO_2 + HCl$ (1). With $SOCl_2$ the by-products are gases that escape, leaving a pure product (1).

19. (a) $C_2H_5ONa + C_2H_5Br \rightarrow C_2H_5OC_2H_5 + NaBr$ (1). (b) $C_6H_5ONa + CO_2 \rightarrow$ (400 K, 4–7 atm) sodium salicylate $\rightarrow$ (H^+) salicylic acid (1). (c) $C_6H_5OH + CHCl_3$ + aq NaOH $\rightarrow$ (then H^+) salicylaldehyde (1). (d) The phenoxide ion is stabilised by resonance, the charge spreading over the ring; the ethoxide ion is not (1).

OR (a) $2CH_3CHO \rightarrow$ (dil. NaOH) $CH_3CH(OH)CH_2CHO$ (1). (b) $2HCHO$ + conc. NaOH $\rightarrow CH_3OH + HCOONa$ (1). (c) $CH_3CHO + HCN \rightarrow CH_3CH(OH)CN$ (1). (d) $RCHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow RCOO^- + 2Ag$ (silver mirror) $+ 4NH_3 + 2H_2O$ (1).

20. (a) $RCONH_2 + Br_2 + 4NaOH \rightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O$ (1). (b) Phthalimide + KOH $\rightarrow$ potassium phthalimide; + RX $\rightarrow$ N-alkylphthalimide; + NaOH (aq) $\rightarrow RNH_2$ + sodium phthalate (1). (c) $C_6H_5NH_2 + NaNO_2 + 2HCl \rightarrow$ (273–278 K) $C_6H_5N_2^+Cl^- + NaCl + 2H_2O$ (1). (d) The nitrogen atom has a lone pair that can accept a proton (1).

OR With HI it gives n-hexane (straight chain); with bromine water it gives gluconic acid (aldehyde group) (1½). It does not give the 2,4-DNP test or Schiff's test, and its pentaacetate does not react with hydroxylamine (1½). Anomers are cyclic forms differing only in the configuration at C1, e.g. α- and β-D-glucose (1).

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