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Your JEE Guide

MP Board Class XII · Chemistry

Sample Question Paper 3 · 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:* Which of the following ways of expressing concentration does not change with temperature? (a) molarity (b) mass by volume percentage (c) molality (d) normality	1
	(ii) At infinite dilution, which of these has the highest molar conductivity? (a) NaCl (b) CH_3COONa (c) KCl (d) HCl	1
	(iii) The rate-determining step of a reaction is its: (a) last step (b) slowest step (c) first step (d) fastest step	1
	(iv) Which 3d element shows the largest number of oxidation states? (a) manganese (b) zinc (c) scandium (d) copper	1
	(v) The IUPAC name of $CH_3CH(Cl)CH_3$ is: (a) 2-chloropropane (b) isopropyl chloride (c) 1-chloropropane (d) 2-chloropentane	1

	(vi) A primary alcohol is oxidised to a carboxylic acid by: (a) $LiAlH_4$ (b) acidified $KMnO_4$ (c) PCC (d) Cu at 573 K	1
2.	**(i)** *Fill in the blanks:* A liquid mixture that boils at a constant temperature without change in composition is called an _____.	1
	(ii) A cell in which chemical energy is converted into electrical energy is called a _____ cell.	1
	(iii) In the Arrhenius equation $k = Ae^{-Ea/RT}$, A is called the _____ factor.	1
	(iv) The colour of potassium permanganate is _____.	1
	(v) Heating an alkyl halide with alcoholic KOH gives an _____.	1
	(vi) In aqueous solution, amino acids exist as dipolar ions called _____.	1
3.	**(i)** *Write True or False:* A 1 M and a 1 m aqueous solution of the same substance always have exactly the same concentration.	1
	(ii) The standard electrode potential of the standard hydrogen electrode is taken as 0.00 V.	1
	(iii) A catalyst changes the equilibrium constant of a reaction.	1
	(iv) Cerium can show the +4 oxidation state.	1
	(v) Ethanol is a stronger acid than water.	1
	(vi) Primary amines have higher boiling points than tertiary amines of similar molecular mass.	1
4.	Match each compound in column A with its use in column B:	5

Column A	Column B
(i) Iodoform	(a) refrigerant
(ii) Freon (CFC)	(b) insecticide
(iii) DDT	(c) solvent for fats and oils
(iv) Formalin	(d) antiseptic
(v) Chloroform	(e) preserving biological specimens

5.	**(i)** *Answer in one word or one sentence:* What happens to the boiling point of water when common salt is dissolved in it?	1
	(ii) Name the gas given off at the cathode when dilute sulphuric acid is electrolysed with platinum electrodes.	1

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	(iii) Name the enzyme in saliva that hydrolyses starch.	1
	(iv) What is the coordination number of platinum in $[Pt(NH_3)_2Cl_2]$?	1
	(v) Write the IUPAC name of acetone.	1
6.	What is the van't Hoff factor? What is its approximate value for KCl in water and for ethanoic acid in benzene?	2
7.	What is the electrochemical series? Give two of its uses.	2
8.	The rate law of a reaction is rate = $k[A]^{1/2}[B]$. What is its overall order? How does the rate change if [A] becomes four times?	2
9.	Write two uses of lanthanoids or their compounds.	2
10.	What is a ligand? Classify ligands by the number of donor atoms, with one example of each type.	2
11.	What is a racemic mixture? Why is it optically inactive?	2
12.	Give a chemical test to distinguish ethanal from ethanoic acid.	2
13.	State Henry's law. The Henry's law constant for oxygen in water at 298 K is 4.6×10^9 Pa. Find the mole fraction of oxygen dissolved in water when its partial pressure is 2.0×10^4 Pa. Give one application of the law. **OR** What is reverse osmosis? Explain how it is used to obtain drinking water from sea water.	3
14.	For the Daniell cell, $E°_{cell} = 1.10$ V. Calculate $\Delta G°$ for the cell reaction and its equilibrium constant at 298 K. ($F = 96500$ C mol^{-1}) **OR** State three differences between a galvanic cell and an electrolytic cell.	3
15.	What is a pseudo first-order reaction? Give an example. Derive the expression for the half-life of a zero-order reaction. **OR** Sketch the graphs of [R] against time for a zero-order reaction and of log[R] against time for a first-order reaction. What do the slopes give?	3
16.	Describe the structure of the permanganate ion, and write ionic equations for the oxidation of (a) oxalate ions, (b) hydrogen sulphide by acidified permanganate. **OR** How does the magnetic moment of a transition metal ion help find the number of unpaired electrons? The magnetic moment of a divalent ion of iron ($Z = 26$) is 4.90 BM. How many unpaired electrons does it have?	3

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17.	Using crystal field theory, write the configurations of a d^4 ion in an octahedral field when $\Delta_0 < P$ and when $\Delta_0 > P$. What is the spectrochemical series? Why are most transition metal complexes coloured? **OR** Describe four applications of coordination compounds, one each from analytical chemistry, metallurgy, biology and medicine.	4
18.	Write the products formed when bromoethane reacts with (a) KCN, (b) AgCN, (c) KNO_2, (d) $AgNO_2$. Why do KCN and AgCN give different products? **OR** Explain chirality, enantiomers and racemisation, with an example of a chiral haloalkane. What is meant by retention and inversion of configuration?	4
19.	How can primary, secondary and tertiary alcohols be distinguished by (a) the Lucas test, (b) the products of their oxidation? Write equations for the oxidation of ethanol and propan-2-ol. **OR** Explain the mechanism of nucleophilic addition to the carbonyl group. Arrange methanal, ethanal and propanone in order of reactivity and explain.	4
20.	What does glucose give with (a) HI on prolonged heating, (b) bromine water, (c) nitric acid, (d) acetic anhydride? What does each show about its structure? **OR** Write the equations for replacing the diazonium group of benzenediazonium chloride by (a) –Cl, (b) –I, (c) –F, (d) –H.	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)** molality. *Working:* Molality uses only masses; the others use volume, which changes with temperature.

(ii) **(d)** HCl. *Working:* H^+ ions move very fast through water.

(iii) **(b)** slowest step. *Working:* The overall rate cannot exceed that of the slowest step.

(iv) **(a)** manganese. *Working:* Mn shows states from +2 to +7.

(v) **(a)** 2-chloropropane. *Working:* Three-carbon chain with Cl on C2; “isopropyl chloride” is the common name.

(vi) **(b)** acidified $KMnO_4$. *Working:* PCC and hot copper stop at the aldehyde; $LiAlH_4$ is a reducing agent.

Question 2

(i) azeotrope.

(ii) galvanic (voltaic).

(iii) frequency (pre-exponential).

(iv) purple (deep violet).

(v) alkene.

(vi) zwitterions.

Question 3

(i) False: molarity uses the volume of solution, molality the mass of solvent.

(ii) True.

(iii) False.

(iv) True.

(v) False: the ethyl group pushes electrons to oxygen, making it slightly weaker.

(vi) True: they form intermolecular hydrogen bonds.

4. (i) – (d) antiseptic; (ii) – (a) refrigerant; (iii) – (b) insecticide; (iv) – (e) preserving biological specimens; (v) – (c) solvent for fats and oils

Question 5

(i) It rises.

(ii) Hydrogen.

(iii) Salivary amylase (ptyalin).

(iv) 4.

(v) Propanone.

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6. The ratio of the observed colligative property to the value calculated assuming no dissociation or association (1). KCl: about 2 (dissociation); ethanoic acid in benzene: about 0.5 (dimerisation) (1).

7. The arrangement of electrodes in order of their standard reduction potentials (1). It shows which metals are stronger reducing agents, whether a metal can displace another from solution or hydrogen from acids, and gives the emf of cells (any two) (1).

8. Overall order = 1/2 + 1 = 3/2 (1). Rate becomes $4^{1/2} = 2$ times (1).

9. Mischmetall (with Mg) in bullets, shells and lighter flints (1). Mixed lanthanoid oxides as catalysts in petroleum cracking, or as phosphors in display screens (1).

10. An ion or molecule that donates a lone pair to the central metal in a complex (1). Unidentate, e.g. NH_3 or Cl^-; bidentate, e.g. ethane-1,2-diamine or oxalate; polydentate, e.g. $EDTA^{4-}$ (1).

11. An equimolar mixture of the two enantiomers of a compound (1). The rotation caused by one enantiomer is cancelled by the equal and opposite rotation of the other (1).

12. Sodium hydrogencarbonate: ethanoic acid gives brisk effervescence of CO_2, ethanal does not (1). Or Tollens' reagent: ethanal gives a silver mirror, ethanoic acid does not (1).

13. The partial pressure of a gas over a solution is proportional to its mole fraction in the solution, $p = K_H x$ (1). $x = 2.0 \times 10^4 / 4.6 \times 10^9 \approx 4.3 \times 10^{-6}$ (1). Any one: soft drinks are bottled under high CO_2 pressure; scuba divers' "bends"; low oxygen in the blood at high altitudes (1).

OR If a pressure larger than the osmotic pressure is applied to a solution, solvent flows out of it through a semipermeable membrane: reverse osmosis (1½). Sea water under high pressure is passed against a membrane (such as cellulose acetate), which lets water through but holds back the salts (1½).

14. $\Delta G^\circ = -nFE^\circ = -2 \times 96500 \times 1.10 = -2.12 \times 10^5$ J mol^{-1} (1½). $\log K = nE^\circ/0.059 = 2 \times 1.10/0.059 \approx 37.3$, $K \approx 2 \times 10^{37}$ (1½).

OR A galvanic cell turns chemical energy into electrical energy; an electrolytic cell does the reverse (1). The reaction in a galvanic cell is spontaneous; in an electrolytic cell it is driven by an external source (1). In a galvanic cell the anode is negative; in an electrolytic cell the anode is positive (1).

15. A reaction of higher order that behaves as first order because one reactant is in large excess, e.g. acid hydrolysis of ethyl ethanoate (or inversion of cane sugar) (1½). For zero order, $[R] = [R]_0 - kt$; at $t_{½}$, $[R]_0/2 = [R]_0 - kt_{½}$, so $t_{½} = [R]_0/2k$ (1½).

OR Zero order: a straight line falling from $[R]_0$, slope = $-k$ (1½). First order: log[R] against t is a straight line with slope = $-k/2.303$ (1½).

16. Mn is at the centre of a tetrahedron of four oxygen atoms (1). (a) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$ (1). (b) $2MnO_4^- + 5H_2S + 6H^+ \rightarrow 2Mn^{2+} + 5S + 8H_2O$ (1).

OR The spin-only formula is $\mu = \sqrt{(n(n+2))}$ BM, where n is the number of unpaired electrons, so measuring μ gives n (1½). $\sqrt{(n(n+2))} = 4.90$ gives n = 4, as expected for Fe^{2+}, $3d^6$ (1½).

17. $\Delta_0 < P$ (weak field): $t_2g^3e_g^1$, high spin (1). $\Delta_0 > P$ (strong field): $t_2g^4e_g^0$, low spin (1). The series of ligands in increasing order of field strength, e.g. $I^- < Cl^- < F^- < H_2O < NH_3 < en < CN^- < CO$ (1).

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An electron absorbs visible light to move from t_2g to e_g, and the complementary colour is seen (1).

OR Analysis: EDTA is used to estimate Ca^{2+} and Mg^{2+} (hardness of water), or dimethylglyoxime to detect Ni^{2+} (1). Metallurgy: gold and silver are extracted as cyanide complexes (1). Biology: chlorophyll (Mg), haemoglobin (Fe) and vitamin B_{12} (Co) are complexes (1). Medicine: cisplatin is used against cancer (1).

18. (a) Propanenitrile, CH_3CH_2CN (½). (b) Ethyl isocyanide, CH_3CH_2NC (½). (c) Ethyl nitrite, CH_3CH_2ONO (½). (d) Nitroethane, $CH_3CH_2NO_2$ (½). Cyanide is ambident: KCN is ionic, so the more nucleophilic carbon attacks; AgCN is largely covalent, so the lone pair on nitrogen attacks (2).

OR A molecule whose mirror image cannot be superimposed on it is chiral; a carbon with four different groups is a stereocentre, e.g. 2-chlorobutane (1). The two mirror-image forms are enantiomers, which rotate plane-polarised light equally in opposite directions (1). Converting one enantiomer into an equal mixture of both is racemisation (1). Retention: the product has the same spatial arrangement as the reactant; inversion: the opposite arrangement, as in S_N2 (1).

19. (a) With conc. HCl and $ZnCl_2$, tertiary alcohols give turbidity at once, secondary in about five minutes and primary only on heating (2). (b) Primary alcohols give aldehydes, then acids: $CH_3CH_2OH \rightarrow CH_3CHO \rightarrow CH_3COOH$ (1); secondary alcohols give ketones: $(CH_3)_2CHOH \rightarrow CH_3COCH_3$; tertiary alcohols resist oxidation (1).

OR The nucleophile attacks the electrophilic carbonyl carbon from above or below the plane, forming a tetrahedral alkoxide intermediate (1). This takes a proton to give the product (1). Reactivity: methanal > ethanal > propanone (1). Alkyl groups release electrons and crowd the carbonyl carbon (1).

20. (a) n-Hexane: a straight chain of six carbons (1). (b) Gluconic acid: an aldehyde group (1). (c) Saccharic acid: a primary alcohol group in addition to the aldehyde (1). (d) Glucose pentaacetate: five –OH groups (1).

OR (a) With CuCl/HCl (Sandmeyer): $C_6H_5Cl + N_2$ (1). (b) With KI: $C_6H_5I + N_2 + KCl$ (1). (c) With HBF_4, then heat (Balz–Schiemann): $C_6H_5F + BF_3 + N_2$ (1). (d) With H_3PO_2 and water: $C_6H_6 + N_2$ (1).

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