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Your JEE Guide

MP Board Class XII · Chemistry

Sample Question Paper 7 · 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 is a solid solution? (a) soda water (b) brass (c) fog (d) sugar dissolved in water	1
	(ii) Which of these metals is the strongest reducing agent? (a) magnesium (b) copper (c) zinc (d) lithium	1
	(iii) The activation energy of a reaction can be found by: (a) measuring its rate constant at two temperatures (b) finding its order (c) measuring its rate at one concentration (d) measuring ΔH	1
	(iv) Which of the following ions is the strongest oxidising agent in aqueous solution? (a) Fe^{3+} (b) Ti^{3+} (c) Mn^{3+} (d) Cr^{3+}	1

	(v) Which of these halomethanes has the highest boiling point? (a) CH_3Cl (b) CH_3I (c) CH_3F (d) CH_3Br	1
	(vi) Which of the following is the weakest acid? (a) CH_3COOH (b) $ClCH_2COOH$ (c) $Cl_2CHCOOH$ (d) FCH_2COOH	1
2.	**(i)** *Fill in the blanks:* Two solutions with the same osmotic pressure at a given temperature are called _____ solutions.	1
	(ii) The reciprocal of resistance is called _____.	1
	(iii) The rate of a zero-order reaction is _____ of the concentration of the reactant.	1
	(iv) Most 3d metals show the _____ oxidation state by losing their two 4s electrons.	1
	(v) Phenol is also called _____ acid.	1
	(vi) The –CO–NH– link that joins two amino acids is called a _____ bond.	1
3.	**(i)** *Write True or False:* Ideal solutions obey Raoult's law at all concentrations.	1
	(ii) The unit of molar conductivity is S cm^{-1}.	1
	(iii) The rate constant of a reaction depends on temperature.	1
	(iv) The lanthanoids are also called rare earth elements.	1
	(v) Phenol gives a violet colour with neutral ferric chloride.	1
	(vi) Fructose is an aldose.	1
4.	Match each scientist in column A with the work in column B:	5

Column A	Column B
(i) Raoult	(a) solubility of gases in liquids
(ii) Henry	(b) independent migration of ions
(iii) Faraday	(c) laws of electrolysis
(iv) Kohlrausch	(d) temperature dependence of the rate constant
(v) Arrhenius	(e) vapour pressure of solutions

5.	**(i)** *Answer in one word or one sentence:* What is the van't Hoff factor of urea in water?	1

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	(ii) Name a metal that can be used as a sacrificial anode to protect iron.	1
	(iii) What is the unit of the rate of a reaction?	1
	(iv) Name the ore from which chromium compounds are obtained.	1
	(v) What is the main organic product when ethanamine reacts with nitrous acid?	1
6.	Why does the solubility of a gas in water decrease as the temperature rises?	2
7.	Write the Nernst equation for the Daniell cell. How does its emf change if $[Cu^{2+}]$ is increased?	2
8.	For the reaction A → B, the rate becomes 27 times when the concentration of A is tripled. Find the order and write the rate law.	2
9.	Write the electronic configurations of Cu (Z = 29) and Cu^{2+}. Is Cu^{2+} coloured? Why?	2
10.	What is an ambidentate ligand? Give two examples.	2
11.	Write the main products when (a) benzene reacts with chlorine in the presence of anhydrous $FeCl_3$, (b) toluene reacts with chlorine in sunlight.	2
12.	Write the names and structures of the two compounds of formula C_3H_6O that contain a carbonyl group, and a test to distinguish them.	2
13.	Calculate the depression in freezing point of a 0.10 m aqueous solution of K_2SO_4, assuming complete dissociation. (K_f = 1.86 K kg mol^{-1}) **OR** What is meant by an abnormal molar mass? How do dissociation and association of the solute affect the observed molar mass?	3
14.	Using Kohlrausch's law, calculate Λ°_m for K_2SO_4 and for NaBr. (λ° in S cm^2 mol^{-1}: K^+ 73.5, Na^+ 50.1, Br^- 78.1, SO_4^{2-} 160.0) **OR** Distinguish between primary and secondary batteries, with one example of each. Write the overall reaction of the lead storage battery on discharge.	3
15.	According to collision theory, what two conditions must a collision satisfy to lead to a reaction? Illustrate the role of orientation with the reaction of CH_3Br with OH^-. **OR** A first-order reaction is 87.5% complete in 45 minutes. Find its half-life and its rate constant.	3

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16.	Write balanced ionic equations for the reaction of acidified dichromate with (a) H_2S, (b) Sn^{2+} ions, (c) SO_2. **OR** Calculate the number of unpaired electrons and the spin-only magnetic moment of Cr^{3+} and of high-spin Co^{2+}. (Atomic numbers: Cr 24, Co 27)	3
17.	Write the IUPAC names of the following and state the type of isomerism each shows: (a) $[Pt(NH_3)_2Cl_2]$, (b) $[Co(en)_2Cl_2]^+$, (c) $[Co(NH_3)_5(NO_2)]^{2+}$, (d) $[Cr(H_2O)_6]Cl_3$. **OR** What is meant by the stability of a coordination compound in solution? What is the stability constant? Write three factors that increase stability.	4
18.	Write equations for the reaction of (a) methoxymethane with excess HI, (b) anisole with HI. Also write equations for (c) bromination of anisole, (d) Friedel–Crafts acylation of anisole. **OR** What happens when phenol is (a) heated with zinc dust, (b) oxidised with chromic acid, (c) treated with ethanoyl chloride? (d) Why does phenol give 2,4,6-tribromophenol with bromine water?	4
19.	Explain, with one equation each, the reactions of carboxylic acids involving: (a) cleavage of the O–H bond, (b) cleavage of the C–OH bond, (c) the –COOH group as a whole, (d) the hydrocarbon part. **OR** Explain why carboxylic acids are stronger acids than phenols. How do electron-withdrawing and electron-donating groups affect the acidity of carboxylic acids? Give examples.	4
20.	Explain: (a) denaturation of proteins, (b) the peptide linkage, (c) the native state of a protein, (d) why amino acids are amphoteric. **OR** Classify vitamins on the basis of solubility. Name the deficiency disease caused by a lack of each of vitamins A, B_1, B_{12}, C and D.	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) **(b)** brass. *Working:* Brass is zinc dissolved in solid copper.

(ii) **(d)** lithium. *Working:* Li has the most negative standard reduction potential (–3.05 V).

(iii) **(a)** measuring its rate constant at two temperatures. *Working:* Using $\log(k_2/k_1) = (E_a/2.303R)(1/T_1 - 1/T_2)$.

(iv) **(c)** Mn^{3+}. *Working:* Mn^{3+} ($3d^4$) readily gains an electron to form the stable half-filled Mn^{2+} ($3d^5$).

(v) **(b)** CH_3I. *Working:* Larger, heavier molecules have stronger van der Waals forces.

(vi) **(a)** CH_3COOH. *Working:* It has no electron-withdrawing halogen.

Question 2

(i) isotonic.

(ii) conductance.

(iii) independent.

(iv) +2.

(v) carbolic.

(vi) peptide.

Question 3

(i) True.

(ii) False: it is S cm^2 mol^{-1}; S cm^{-1} is the unit of conductivity.

(iii) True.

(iv) True.

(v) True.

(vi) False: it is a ketose.

4. (i) – (e) vapour pressure of solutions; (ii) – (a) solubility of gases in liquids; (iii) – (c) laws of electrolysis; (iv) – (b) independent migration of ions; (v) – (d) temperature dependence of the rate constant

Question 5

(i) 1.

(ii) Zinc (or magnesium).

(iii) mol L^{-1} s^{-1}.

(iv) Chromite, $FeCr_2O_4$.

(v) Ethanol.

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6. Dissolving a gas is an exothermic process (1). By Le Chatelier's principle a rise in temperature shifts the equilibrium towards the undissolved gas (K_H increases) (1).

7. $E = E^\circ - \frac{0.059}{2}\log\frac{[Zn^{2+}]}{[Cu^{2+}]}$ (1). Increasing [Cu^{2+}] makes the log term smaller, so the emf increases (1).

8. $3^n = 27$, so n = 3 (1). Rate = $k[A]^3$ (1).

9. Cu: $[Ar]3d^{10}4s^1$; Cu^{2+}: $[Ar]3d^9$ (1). Yes: it has an unpaired d electron, so d–d transitions occur (1).

10. A unidentate ligand that can bind to the metal through either of two different atoms (1). NO_2^- (through N or O) and SCN^- (through S or N) (1).

11. (a) Chlorobenzene, C_6H_5Cl (ring substitution) (1). (b) Benzyl chloride, $C_6H_5CH_2Cl$ (side-chain substitution) (1).

12. Propanal, CH_3CH_2CHO, and propanone, CH_3COCH_3 (1). Tollens' reagent: propanal gives a silver mirror, propanone does not (or the iodoform test is given only by propanone) (1).

13. $K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$, so i = 3 (1). $\Delta T_f = iK_fm$ (1) = 3 × 1.86 × 0.10 = 0.558 K (1).

OR A molar mass found from a colligative property that differs from the true value (1). Dissociation increases the number of particles, so the observed molar mass is lower than the true one (1). Association decreases the number of particles, so it is higher, e.g. ethanoic acid in benzene (1).

14. $\Lambda^\circ_m = \nu_+\lambda^\circ_+ + \nu_-\lambda^\circ_-$ (1). K_2SO_4: 2 × 73.5 + 160.0 = 307.0 S cm^2 mol^{-1} (1). NaBr: 50.1 + 78.1 = 128.2 S cm^2 mol^{-1} (1).

OR A primary battery cannot be recharged, e.g. the dry cell or mercury cell (1). A secondary battery can be recharged by passing current in the opposite direction, e.g. the lead storage battery (1). $Pb + PbO_2 + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O$ (1).

15. The colliding molecules must have at least the threshold energy (1) and the proper orientation (1). OH^- must approach the carbon from the side opposite the bromine; a collision at the bromine end does not give methanol (1).

OR 87.5% completion leaves 1/8 = $(1/2)^3$, i.e. three half-lives (1), so $t_{½}$ = 15 min (1). k = 0.693/15 = 0.0462 min^{-1} (1).

16. (a) $Cr_2O_7^{2-} + 3H_2S + 8H^+ \rightarrow 2Cr^{3+} + 3S + 7H_2O$ (1). (b) $Cr_2O_7^{2-} + 3Sn^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 3Sn^{4+} + 7H_2O$ (1). (c) $Cr_2O_7^{2-} + 3SO_2 + 2H^+ \rightarrow 2Cr^{3+} + 3SO_4^{2-} + H_2O$ (1).

OR Cr^{3+}: $3d^3$, three unpaired electrons, μ = √15 = 3.87 BM (1½). Co^{2+}: $3d^7$, high spin, three unpaired electrons, μ = 3.87 BM (1½).

17. (a) Diamminedichloridoplatinum(II): geometrical (cis–trans) (1). (b) Dichloridobis(ethane-1,2-diamine)cobalt(III) ion: geometrical, and the cis form optical (1). (c) Pentaamminenitrito-N-cobalt(III) ion: linkage isomerism (1). (d) Hexaaquachromium(III) chloride: hydrate (solvate) isomerism (1).

OR The degree to which the complex holds together rather than dissociating in solution (1). For M + 4L ⇌ ML_4, $\beta_4 = [ML_4]/([M][L]^4)$; a larger β means a more stable complex (1). Higher charge and smaller size of the metal ion; more basic ligands; chelating ligands (chelate effect) (2).

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18. (a) $CH_3OCH_3 + 2HI \rightarrow 2CH_3I + H_2O$ (1). (b) $C_6H_5OCH_3 + HI \rightarrow C_6H_5OH + CH_3I$ (1). (c) With Br_2 in ethanoic acid: mainly p-bromoanisole, with some o-bromoanisole (1). (d) With CH_3COCl/anhydrous $AlCl_3$: 2- and 4-methoxyacetophenone (1).

OR (a) Benzene is formed (1). (b) Benzoquinone (1). (c) Phenyl ethanoate (an ester) (1). (d) The –OH group strongly activates the ring, and water helps ionise bromine, so all the ortho and para positions are substituted (1).

19. (a) With $NaHCO_3$: $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$ (1). (b) Esterification: $CH_3COOH + C_2H_5OH \rightleftharpoons (H^+) CH_3COOC_2H_5 + H_2O$ (1). (c) Reduction: $CH_3COOH \rightarrow (LiAlH_4) CH_3CH_2OH$ (1). (d) HVZ: $CH_3COOH + Cl_2 \rightarrow$ (red P) $ClCH_2COOH + HCl$ (1).

OR In the carboxylate ion the negative charge is shared equally by two electronegative oxygen atoms; in phenoxide it is spread over less electronegative carbon atoms (2). Electron-withdrawing groups increase acidity, e.g. $FCH_2COOH > CH_3COOH$ (1). Electron-donating groups decrease it, e.g. $CH_3COOH > CH_3CH_2COOH$ (1).

20. (a) Loss of biological activity when heat or a change in pH breaks the hydrogen bonds that hold the protein's shape; the primary structure remains (1). (b) The –CO–NH– bond formed between the –COOH of one amino acid and the $–NH_2$ of another, with loss of water (1). (c) The protein's natural, biologically active shape in the cell (1). (d) They have both an acidic –COOH group and a basic $–NH_2$ group (as the zwitterion $H_3N^+–CHR–COO^-$), so they react with both acids and bases (1).

OR Fat-soluble: A, D, E, K; water-soluble: B group and C (1½). A: night blindness (xerophthalmia); B_1: beriberi; B_{12}: pernicious anaemia; C: scurvy; D: rickets (2½).

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