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Your JEE Guide

CBSE Class XII · Chemistry (043)

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 official CBSE 2026-27 design; it is not issued by CBSE.

General instructions:

1. There are 33 questions in this question paper with internal choice.
2. Section A consists of 16 multiple-choice questions carrying 1 mark each.
3. Section B consists of 5 very short answer questions carrying 2 marks each.
4. Section C consists of 7 short answer questions carrying 3 marks each.
5. Section D consists of 2 case-based questions carrying 4 marks each.
6. Section E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

Section A

1.	Molality is often preferred to molarity because molality: (A) is always larger (B) depends on the volume of solution (C) does not change with temperature (D) is easier to measure	1
2.	Which mixture shows positive deviation from Raoult's law? (A) nitric acid and water (B) phenol and aniline (C) chloroform and acetone (D) ethanol and acetone	1
3.	In the electrolysis of aqueous sodium chloride, the product at the cathode is: (A) oxygen (B) hydrogen (C) chlorine (D) sodium	1
4.	The half-life of a first-order reaction: (A) is independent of the initial concentration (B) is inversely proportional to the initial concentration (C) depends on the square of the initial concentration (D) is proportional to the initial concentration	1
5.	The oxidation state of chromium in $K_2Cr_2O_7$ is: (A) +7 (B) +2 (C) +6 (D) +3	1

6.	Misch metal is an alloy of: (A) lead and tin (B) a lanthanoid metal (about 95%) with iron (C) copper and zinc (D) iron and carbon	1
7.	The denticity of $EDTA^{4-}$ is: (A) 6 (B) 2 (C) 4 (D) 1	1
8.	The number of unpaired electrons in $[Ni(CN)_4]^{2-}$ is: (A) 1 (B) 2 (C) 4 (D) 0	1
9.	The best reagent to convert an alcohol into a pure alkyl chloride is: (A) PCl_3 (B) Cl_2 (C) conc. HCl alone (D) $SOCl_2$	1
10.	Ethers are cleaved by hot concentrated HI to give: (A) a carboxylic acid (B) an alkyl iodide and an alcohol (C) an aldehyde (D) two alkenes	1
11.	The reagent used in Clemmensen reduction is: (A) zinc amalgam and concentrated HCl (B) $H_2/Pd–BaSO_4$ (C) $LiAlH_4$ (D) hydrazine and KOH	1
12.	Starch is a polymer of: (A) fructose (B) galactose (C) α-D-glucose (D) β-D-glucose	1
13.	**Assertion (A):** A solution of a non-volatile solute has a lower vapour pressure than the pure solvent. **Reason (R):** Solute particles occupy part of the surface, so fewer solvent molecules escape. (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1
14.	**Assertion (A):** On dilution, the molar conductivity of a weak electrolyte increases sharply. **Reason (R):** Molar conductivity is conductivity divided by concentration. (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1

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15.	**Assertion (A):** Vitamin D deficiency causes rickets. **Reason (R):** Vitamin D is water-soluble. (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1
16.	**Assertion (A):** Benzoic acid undergoes the Friedel–Crafts reaction readily. **Reason (R):** The carboxyl group deactivates the benzene ring. (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, and R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1

Section B

17.	Henry's law constant for methane in benzene at 298 K is 4.27×10^5 mm Hg. Find the mole fraction of methane in benzene when its partial pressure is 760 mm Hg. **OR** A 0.1 m solution of $CaCl_2$ is 80% dissociated. Find its van't Hoff factor.	2
18.	Write the reactions at the anode and cathode during the rusting of iron.	2
19.	A first-order reaction has $k = 1.15 \times 10^{-3}$ s^{-1}. How long will it take for 5 g of the reactant to fall to 3 g?	2
20.	Explain: (i) transition metals have high enthalpies of atomisation; (ii) Sc^{3+} is colourless in aqueous solution.	2
21.	Write the equations for (i) the Rosenmund reduction, (ii) the Etard reaction.	2

Section C

22.	The vapour pressures of pure liquids A and B at 350 K are 450 and 700 mm Hg. A mixture of them has a total vapour pressure of 600 mm Hg. Find the composition of the liquid and of the vapour, assuming ideal behaviour.	3
23.	For the cell Mg | Mg^{2+} || Ag^+ | Ag, $E^\circ(Mg^{2+}/Mg) = -2.37$ V and $E^\circ(Ag^+/Ag) = 0.80$ V. Find E°_{cell} and ΔG° ($F = 96\,500$ C mol^{-1}).	3
24.	The rate constant for the decomposition of a hydrocarbon is $k = 4.5 \times 10^{11} e^{-28000\,K/T}$ s^{-1}. Find its activation energy ($R = 8.314$ J K^{-1} mol^{-1}). What does the factor 4.5×10^{11} represent? **OR** What is a pseudo first-order reaction? Give an example. How does molecularity differ from order?	3
25.	What is lanthanoid contraction? Give two of its consequences.	3

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26.	Explain, using crystal field theory, why $[Ti(H_2O)_6]^{3+}$ is violet. Why is $[Ni(CO)_4]$ tetrahedral and diamagnetic?	3
27.	Write the reactions for (i) the conversion of chlorobenzene to phenol, (ii) the Fittig reaction, (iii) the chlorination of chlorobenzene. Name the products in (iii).	3
28.	How will you convert (i) ethanol to 3-hydroxybutanal, (ii) benzene to m-nitroacetophenone, (iii) propanone to propene?	3

Section D

29.	**Case study.** Batteries convert chemical energy into electrical energy. A dry cell cannot be recharged, while a lead storage battery can. A mercury cell gives a nearly constant voltage throughout its life. Fuel cells, such as the hydrogen–oxygen cell, convert the energy of combustion of a fuel directly into electricity. (i) Which of these is a primary cell? (A) lead storage battery (B) nickel–cadmium cell (C) dry (Leclanché) cell (D) fuel cell *[1]* (ii) What is the anode of a dry cell? *[1]* (iii) Why does a mercury cell give a constant voltage? *[2]* **OR** (iii) Give two advantages of fuel cells over ordinary batteries. *[2]*	4
30.	**Case study.** The pKb values of some amines in water at 298 K are: methylamine 3.38, dimethylamine 3.27, trimethylamine 4.22 and aniline 9.38. A smaller pKb means a stronger base. (i) Which of these is the strongest base in water? (A) methylamine (B) dimethylamine (C) trimethylamine (D) aniline *[1]* (ii) Which is the weakest base? *[1]* (iii) Why is trimethylamine a weaker base than dimethylamine in water, although it has more alkyl groups? *[2]* **OR** (iii) Why is aniline the weakest base of these? *[2]*	4

Section E

31.	(a) Show that for a non-volatile solute the relative lowering of vapour pressure equals the mole fraction of the solute. (b) Explain positive and negative deviations from Raoult's law with one example each, and draw the vapour pressure graphs. **OR** (a) What are abnormal molar masses? Explain with one example each of association and dissociation, and define the van't Hoff factor. (b) Find the freezing point of a 0.1 m aqueous KCl solution, assuming complete dissociation (Kf = 1.86 K kg mol^{-1}).	5

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32.	(a) Why are aldehydes generally more reactive than ketones towards nucleophilic addition? (b) Give simple chemical tests to distinguish (i) propanal and propanone, (ii) benzoic acid and phenol, (iii) ethanal and ethanol. **OR** (a) Write the mechanism of the nucleophilic addition of HCN to a carbonyl compound. (b) Arrange in increasing order of reactivity towards nucleophilic addition, with reason: ethanal, propanal, propanone, butanone.	5
33.	(a) What happens when glucose reacts with (i) bromine water, (ii) nitric acid, (iii) acetic anhydride? (b) What is the difference between a nucleoside and a nucleotide? Give two differences between DNA and RNA. **OR** (a) Using crystal field theory, write the configurations of a d^4 ion in an octahedral field when (i) $\Delta o > P$, (ii) $\Delta o < P$. Which is high-spin? (b) Why is $[Co(NH_3)_6]^{3+}$ diamagnetic while $[CoF_6]^{3-}$ is paramagnetic?	5

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Answers and Marking Scheme

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

Section A

1. **(C)** does not change with temperature. *Working:* It is based on masses, not volume.

2. **(D)** ethanol and acetone. *Working:* Ethanol's hydrogen bonds are weakened on mixing with acetone.

3. **(B)** hydrogen. *Working:* Water is reduced more easily than Na^+.

4. **(A)** is independent of the initial concentration. *Working:* $t_{½} = 0.693/k$.

5. **(C)** +6. *Working:* $2(+1) + 2x + 7(-2) = 0$.

6. **(B)** a lanthanoid metal (about 95%) with iron. *Working:* It is used in lighter flints.

7. **(A)** 6. *Working:* Two N and four O donor atoms.

8. **(D)** 0. *Working:* CN^- pairs the d^8 electrons; dsp^2 square planar.

9. **(D)** $SOCl_2$. *Working:* The by-products SO_2 and HCl escape as gases.

10. **(B)** an alkyl iodide and an alcohol. *Working:* R–O–R′ + HI → RI + R′OH.

11. **(A)** zinc amalgam and concentrated HCl. *Working:* It reduces >C=O to $>CH_2$.

12. **(C)** α-D-glucose. *Working:* Amylose and amylopectin are made of α-D-glucose units.

13. **(A)** Both A and R are true, and R is the correct explanation of A. *Working:* The reduced surface fraction of solvent lowers the vapour pressure.

14. **(B)** Both A and R are true, and R is not the correct explanation of A. *Working:* Both are true, but the sharp rise is due to the increase in degree of dissociation on dilution.

15. **(C)** A is true but R is false. *Working:* A is true. R is false: vitamin D is fat-soluble.

16. **(D)** A is false but R is true. *Working:* A is false: the deactivated ring also binds $AlCl_3$, so Friedel–Crafts reactions do not occur. R is true.

Section B

17. $p = K_H x$ (1), so $x = \frac{760}{4.27 \times 10^5} \approx 1.78 \times 10^{-3}$ (1).

OR $CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$; $i = 1 + (3 - 1)\alpha$ (1) $= 1 + 2 \times 0.8 = 2.6$ (1).

18. Anode: $2Fe \rightarrow 2Fe^{2+} + 4e^-$ (1). Cathode: $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$; Fe^{2+} is further oxidised to hydrated ferric oxide, $Fe_2O_3 \cdot xH_2O$ (rust) (1).

19. $t = \frac{2.303}{k} \log \frac{5}{3}$ (1) $= \frac{2.303}{1.15 \times 10^{-3}} \times 0.2218 \approx 444$ s (1).

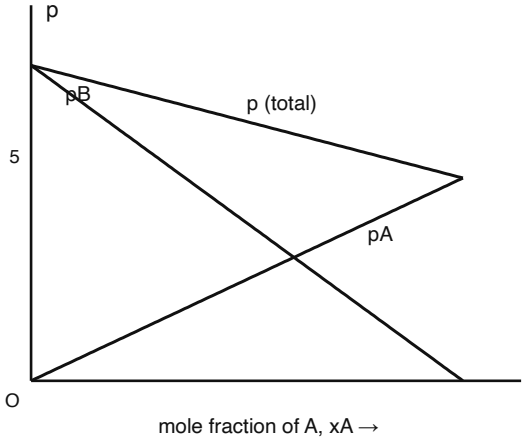
20. (i) Many unpaired electrons give strong metallic bonding between atoms (1). (ii) Sc^{3+} is $3d^0$, so no d–d transition is possible (1).

21. (i) $C_6H_5COCl + H_2$ (Pd–$BaSO_4$) → $C_6H_5CHO + HCl$ (1). (ii) $C_6H_5CH_3 + CrO_2Cl_2$ (in CS_2), then $H_3O^+ \rightarrow C_6H_5CHO$ (1).

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Section C

22. $600 = 450x_A + 700(1 - x_A)$, so $x_A = 0.4$, $x_B = 0.6$ (1½). In the vapour $y_A = \frac{0.4 \times 450}{600} = 0.3$, $y_B = 0.7$ (1). Graph (½):



23. E°cell = 0.80 − (−2.37) = 3.17 V (1). Mg + 2Ag⁺ → Mg²⁺ + 2Ag, n = 2 (1). ΔG° = −nFE° = −2 × 96 500 × 3.17 ≈ −611.8 kJ mol⁻¹ (1).

24. Comparing with $k = Ae^{-E_a/RT}$: $\frac{E_a}{R} = 28000$ K (1). E_a = 28 000 × 8.314 ≈ 232.8 kJ mol⁻¹ (1). 4.5 × 10¹¹ s⁻¹ is the frequency factor A (1).

OR A reaction of higher order that behaves as first order because one reactant is in large excess (1); e.g. the acid hydrolysis of ethyl acetate in excess water (1). Molecularity is the number of species colliding in an elementary step and is always a whole number; order is found by experiment and can be zero or fractional (1).

25. The steady decrease in atomic and ionic radii from La to Lu, due to poor shielding by 4f electrons (1). Consequences (any two): the 4d and 5d elements of a group have very similar radii (e.g. Zr and Hf) and occur together; the basic character of the hydroxides decreases from $La(OH)_3$ to $Lu(OH)_3$; separation of lanthanoids is difficult (2).

26. Ti^{3+} is d^1; the electron is in the t_2g level. It absorbs visible light (green-yellow) to jump to e_g, and the complementary violet colour is seen (1½). In $[Ni(CO)_4]$, Ni is in the 0 state ($3d^8 4s^2$); the strong-field CO pairs the electrons to give $3d^{10}$, and sp^3 hybridisation makes it tetrahedral with no unpaired electrons (1½).

27. (i) C_6H_5Cl + NaOH (623 K, 300 atm), then H^+ → C_6H_5OH (1). (ii) $2C_6H_5Cl$ + 2Na (dry ether) → $C_6H_5–C_6H_5$ + 2NaCl (1). (iii) With $Cl_2/FeCl_3$: 1,2-dichlorobenzene and 1,4-dichlorobenzene (major) (1).

28. (i) Oxidise ethanol to ethanal (PCC), then aldol condensation with dilute NaOH (1). (ii) Friedel–Crafts acylation with $CH_3COCl/AlCl_3$, then nitration (the acetyl group is meta-directing) (1). (iii) Reduce with $NaBH_4$ to propan-2-ol, then dehydrate with conc. H_2SO_4 (1).

Section D

29. (i) (C) the dry cell.
(ii) The zinc container.
(iii) Its overall reaction, Zn(Hg) + HgO → ZnO + Hg, involves no ions in solution, so the

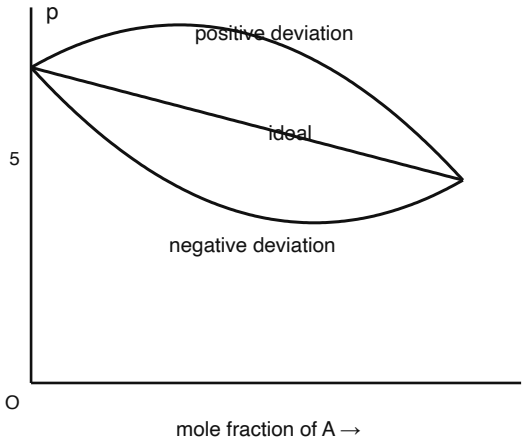
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concentrations and hence the voltage do not change. **OR** High efficiency (about 70%), pollution-free products, and continuous supply as long as fuel is fed.

30. (i) (B) dimethylamine.
(ii) Aniline.
(iii) Its conjugate acid has fewer N–H bonds, so it is less stabilised by hydrogen bonding with water (poor solvation), and the bulky groups hinder solvation. **OR** The lone pair on nitrogen is delocalised into the benzene ring, so it is less available to accept a proton.

Section E

31. (a) $p_1 = x_1 p_1^\circ$, so $\frac{p_1^\circ - p_1}{p_1^\circ} = 1 - x_1 = x_2$ (2). (b) Positive deviation: A–B attractions weaker than A–A and B–B, so the vapour pressure is higher than ideal (ethanol + acetone); negative deviation: A–B attractions stronger, vapour pressure lower (chloroform + acetone) (2). Graph (1):



OR (a) Molar masses found from colligative properties that differ from the true values because the solute associates or dissociates (1). Ethanoic acid dimerises in benzene, so the observed molar mass is higher; KCl dissociates in water, so it is lower (1). i = observed colligative property / calculated value (1). (b) ΔTf = iKfm = 2 × 1.86 × 0.1 = 0.372 K, so the freezing point is –0.372 °C (2).

32. (a) Ketones have two electron-releasing alkyl groups that reduce the positive charge on the carbonyl carbon, and they hinder the approach of the nucleophile sterically (2). (b) (i) Tollens' reagent: propanal gives a silver mirror (1). (ii) $NaHCO_3$: benzoic acid gives brisk effervescence of CO_2; phenol does not (1). (iii) Tollens' or Fehling's reagent: only ethanal reacts (1).

OR (a) CN^- (from HCN + base) attacks the carbonyl carbon to give an alkoxide intermediate (1½); it takes a proton to form the cyanohydrin (1½). (b) Butanone < propanone < propanal < ethanal, as reactivity falls with more and bigger alkyl groups (2).

33. (a) (i) Gluconic acid, showing a –CHO group (1). (ii) Saccharic (glucaric) acid, showing a primary –OH group (1). (iii) Glucose pentaacetate, showing five –OH groups (1). (b) Nucleoside = base + sugar; nucleotide = base + sugar + phosphate (1). DNA has deoxyribose and thymine and is double-stranded; RNA has ribose and uracil and is single-stranded (1).

OR (a) (i) Δo > P: $t_2g^4e_g^0$, low spin (1½). (ii) Δo < P: $t_2g^3e_g^1$, high spin (1½). (b) Co^{3+} is d^6; NH_3 is a strong-field ligand, giving t_2g^6 with no unpaired electrons; F^- is weak-field, giving $t_2g^4e_g^2$ with four unpaired electrons (2).

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