Chemistry

HSC Board Exam February–March 2027 – Practice Paper

Practice Question Paper

Time: 3 hours **Max. Marks: 70**

(1) The question paper is divided into four sections.
(2) Section A: Q. No. 1 contains ten multiple choice type questions carrying one mark each. Q. No. 2 contains eight very short answer type questions carrying one mark each.
(3) Section B: Q. No. 3 to Q. No. 14 contain twelve short answer type questions carrying two marks each. (Attempt any eight)
(4) Section C: Q. No. 15 to Q. No. 26 contain twelve short answer type questions carrying three marks each. (Attempt any eight)
(5) Section D: Q. No. 27 to Q. No. 31 contain five long answer type questions carrying four marks each. (Attempt any three)
(6) Use of log table is allowed. Use of calculator is not allowed.
(7) Figures to the right indicate full marks.
(8) For each MCQ, the correct answer must be written along with its alphabet, e.g. (A) ..... / (B) ..... Only the first attempt will be considered for evaluation.
(9) Physical constants: R = 8.314 J K^{-1} mol^{-1}; F = 96500 C mol^{-1}; $N_A = 6.022 \times 10^{23}$ mol^{-1}; 2.303RT/F = 0.0592 V at 298 K.

SECTION A – Q.1 Select and write the correct answer for the following multiple choice type of questions. **[10]**

(i) The coordination number of each atom in a body-centred cubic (bcc) crystal lattice is _____.
(A) 4 (B) 6
(C) 8 (D) 12

(ii) Which of the following 0.1 m aqueous solutions has the highest boiling point?
(A) Glucose (B) Urea
(C) NaCl (D) K_2SO_4

(iii) The SI unit of molar conductivity is _____.
(A) Ω^{-1} m^{-1} (B) Ω^{-1} m^2 mol^{-1}
(C) Ω m (D) Ω^{-1} cm mol^{-1}

(iv) The unit of the rate constant of a first order reaction is _____.
(A) mol dm^{-3} s^{-1} (B) dm^3 mol^{-1} s^{-1}
(C) s^{-1} (D) mol^{-1} s

(v) The oxidation state of sulfur in peroxodisulfuric acid ($H_2S_2O_8$) is _____.
(A) +5 (B) +6
(C) +7 (D) +8

(vi) The spin-only magnetic moment of Ti^{3+} (Z = 22) is _____.
(A) 1.73 BM (B) 2.84 BM
(C) 3.87 BM (D) 0 BM

(vii) The coordination number of iron in $K_3[Fe(C_2O_4)_3]$ is _____.

(A) 3 (B) 4

(C) 6 (D) 9

(viii) Which of the following alkyl halides undergoes S_N1 reaction most readily?

(A) CH_3Br (B) CH_3CH_2Br

(C) $(CH_3)_2CHBr$ (D) $(CH_3)_3CBr$

(ix) Which of the following compounds gives a positive iodoform test?

(A) HCHO (B) CH_3CH_2CHO

(C) C_6H_5CHO (D) $CH_3COCH_2CH_3$

(x) The monomer used for the manufacture of nylon-6 is _____.

(A) adipic acid (B) caprolactam

(C) hexamethylenediamine (D) vinyl chloride

SECTION A – Q.2 Answer the following questions. **[8]**

(i) Calculate the pH of 0.001 M HCl solution.

(ii) What is the value of ΔU for an isolated system?

(iii) Write the IUPAC name of $CH_3–CH_2–O–CH(CH_3)_2$.

(iv) Name the test in which a primary amine, on warming with chloroform and alcoholic KOH, gives an offensive smell.

(v) Name the linkage that joins two monosaccharide units in a disaccharide.

(vi) What is the size range of nanoparticles?

(vii) Name the point defect in ionic solids that decreases the density of the crystal.

(viii) What is the shape of the ClF_3 molecule?

SECTION B Attempt any EIGHT of the following questions. (Q.3 to Q.14) **[16]**

Q.3 Air contains 80 % nitrogen by volume. The Henry's law constant for nitrogen in water at 25 °C is 6.5×10^{-4} mol dm^{-3} bar^{-1}. Calculate the solubility of nitrogen in water at 25 °C exposed to air at a total pressure of 1.0 bar.

Q.4 The dissociation constant (K_a) of a weak monobasic acid HA is 4.0×10^{-6}. Calculate its degree of dissociation and the pH of its 0.01 M solution. (log 2 = 0.3010)

Q.5 1.5 mol of an ideal gas expands isothermally from 12 dm^3 to 27 dm^3 against a constant external pressure of 2.0 bar. Calculate the work done in joules. (1 dm^3 bar = 100 J)

Q.6 State Kohlrausch's law of independent migration of ions. Write the expression for the limiting molar conductivity (Λ_0) of $CaCl_2$ in terms of the limiting molar conductivities of its ions.

Q.7 The rate constant of a first order reaction is 6.93×10^{-3} s^{-1}. Calculate (a) its half-life and (b) the time required for 75 % of the reaction to be completed.

Q.8 Write balanced chemical equations for:
(a) Chlorine reacts with cold and dilute sodium hydroxide.
(b) Complete hydrolysis of xenon hexafluoride.

Q.9 Why are most compounds of transition metals coloured? Explain why Zn^{2+} salts are white. (Zn: Z = 30)

Q.10 Write the IUPAC names of:
(a) $[Co(NH_3)_4(H_2O)Cl]SO_4$
(b) $K_2[Zn(OH)_4]$

Q.11 Write chemical equations for:
(a) Finkelstein reaction, using 1-bromopropane.
(b) Swarts reaction, using 2-bromopropane.

Q.12 Phenol is more acidic than ethanol. Explain.

Q.13 Distinguish between DNA and RNA (any four points).

Q.14 State any four principles of green chemistry.

SECTION C Attempt any EIGHT of the following questions. (Q.15 to Q.26) **[24]**

Q.15 An element crystallises in a face-centred cubic (fcc) lattice with unit cell edge length 389 pm. The density of the element is 12.0 g cm^{-3}. Calculate (a) the molar mass of the element and (b) the radius of its atom. ($N_A = 6.022 \times 10^{23}$ mol^{-1}; $\sqrt{2} = 1.414$)

Q.16 (a) A solution containing 3.0 g of a non-volatile non-electrolyte in 50 g of water freezes at −0.62 °C. Calculate the molar mass of the solute. (K_f for water = 1.86 K kg mol^{-1}; freezing point of water = 0 °C) [2]
(b) Define cryoscopic constant. [1]

Q.17 (a) Define solubility product. [1]
(b) The solubility product of lead(II) fluoride (PbF_2) at 298 K is 3.2×10^{-8}. Calculate its molar solubility. [2]

Q.18 For a reaction at 300 K, $\Delta H = +40$ kJ mol^{-1} and $\Delta S = +120$ J K^{-1} mol^{-1}. Calculate ΔG and predict whether the reaction is spontaneous at 300 K. Above what temperature will the reaction become spontaneous? (Assume ΔH and ΔS do not change with temperature.)

Q.19 Write the cell reaction and calculate the emf of the following cell at 298 K:
Ni(s) | Ni^{2+}(0.10 M) || Ag^{+}(0.010 M) | Ag(s)
($E^\circ_{Ni} = -0.25$ V, $E^\circ_{Ag} = 0.80$ V)

Q.20 The rate constant of a reaction becomes four times when the temperature is raised from 300 K to 320 K. Calculate the energy of activation of the reaction. ($R = 8.314$ J K^{-1} mol^{-1}; log 4 = 0.6021)

Q.21 Optically active (R)-2-bromobutane reacts with aqueous NaOH by the S_N2 mechanism. Explain the mechanism with the transition state, and state the configuration of the product formed. Why is this reaction called bimolecular?

Q.22 The atomic radii of zirconium (Zr, 160 pm) and hafnium (Hf, 159 pm) are almost equal, although Hf lies one period below Zr in the same group. Name the effect responsible for this. Explain its cause and state one other consequence of this effect.

Q.23 Write chemical equations for:
(a) Reimer–Tiemann reaction
(b) Preparation of ethyl methyl ether by Williamson synthesis
(c) Action of hot concentrated HI on anisole

Q.24 Write chemical equations for:
(a) Cannizzaro reaction of benzaldehyde
(b) Clemmensen reduction of acetophenone
(c) Action of thionyl chloride on propanoic acid

Q.25 (a) Write the Hofmann bromamide degradation of propanamide. [1]
(b) Write the reaction for the diazotisation of aniline. [1]
(c) Aniline is a weaker base than methylamine. Give reason. [1]

Q.26 (a) What are biodegradable polymers? Give one example. [1]
(b) Write the names and structures of the monomers of PHBV. [1]
(c) Write the names and structures of the monomers of Buna-S. [1]

SECTION D Attempt any THREE of the following questions. (Q.27 to Q.31) **[12]**

Q.27 (a) On the basis of valence bond theory, explain the hybridisation, geometry and magnetic behaviour of $[Mn(CN)_6]^{3-}$. Also calculate its spin-only magnetic moment. (Mn: Z = 25) [3]
(b) What is an ambidentate ligand? Give one example. [1]

Q.28 (a) Write the aldol condensation of ethanal. Name the products formed. [2]
(b) Arrange the following in increasing order of acid strength and explain: CH_3COOH, $Cl_2CHCOOH$, $ClCH_2COOH$ [2]

Q.29 (a) Calculate the standard enthalpy of formation of propane, $C_3H_8(g)$, from the following data: [3]
(i) $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$; $\Delta_cH° = -2220.0$ kJ mol^{-1}
(ii) C(graphite) + $O_2(g) \rightarrow CO_2(g)$; $\Delta_fH° = -393.5$ kJ mol^{-1}
(iii) $H_2(g) + ½O_2(g) \rightarrow H_2O(l)$; $\Delta_fH° = -285.8$ kJ mol^{-1}
(b) Predict the sign of ΔS when steam condenses to liquid water. Give reason. [1]

Q.30 (a) In the contact process for the manufacture of sulfuric acid:
(i) Write the equation for the catalytic oxidation of SO_2, name the catalyst and state the temperature and pressure used. Using Le Chatelier's principle, explain why the temperature is not kept very low although the reaction is exothermic. [2]
(ii) Why is SO_3 absorbed in concentrated H_2SO_4 and not in water? Write the equations for the formation of oleum and its conversion to sulfuric acid. [1]
(b) Fluorine is a stronger oxidising agent than chlorine. Give reason. [1]

Q.31 (a) Finely divided MnO_2 (pyrolusite) is fused with KOH and potassium chlorate ($KClO_3$) to give a dark green compound X. When X is dissolved in water and the solution is acidified, it gives a purple solution of Y and a brown precipitate Z. Identify X, Y and Z and write balanced equations for both steps. [2]
(b) What happens when glucose is treated with (i) HI on prolonged heating (ii) bromine water? Write chemical equations. [2]

All the best for your exam!