

Celebrating

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UTTAM'S

PAPERS

with

SOLUTIONTM

With Marking Scheme

Chemistry

Std XII



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Mumbai - 400 004

CHEMISTRY (STD. XII)

Chapterwise Distribution of Marks

Area	Topic No.	Unit	Weightage of Unit Without Option	Weightage of Units with Option
Physical Chemistry	1	Solid State	3	5
	2	Solutions	4	6
	3	Ionic Equilibria	4	6
	4	Chemical Thermodynamics	6	8
	5	Electrochemistry	5	7
	6	Chemical Kinetics	4	6
			26	38
Inorganic Chemistry	7	Elements of Group 16, 17 & 18	6	8
	8	Transition & Inner Transition Elements	6	8
	9	Coordination Compounds	5	7
			17	23
Organic Chemistry	10	Halogen Derivatives	5	7
	11	Alcohols, Phenols and Ethers	4	6
	12	Aldehydes, Ketones and Carboxylic acids	6	8
	13	Amines	3	4
			18	25
Applied Chemistry	14	Biomolecules	3	4
	15	Introduction to Polymer Chemistry	3	4
	16	Green Chemistry and Nano Chemistry	3	4
			09	12
			70	98

Weightage to Learning Objectives

Sr. No.	Learning Objectives	Total Weightage (With Option)	Percentage
1.	Knowledge	29 Marks	30%
2.	Understanding	41 Marks	42%
3.	Application & Skill	28 Marks	28%
	Total	98 Marks	100%

Difficulty level of the questions

Sr. No.	Difficulty Level	Total Weightage (With Option)	Percentage
1.	Easy	29 Marks	30%
2.	Average	49 Marks	50%
3.	Difficult	20 Marks	20%
	Total	98 Marks	100%

Weightage as per type of questions

Type of questions	Number of questions	Marks for each questions	Total Marks
Multiple Choice Questions	Q. No. 1 [(i) to (x)] (Ten)	1 Mark each	10 Marks
Very Short Answers	Q. No. 2 [(i) to (viii)] (Eight)	1 Mark each	08 Marks
Short Answers - I	Q. No. 3 to 14 (Twelve)	2 Marks each	24 Marks
Short Answers - II	Q. No. 15 to 26 (Twelve)	3 Marks each	36 Marks
Long Answers	Q. No. 27 to 31 (Five)	4 Marks each	20 Marks
	Total		98 Marks

SUMMARY OF QUESTIONS ASKED IN PREVIOUS BOARD EXAMS

1

SOLID STATE

- (1) Distinguish between crystalline solid and amorphous solid. (March 2013, 2014, 2017) (2)
- (2) Gold occurs as face centered cube and has a density of 19.30 kg dm^{-3} . Calculate atomic radius of gold. (March 2013) (2)
(Molar mass of Au = 197) [Ans. $r = 144 \text{ pm}$]
- (3) Calculate the number of atoms present in 2 gram of crystal which has face-centered cubic (fcc) crystal lattice having edge length of 100 pm and density 10 g cm^{-3} . (Oct. 2013) (3)
[Ans. 8×10^{23} atoms]
- (4) What are Schottky defect and Frenkel defect? (Oct. 2013) (2)
- (5) Face centered cubic crystal lattice of copper has density of 8.966 g cm^{-3} . Calculate the volume of the unit cell. Given molar mass of copper is 63.5 g mol^{-1} and Avogadro number N_A is 6.022×10^{23} . (March 2014) (3)
[Ans. $4.702 \times 10^{-23} \text{ cm}^3$]
- (6) A unit cell of iron crystal has edge length 288 pm and density 7.86 g cm^{-3} . Find the number of atoms per unit cell and type of the crystal lattice. [Given: Molar mass of iron = 56 g mol^{-1} ; Avogadro's Number, $N_A = 6.022 \times 10^{23}$] (Oct. 2014) (3)
[Ans. 2, Type - bcc]
- (7) Explain impurity defect in stainless steel with diagram. (March 2015) (2)
- (8) Niobium crystallises as body centered cube (BCC) and has density of 8.55 kg dm^{-3} . Calculate the atomic radius of niobium. (Given: Atomic mass of niobium = 93). (March 2015) (3)
[Ans. 0.143 nm]
- (9) Silver crystallises in F.C.C. (face-centered cubic crystal) structure. The edge length of the unit cell is found to be 408.7 pm . Calculate density of the unit cell. (Oct. 2015) (3)
[Given: Molar mass of silver is 108 g mol^{-1}]. [Ans. 10.51 g cm^{-3}]
- (10) What is ferromagnetism? Iron ($Z = 26$) is strongly ferromagnetic. Explain. (March 2016) (2)
- (11) Silver crystallises in FCC structure. If density of silver is 10.51 g cm^{-3} , calculate the volume of unit cell. (March 2016) (3)
[Atomic mass of silver (Ag) = 108 g mol^{-1}] [Ans. $68.24 \times 10^{-24} \text{ cm}^3$]
- (12) A face centered cube (FCC) consists of how many atoms? Explain. (July 2016) (2)
- (13) Determine the density of Cesium chloride which crystallizes in BCC type structure with the edge length 412.1 pm . The atomic masses of Cs and Cl are 133 and 35.5 respectively. Predict the co-ordination number of Cs^+ ion if $r_{\text{Cs}^+} = 1.69 \text{ \AA}$ and $r_{\text{Cl}^-} = 1.81 \text{ \AA}$. (July 2016) (3)
[Ans. 4 g cm^{-3} ; C.N. = 8]
- (14) Calculate the percentage efficiency of packing in case of simple cubic cell. (March 2017) (2)
[Ans. 52.4%]
- (15) Calculate the number of atoms in a unit cell of a metal crystallising in face centered cubic structure. (March 2017) (2)
[Ans. 4 atoms]
- (16) Classify the following molecular solids into different types: (July 2017) (2)
(a) Ammonium phosphate (b) Brass (c) S_8 molecule (d) Diamond.
- (17) A metal crystallises into two cubic faces namely face centered (FCC) and body centered (BCC), whose unit cell edge lengths are 3.5 \AA and 3.0 \AA respectively. Find the ratio of the densities of FCC and BCC. (July 2017) (3)
[Ans. $d_1 : d_2 = 1.26$]
- (18) Ionic solids are hard and brittle. Explain. (March 2018) (2)
- (19) The density of iron crystal is $8.54 \text{ gram cm}^{-3}$. If the edge length of unit cell is 2.8 \AA and atomic mass is 56 gram mol^{-1} , find the number of atoms in the unit cell. (March 2018) (3)
[Given: Avogadro's number = 6.022×10^{23} , $1 \text{ \AA} = 1 \times 10^{-8} \text{ cm}$] [Ans. $Z = 2.017 \approx 2$]
- (20) Classify the following molecular solids into different types: (July 2018) (2)
(a) HCl (b) CO_2 (c) Solid ice (d) SO_2
- (21) The density of silver having atomic mass $107.8 \text{ gram mol}^{-1}$ is $10.8 \text{ gram cm}^{-3}$. If the edge length of cubic unit cell is $4.05 \times 10^{-8} \text{ cm}$, find the number of silver atoms in the unit cell. (July 2018) (3)
[$N_A = 6.022 \times 10^{23}$, $1 \text{ \AA} = 10^{-8} \text{ cm}$] [Ans. $Z = 4.009 \approx 4$]
- (22) What is the ratio of octahedral holes to the number of anions in hexagonal closed packed structure? (March 2019) (1)
[Ans. 1:1]
- (23) Define Anisotropy. Distinguish between crystalline solids and amorphous solids. (March 2019) (3)
- (24) Give the relation between radius of atom and edge length in body centered cubic crystal. (July 2019) (1)
- (25) Classify the following solids: (i) Diamond (ii) NaCl (iii) P_4 molecule (iv) Brass. (July 2019) (3)
What is Schottky defect? (March 2020) (2)
- (26) Classify the following into different types: (a) Silver (b) P_4 (c) Diamond (d) NaCl (March 2020) (3)
- (27) Unit cell of a metal has edge length of 288 pm and density of 7.86 g cm^{-3} . Determine the type of crystal lattice. (Atomic mass of metal = 56 g mol^{-1}) (Sept. 2021) (1)
[Ans. bcc]
- (28) What is the coordination number of atoms in simple cubic crystal lattice?
- (29) A compound forms hexagonal close packed (hcp) structure. What is the number of (i) Octahedral voids (ii) Tetrahedral voids (iii) Total voids formed in 0.4 mol of it? (Sept. 2021) (3)
[Ans. (i) 2.4098×10^{23} ; (ii) 4.818×10^{23} ; (iii) 7.227×10^{23}]

- (30) Write the consequences of Schottky defect with reasons. (March 2022) (2)
- (31) Gold crystallises into face-centred cubic cells. The edge length of unit cell is 4.08×10^{-8} cm. Calculate the density of gold. [Molar mass of gold = 197 g mol^{-1}] [Ans. $19.27 \times 10^{-3} \text{ kg dm}^{-3}$] (March 2022) (2)
- (32) Explain metal deficiency defect with example. (March 2022) (2)
- (33) Distinguish between Schottky and Frenkel defect. (July 2022) (2)
- (34) Calculate the number of atoms and unit cell present in 0.5 g of Niobium if it forms body centred cubic structure. The density of Niobium is 8.55 g cm^{-3} and edge length of unit cell is 330.6 pm. [Ans. No. of atoms = 3.25×10^{23} , No. of unit cells = 1.62×10^{21}] (July 2022) (2)
- (35) Explain the following terms: (March 2023) (2)
- (a) Substitutional impurity defect (b) Interstitial impurity defect.
- (36) Silver crystallizes in fcc structure. If edge length of unit cell is 400 pm, calculate density of silver. (Atomic mass of Ag = 108). [Ans. Density of silver (ρ) = 11.20 g cm^{-3} .] (March 2023) (2)

2

SOLUTIONS

- (1) Derive the relationship between relative lowering of vapour pressure and molar mass of non-volatile solute. (March 2013, 2017) (2)
- (2) Define osmosis. (March 2013) (1)
- (3) What is boiling point? (March 2013) (1)
- (4) State Henry's law. How does solubility of a gas in water varies with the temperature? (Oct. 2013; July 2017) (2)
- (5) Define 'Isotonic solution'. (March 2009, Oct. 2013) (1)
- (6) Calculate the amount of CaCl_2 (van't Hoff factor, $i = 2.47$) dissolved in 2.5 L solution so that its osmotic pressure at 300K is 0.75 atmosphere. [Given: Molar mass of CaCl_2 is 111 g mol^{-1} , $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$] [Ans. $W = 3.425 \text{ g}$] (March 2014) (3)
- (7) Explain, why do aquatic animals prefer to stay at lower level of water during summer? (March 2014) (2)
- (8) A solution containing 0.73 g of camphor (molar mass 152 g mol^{-1}) in 36.8 g of acetone (boiling point 56.3°C) boils at 56.55°C . A solution of 0.564 g of unknown compound in the same weight of acetone boils at 56.46°C . Calculate the molar mass of the unknown compound. [Ans. 183.5 g mol^{-1}] (Oct. 2014) (3)
- (9) Define van't Hoff factor. How is it related to the degree of dissociation? (Oct. 2014) (2)
- (10) Define: Cryoscopic constant. (Oct. 2014, July 2018) (1)
- (11) Derive van't Hoff general solution equation. (March 2015, 2019; July 2017) (2)
- (12) $1.0 \times 10^{-3} \text{ kg}$ of urea when dissolved in 0.0985 kg of a solvent, decreases freezing point of the solvent by 0.211 K . $1.6 \times 10^{-3} \text{ kg}$ of another non-electrolyte solute when dissolved in 0.086 g of the same solvent depresses the freezing point by 0.34 K . Calculate the molar mass of the another solute. [Given: Molar mass of urea = 60] [Ans. 68.28 g mol^{-1}] (March 2015) (3)
- (13) Define ebullioscopic constant. Write its unit. (Oct 2015) (2)
- (14) What is the effect of temperature on solubility of gas in a liquid? (Oct 2015) (2)
- (15) Define boiling point. Write the formula to determine molar mass of a solute using freezing point depression method. (March 2016) (2)
- (16) The vapour pressure of pure benzene is 640 mm of Hg. $2.175 \times 10^{-3} \text{ kg}$ of non-volatile solute is added to 39 gram of benzene, the vapour pressure of solution is 600 mm of Hg. Calculate molar mass of solute. [$C = 12$, $H = 1$]. [Ans. $69.6 \times 10^{-3} \text{ kg}$] (March 2016) (3)
- (17) Why is molality of a solution independent of temperature? (March 2016) (1)
- (18) Define: (a) Osmosis (b) Freezing point. (July 2016) (2)
- (19) 3.795 g of sulphur is dissolved in 100 g of CS_2 . This solution boils at 319.81 K. What is the molecular formula of sulphur in solution? The boiling point of CS_2 is 319.45 K. [Given that K_b for $\text{CS}_2 = 2.42 \text{ K kg mol}^{-1}$ and atomic mass of S = 32.] [Ans. S_8] (July 2016) (3)
- (20) State Henry's law. (July 2016) (1)
- (21) A solution of a substance having mass $1.8 \times 10^{-3} \text{ kg}$ has the osmotic pressure of 0.52 atm at 280K. Calculate the molar mass of the substance used. [Volume = 1 dm^3 , $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$] [Ans. 79.49 g mol^{-1}] (March 2017) (2)
- (22) The boiling point of benzene is 353.23 K. When 1.80 gram of non-volatile solute was dissolved in 90 gram of benzene. The boiling point is raised to 354.11 K. Calculate the molar mass of solute. [K_b for benzene = 2.53 K mol^{-1}] [Ans. 57.5 g mol^{-1}] (March 2017) (2)
- (23) State Henry's Law. How does solubility of a gas in water varies with temperature? (July 2017) (2)
- (24) Define: (a) Molality (b) Osmotic pressure. (July 2017) (2)

- (25) An organic substance ($M = 169 \text{ gram mol}^{-1}$) is dissolved in 2000 cm^3 of water. Its osmotic pressure at 12°C was found to be 0.54 atm . If $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$, calculate the mass of the solute. **[Ans. 7.796 g]** (July 2017) (2)
- (26) Derive the relation between elevation of boiling point and molar mass of solute. (March 2018) (2)
- (27) Define: Semipermeable membrane. (March 2018) (1)
- (28) (a) State Henry's law
(b) 22.22 gram of urea was dissolved in 300 grams of water. Calculate the number of moles of urea and molality of the urea solution.
(Given: Molar mass of urea = 60 gram mol^{-1}) **[Ans. 0.3703 mol; 0.1234 mol kg^{-1}]** (March 2018) (2)
- (29) Derive van't Hoff general solution equation for 'n' moles of solute. (July 2018; March 2019) (2)
- (30) What is freezing point of a liquid? The freezing point of pure benzene is 278.4 K . Calculate the freezing point of the solution when 2.0 gram of a solute having molecular weight 100 gram is added to 100 gram of benzene. [K_f for benzene = 5.12 kg mol^{-1}] **[Ans. $T = 277.376 \text{ K}$]** (July 2018) (3)
- (31) Define the following terms:
(i) Isotonic solution (ii) Hypertonic solution (iii) Hypotonic solution. (March 2019) (3)
- (32) Define osmotic pressure. Write mathematical expression between cryoscopic constant and molar mass of solute. (July 2019) (2)
- (33) Derive $\pi = CRT$. (July 2019) (2)
- (34) Define the following: (i) Molality (ii) Mole fraction. (July 2019) (2)
- (35) What is the concentration of dissolved oxygen at 50°C under pressure of one atmosphere if partial pressure of oxygen at 50°C is 0.14 atm .
(Henry's law constant for oxygen = $1.3 \times 10^{-3} \text{ mol dm}^{-3} \text{ atm}^{-1}$) **[Ans. $1.82 \times 10^{-4} \text{ mol dm}^{-3}$]** (March 2020) (1)
- (36) Define: (a) Molality (b) Osmotic pressure. (March 2020) (2)
- (37) Derive the mathematical expression between molar mass of a non-volatile solute and elevation of boiling point. State and explain van't Hoff-Avogadro's law. (March 2020) (4)
- (38) Define 'Cryoscopic constant'. Derive the relation between elevation of boiling point and molar mass of solute. (Sept. 2021) (3)
- (39) What is the molar mass of a solute if a solution prepared by dissolving 0.822 g of it in 0.3 dm^3 of water has an osmotic pressure of 0.196 atm at 298 K ? **[Ans. 341.9 g mol^{-1}]** (Sept. 2021) (3)
- (40) Derive an expression to calculate molar mass of non volatile solute by osmotic pressure measurement. (March 2022) (2)
- (41) Henry's law constant for $\text{CH}_3\text{Br}_{(g)}$ is $0.159 \text{ mol dm}^{-3} \text{ bar}^{-1}$ at 25°C .
What is solubility of $\text{CH}_3\text{Br}_{(g)}$ in water at same temperature and partial pressure of 0.164 bar ? **[Ans. $0.026 \text{ mol dm}^{-3}$]** (March 2022) (2)
- (42) Define the following terms: (i) Isotonic solution (ii) Osmosis. (March 2022) (2)
- (43) Define: (i) Osmotic pressure (ii) Ebullioscopic constant. (July 2022) (2)
- (44) 5% aqueous solution of cane sugar has freezing point of 271 K . Calculate freezing point of 5% glucose solution. [Molar mass of cane sugar = 342 g mol^{-1}] **[Ans. 269.2 K]** (July 2022) (2)
- (45) The normal boiling point of ethyl acetate is 77.06°C . A solution of 50 g of non-volatile solute in 150 g of ethyl acetate boils at 84.27°C . Evaluate the molar mass of solute if K_b for ethyl acetate is $2.77 \text{ K kg mol}^{-1}$. **[Ans. 128 g mol^{-1}]** (July 2022) (2)
(March 2023) (1)
- (46) Write the SI unit of cryoscopic constant.
- (47) Calculate the mole fraction of solute, if the vapour pressure of pure benzene at certain temperature is 640 mm Hg and vapour pressure of solution of a solute in benzene is 600 mm Hg . **[Ans. Mole fraction = 0.062]** (March 2023)
- (48) Define osmosis. How will you determine molar mass of non-volatile solute by elevation of boiling point. (March 2023) (3)

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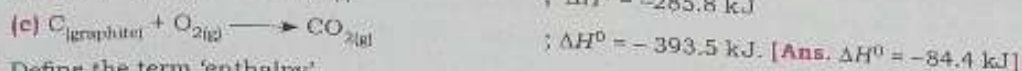
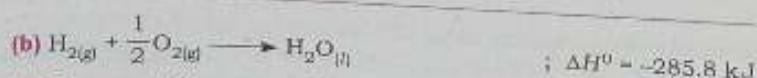
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(Sept. 2021, March 2022) (2)

- (1) Derive the relationship between pH and pOH. (Sept. 2021) (3)
- (2) Define 'Solubility product'. Derive the relationship between solubility and solubility product for PbI_2 . (March 2022) (3)
- (3) Calculate the pH of buffer solution composed of 0.01 M weak base BOH and 0.02 M of its salt BA. [$K_b = 1.8 \times 10^{-5}$ for weak base] **[Ans. pH = 13.95]** (July 2022) (2)
- (4) The pH of solution is 3.12. Calculate the concentration of H_3O^+ ion. **[Ans. $7.568 \times 10^{-4} \text{ M}$]** (July 2022) (2)
- (5) Derive an expression of Ostwald's dilution law for weak acid. (March 2023) (2)
- (6) Define: Acidic buffer solution. Write the relationship between solubility and solubility product for PbCl_2 . (March 2023) (2)
- (7) A weak monobasic acid is 10% dissociated in 0.05 M solution. What is percent dissociation in 0.15 M solution? **[Ans. % dissociation = 5.74%]** (March 2023) (2)

4 CHEMICAL THERMODYNAMICS

- (1) Prove that $\Delta H = \Delta U + \Delta nRT$. What is the condition under which $\Delta U = \Delta H$? (March 2013) (2)
- (2) 300 mol of perfect gas occupies 13L at 320 K. Calculate the work done in joules when the gas expands-
 (a) isothermally against a constant external pressure of 0.20 atm.
 (b) isothermal and reversible process.
 (c) into vacuum until the volume of gas is increased by 3L. ($R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$)
[Ans. (a) -60.78 J (b) -165.8 J (c) 0] (March 2013) (2)
- (3) Explain with reason sign conventions of ΔS in the following reactions:
 (i) $\text{N}_{2(g)} + 3\text{H}_{2(g)} \longrightarrow 2\text{NH}_{3(g)}$
 (ii) $\text{CO}_{2(g)} \longrightarrow \text{CO}_{2(aq)}$ (March 2013) (2)
- (4) Calculate ΔH° for the following reaction:
 $2\text{H}_3\text{BO}_{3(aq)} \longrightarrow \text{B}_2\text{O}_{3(s)} + 3\text{H}_2\text{O}_{(l)}$
 Given that: (a) $\text{H}_3\text{BO}_{3(aq)} \longrightarrow \text{HBO}_{2(aq)} + \text{H}_2\text{O}_{(l)}$, $\Delta H^\circ_1 = -0.02 \text{ kJ}$
 (b) $\text{H}_2\text{B}_4\text{O}_{7(s)} \longrightarrow 2\text{B}_2\text{O}_{3(s)} + \text{H}_2\text{O}_{(l)}$, $\Delta H^\circ_2 = 17.3 \text{ kJ}$
 (c) $\text{H}_2\text{B}_4\text{O}_{7(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow 4\text{HBO}_{2(aq)}$, $\Delta H^\circ_3 = -11.58 \text{ kJ}$ [Ans. $\Delta H^\circ = +14.40 \text{ kJ}$] (Oct. 2013) (3)
- (5) What are the conditions for spontaneous and non-spontaneous reactions in terms of free energy change? Define entropy. (Oct. 2013) (2)
- (6) Derive the relation $\Delta H - \Delta U = \Delta nRT$. (Oct. 2013) (2)
- (7) Derive a relation between ΔH and ΔU for a chemical reaction. (March 2014) (2)
- (8) One mole of a gas expands by 3L against a constant pressure of 3 atmosphere. Calculate the work done in-
 (a) L. atmosphere (b) Joules (c) Calories. [Ans. (a) -90 L. atm (b) -911.7 J (c) -217.98 cal.] (March 2014) (3)
- (9) Derive the relation between ΔG° and equilibrium constant (K) for the reaction-
 $aA + bB \rightleftharpoons cC + dD$ (March 2014) (2)
- (10) What is the value of ΔS_{sur} for the following reaction at 298K?
 $6\text{CO}_{2(g)} + 6\text{H}_2\text{O}_{(l)} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6(s) + 6\text{O}_{2(g)}$
 Given that, $\Delta G^\circ = 2879 \text{ kJ mol}^{-1}$, $\Delta S = -210 \text{ J K}^{-1} \text{ mol}^{-1}$. [Ans. -9.451 kJ] (Oct. 2014) (3)
- (11) State and explain Hess's law of constant heat summation. (Oct. 2014; July 2018; March 2020) (2)
- (12) Derive the equation: $W = -P_{\text{ext}} \Delta V$. (March 2015) (3)
- (13) Define the following terms: (a) Enthalpy of fusion (b) Enthalpy of atomization. (March 2015) (2)
- (14) Determine whether the reactions with the following ΔH and ΔS values are spontaneous or non-spontaneous. State whether the reactions are exothermic or endothermic.
 (a) $\Delta H = -110 \text{ kJ}$, $\Delta S = +40 \text{ JK}^{-1}$ at 400 K (b) $\Delta H = +40 \text{ kJ}$, $\Delta S = -120 \text{ JK}^{-1}$ at 250 K.
 [Ans. (a) spontaneous and exothermic (b) non-spontaneous and endothermic] (March 2015) (3)
- (15) Write one statement of first law of thermodynamics and its mathematical expression. (March 2015) (2)
- (16) Derive an expression for maximum work in isothermal reversible expansion of two moles of an ideal gas. (Oct. 2015) (2)
- (17) The equilibrium constant K_p for the reaction
 $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}_{(g)}$ is 130 at 510 K. Calculate ΔG° for the following reaction at the same temperature.
 $2\text{HI} \rightleftharpoons \text{H}_{2(g)} + \text{I}_{2(g)}$ [Given: $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$] [Ans. $\Delta G^\circ = 20490 \text{ J}$] (Oct. 2015) (3)
- (18) State: (a) Second law of thermodynamics in terms of entropy
 (b) Third law of thermodynamics. (Oct. 2015) (2)
- (19) Write mathematical equations of first law of thermodynamics for the following processes:
 (a) Adiabatic process (b) Isochoric process. (March 2016) (3)
- (20) Define Enthalpy of sublimation. How is it related to enthalpy of fusion and enthalpy of vaporization? (March 2016) (2)
- (21) Calculate C - Cl bond enthalpy from following reaction:
 $\text{CH}_3\text{Cl}_{(g)} + \text{Cl}_{2(g)} \longrightarrow \text{CH}_2\text{Cl}_{2(g)} + \text{HCl}_{(g)}$; $\Delta H^\circ = -104 \text{ kJ}$ if C - H, Cl - Cl and H - Cl bond enthalpies are 414, 243 and 431 kJ mol^{-1} respectively. [Ans. 330 kJ mol^{-1}] (March 2016) (3)
- (22) Explain the relationship between Gibb's standard energy change of the reaction and equilibrium constant. (July 2016) (2)
- (23) Calculate the standard enthalpy of the reaction,
 $2\text{C}_{(\text{graphite})} + 3\text{H}_{2(g)} \longrightarrow \text{C}_2\text{H}_{6(g)}$; $\Delta H^\circ = ?$ from the following ΔH° values:
 (a) $\text{C}_2\text{H}_{6(g)} + \frac{7}{2}\text{O}_{2(g)} \longrightarrow 2\text{CO}_{2(g)} + 3\text{H}_2\text{O}_{(l)}$; $\Delta H^\circ = -1560 \text{ kJ}$



(24) Define the term 'enthalpy'.

What will happen to the internal energy if work is done by the system?

(25) Calculate ΔH° for the reaction between ethene and water to form ethyl alcohol from the following data: (March 2017) (2)

$\Delta_c H^\circ \text{C}_2\text{H}_5\text{OH}_{(l)} = -1368 \text{ kJ}$; $\Delta_c H^\circ \text{C}_2\text{H}_{4(g)} = -1410 \text{ kJ}$.

Does the calculated ΔH° represent the enthalpy of formation of liquid ethanol?

[Ans. $\Delta H^\circ = -42 \text{ kJ}$, is not enthalpy of formation of liquid ethanol.] (March 2017) (3)

(26) Derive an expression for maximum work.

(27) Write the mathematical expression of the first law of thermodynamics for the following processes (March 2017) (2)

(a) Isothermal (b) Adiabatic (c) Isochoric (d) Isobaric.

(28) Calculate the standard enthalpy of combustion of $\text{CH}_3\text{COOH}_{(l)}$ from the following data: (July 2017) (2)

$\Delta_f H^\circ (\text{CO}_2) = 393.3 \text{ kJ mol}^{-1}$; $\Delta_f H^\circ (\text{H}_2\text{O}) = -285.8 \text{ kJ mol}^{-1}$; $\Delta_f H^\circ (\text{CH}_3\text{COOH}) = -483.2 \text{ kJ mol}^{-1}$

[Ans. $\Delta H^\circ = -875 \text{ kJ mol}^{-1}$.] (July 2017) (3)

(29) Distinguish between isothermal process and adiabatic process.

(30) State third law of thermodynamics. Give its two uses. (July 2017) (2)

(31) Calculate the internal energy at 298K for the formation of one mole of ammonia, if the enthalpy change at constant pressure is $-42.0 \text{ kJ mol}^{-1}$. (Given: $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$) [Ans. -39.523 kJ] (March 2018) (3)

(32) Define: (a) Enthalpy of atomization (b) Enthalpy of vaporization. (March 2018) (2)

(33) 5 moles of helium expand isothermally and reversibly from a pressure $40 \times 10^{-5} \text{ Nm}^{-2}$ to $4 \times 10^{-5} \text{ Nm}^{-2}$ at 300 K. Calculate the work done, change in internal energy and heat absorbed during the expansion.

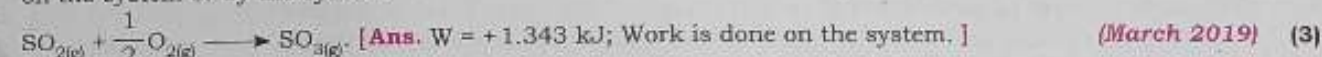
($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$) [Ans. $W_{\text{max}} = -28.720 \text{ kJ}$, $\Delta U = 0$, $q = 287.720 \text{ kJ}$] (July 2018) (3)

(34) State and explain Hess's law of constant heat summation. (July 2018; March 2020; 2022) (2)

(35) Write the features of reversible process. (July 2018) (2)

(36) Write the conditions for maximum work done by the system. (March 2019) (2)

(37) Calculate the work done in the following reaction at 50°C . State whether work is done on the system or by the system.



(38) The standard enthalpy of combustion of formaldehyde $\Delta_c H^\circ = -571 \text{ kJ}$. How much heat will be evolved in the formation of 22 g of CO_2 ? [Ans. 285.5 kJ] (March 2019) (3)

(39) Conversion of carbon into carbon dioxide can not perform the work. Give reason. (July 2019) (1)

(40) Define the term enthalpy. Classify the following properties into intensive and extensive properties: (July 2019) (3)

(i) Pressure (ii) Density (iii) Work (iv) Heat.

(41) Calculate the work done by the following chemical reaction:



State whether the work is done on the system or by the system.

[Ans. $W = -18.62 \text{ kJ}$, work is done by the system.] (July 2019) (2)

(42) For the reaction: $\text{N}_2\text{O}_{4(g)} \longrightarrow 2\text{NO}_{2(g)}$; $\Delta H^\circ = +57.24 \text{ kJ}$, $\Delta S^\circ = 175.8 \text{ JK}^{-1}$.

At what temperature the reaction will be spontaneous?

[Ans. $T > 325.6 \text{ K}$, the reaction will be spontaneous.] (March 2020) (2)

(43) Define: (a) Reversible process (b) Standard enthalpy of combustion.

Calculate the enthalpy change for the reaction: $\text{N}_{2(g)} + 3\text{H}_{2(g)} \longrightarrow 2\text{NH}_{3(g)}$.

The bond enthalpies are:

Bond	$\text{N}\equiv\text{N}$	$\text{H}-\text{H}$	$\text{N}-\text{H}$
ΔH° in kJ mol^{-1}	946	435	389

[Ans. $\Delta H^\circ = -83 \text{ kJ}$] (March 2020) (2)

(44) In a particular reaction, 2 kJ of heat is released by the system and 6 kJ of work is done on the system. Calculate ΔU . [Ans. $\Delta U = +4 \text{ kJ}$] (Sept. 2021) (2)

(45) Calculate the standard enthalpy of $\text{N}_2\text{H}_{4(g)} + \text{H}_{2(g)} \longrightarrow 2\text{NH}_{3(g)}$.
if $\Delta H^\circ (\text{N}-\text{H}) = 389 \text{ kJ mol}^{-1}$, $\Delta H^\circ (\text{H}-\text{H}) = 435 \text{ kJ mol}^{-1}$, $\Delta H^\circ (\text{N}-\text{N}) = 159 \text{ kJ mol}^{-1}$. (Sept. 2021) (3)

[Ans. -184 kJ]

(46) Define: (i) Intensive property (ii) Enthalpy of sublimation.
2 moles of an ideal gas are expanded isothermally and reversibly from 20 L to 30 L at 300 K. Calculate the work done. ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$) [Ans. 2023 J] (Sept. 2021) (4)

- (47) One mole of an ideal gas is expanded isothermally and reversibly from 10 L to 15 L at 300 K. Calculate the work done in the process. [Ans. -1.0115 kJ] (March 2022) (2)
- (48) Calculate the standard enthalpy of formation of $\text{CH}_3\text{OH}_{(l)}$ from the following data:
- (i) $\text{CH}_3\text{OH}_{(l)} + \frac{3}{2}\text{O}_{2(g)} \longrightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(l)}$; $\Delta H^\circ = -726 \text{ kJ mol}^{-1}$
- (ii) $\text{C}_{(s)} + \text{O}_{2(g)} \longrightarrow \text{CO}_{2(g)}$; $\Delta H^\circ = -393 \text{ kJ mol}^{-1}$
- (iii) $\text{H}_{2(g)} + \frac{1}{2}\text{O}_{2(g)} \longrightarrow \text{H}_2\text{O}_{(l)}$; $\Delta H^\circ = -286 \text{ kJ mol}^{-1}$
- [Ans. $\Delta_f H^\circ = -239 \text{ kJ mol}^{-1}$.] (March 2022; July 2022) (3)
- (49) Write the mathematical equation for the first law of thermodynamics for
(i) Isothermal process (ii) Adiabatic process. (March 2022) (2)
- (50) Define the relationship between ΔH and ΔU for gas phase reaction. (July 2022) (2)
- (51) Write the correct condition of spontaneity in terms of Gibbs' energy. (March 2023) (1)
- (52) Define extensive property. Calculate the work done during the expansion of 2 moles of an ideal gas from 10 dm^3 to 20 dm^3 at 298 K in vacuum. [Ans. Work done = 0, Free expansion.] (March 2023) (2)
- (53) 2000 mmol of an ideal gas expanded isothermally and reversibly from 20 L to 30 L at 300 K, calculate the work done in the process ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$). [Ans. $W_{\text{max}} = -2023.08 \text{ J}$.] (March 2023) (3)
- (54) Derive relationship between ΔH and ΔU for gaseous reaction. (March 2023) (2)

5

ELECTROCHEMISTRY

- (1) State Kohlrausch Law and write mathematical expression of molar conductivity of the given solution at infinite dilution. (March 2013) (2)
- (2) Write the cell reactions in lead storage battery during discharge. (March 2013) (2)
- (3) In the electrolysis of AgNO_3 solution 0.7 g of Ag is deposited after a certain period of time. Calculate the quantity of electricity required in coulomb. [Molar mass of Ag is 107.9 g mol^{-1}] [Ans. 626.1 coulomb] (March 2013) (2)
- (4) Write electrode reaction and net cell reaction for fuel cell. Calculate e.m.f. of the following cell at 25°C :
 $\text{Zn}_{(s)} | \text{Zn}^{2+}_{(aq)} (0.1 \text{ M}) || \text{Cu}^{2+}_{(aq)} (0.5 \text{ M}) | \text{Cu}_{(s)}$
 Standard reduction potential (SRP) of Zn and Cu are -0.76 V and 0.334 V respectively.
 [Ans. $E_{\text{cell}} = 1.114 \text{ V}$] (Oct. 2013) (2)
- (5) State and explain Faraday's second law of electrolysis. (Oct. 2013) (2)
- (6) Resistance and conductivity of a cell containing 0.001 M KCl solution at 298K are 1500 Ω and $1.46 \times 10^{-4} \text{ S cm}^{-1}$ respectively. What is the cell constant? [Ans. 0.219 cm^{-1} .] (March 2014) (2)
- (7) State the first and second law of electrolysis. (March 2014) (2)
- (8) Write any four applications of electrochemical series. (Oct. 2014) (2)
- (9) With the help of the equation, $\Delta G^\circ = -nFE^\circ_{\text{cell}}$ explain that cell potential is an intensive property. (Oct. 2014) (2)
- (10) How much electricity in terms of Faraday is required to produce:
 (a) 20 g of Ca from molten CaCl_2 (b) 40 g of Al from molten Al_2O_3
 (Given: Molar mass of Calcium and Aluminium are 40 g mol^{-1} and 27 g mol^{-1} respectively.)
 [Ans. (a) 1F (b) 4.4F] (Oct. 2014) (2)
- (11) Draw neat and labelled diagram of dry cell. (March 2015) (2)
- (12) Arrange the following reducing agents in the order of increasing strength under standard state conditions. Justify the answer.
- | Element | $\text{Al}_{(s)}$ | $\text{Cu}_{(s)}$ | $\text{Cl}_{(aq)}$ | $\text{Ni}_{(s)}$ |
|-----------|-------------------|-------------------|--------------------|-------------------|
| E° | -1.66 V | 0.34 V | 1.36 V | -0.26 V |
- (March 2015) (2)
- (13) Calculate E_{cell} and ΔG for the following at 28°C :
 $\text{Mg}_{(s)} + \text{Sn}^{2+} (0.04\text{M}) \longrightarrow \text{Mg}^{2+} (0.06\text{M}) + \text{Sn}_{(s)}$ $E^\circ_{\text{cell}} = 2.23 \text{ V}$.
 Is the reaction spontaneous? [Ans. $E_{\text{cell}} = 2.224 \text{ V}$; $G = -429.2 \text{ kJ}$] (March 2015) (3)
- (14) Can copper sulphate solution be stored in an iron vessel? Explain. (Oct. 2015) (2)
- (15) Resistance of conductivity cell filled with 0.1 M KCl solution is 100 ohms, calculate the conductivity and molar conductivity of 0.02 M KCl solution. [Given: Conductivity of 0.1 MKCl solution is 1.29 S m^{-1} .]
 [Ans. $k_2 = 0.00248 \text{ S cm}^{-1}$, $\Lambda = 124 \text{ S cm}^2 \text{ mol}^{-1}$.] (Oct. 2015) (3)
- (16) Define 'Molar conductivity'. (March 2016) (1)
- (17) Define cell constant. Draw a neat and well labelled diagram of primary reference electrode. (March 2016) (3)

- (18) Conductivity of a solution is $6.23 \times 10^{-5} \Omega^{-1} \text{cm}^{-1}$ and its resistance is 13710Ω . If the electrodes are 0.7 cm apart, calculate the cross-sectional area of electrode. [Ans. $a = 0.82 \text{ cm}^2$] (March 2016) (3)
- (19) Write Nernst equation and explain the terms involved. (July 2016) (2)
- (20) The conductivity of 0.02 M AgNO_3 at 25°C is $2.428 \times 10^{-3} \Omega^{-1} \text{cm}^{-1}$. What is its molar conductivity? [Ans. $\Lambda = 121.4 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$] (July 2016) (2)
- (21) What are 'fuel cells'? Write cathode and anode reaction in a fuel cell. (March 2017) (2)
- (22) 0.05 M NaOH solution offered a resistance of 31.6 W in a conductivity cell at 298 K . If the cell constant of the cell is 0.367 cm^{-1} . Calculate the molar conductivity of NaOH solution. [Ans. $\Lambda = 232.2 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$] (March 2017) (3)
- (23) State Faraday's first law of electrolysis. (March 2017) (1)
- (24) Construct a labelled diagram for the following cell:
 $\text{Zn}_{(s)} | \text{Zn}^{2+} (1 \text{ M}) || \text{H}^+ (1 \text{ M}) | \text{H}_2(\text{g}, 1 \text{ atm}) | \text{Pt}$ (July 2017) (2)
- (25) Write the cell representation and calculate equilibrium constant for the following redox reaction:
 $\text{Ni}_{(s)} + 2\text{Ag}^+_{(\text{aq})} (1 \text{ M}) \longrightarrow \text{Ni}^{2+}_{(\text{aq})} (1 \text{ M}) + 2\text{Ag}_{(\text{s})}$ at 25°C ; $E^\circ_{\text{Ni}} = -0.25 \text{ V}$ and $E^\circ_{\text{Ag}} = 0.799 \text{ V}$
 [Ans. $k = 2.754 \times 10^{35}$] (July 2017) (3)
- (26) Draw a neat and labelled diagram of lead storage battery. (March 2018) (2)
- (27) Define: Reference electrode. (March 2018) (1)
- (28) How many faradays of electricity are required to produce 13 gram of aluminium from aluminium chloride solution? (Given: molar mass of $\text{Al} = 27.0 \text{ gram mol}^{-1}$) [Ans. 1.444 F] (March 2018) (3)
- (29) Represent a cell consisting of $\text{Mg}^{2+} | \text{Mg}$ half cell and $\text{Ag}^+ | \text{Ag}$ half cell and write the cell reaction.
 $(E^\circ_{\text{Ag}} = 0.799 \text{ V}, E^\circ_{\text{Mg}} = -2.37 \text{ V})$ (July 2018) (2)
- (30) How much quantity of electricity in coulomb is required to deposit $1.346 \times 10^{-3} \text{ kg}$ of Ag in 3.5 minutes from AgNO_3 solution? (Given: Molar mass of Ag is $108 \times 10^{-3} \text{ kg mol}^{-1}$)
 [Ans. $Q = 1214 \text{ coulomb}$] (July 2018) (3)
- (31) Define resistivity. (July 2018) (1)
- (32) How many faradays of electricity are required to produce 6 g of Mg from MgCl_2 ? [Ans. 0.50 F] (March 2019) (2)
- (33) The molar conductivity of 0.05 M BaCl_2 solution at 25°C is $223 \Omega^{-1} \text{cm}^{-1}$. What is its conductivity? [Ans. $k = 0.0115 \Omega^{-1} \text{cm}^{-1}$] (March 2019) (2)
- (34) Define electrochemical series. Write its applications. (March 2019) (3)
- (35) The molar conductivity of 0.02 M HCl solution is $407.2 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ at 25°C . Calculate its conductivity. [Ans. $8.144 \times 10^{-3} \Omega^{-1} \text{cm}^{-1}$] (July 2019) (2)
- (36) Draw a neat labelled diagram of $\text{H}_2 - \text{O}_2$ Fuel cell. (July 2019) (2)
- (37) Draw a neat labelled diagram of standard hydrogen electrode. (July 2019) (2)
- (38) The standard e.m.f. of the following cell is 0.463 V
 $\text{Cu}_{(s)} | \text{Cu}^{2+}_{(\text{aq})} (1 \text{ M}) || \text{Ag}^+_{(\text{aq})} (1 \text{ M}) | \text{Ag}_{(s)}$
 If the standard potential of Ag electrode is 0.800 V , what is the standard potential of Cu electrode?
 [Ans. $E^\circ_{\text{Cu}} = 0.337 \text{ V}$] (March 2020) (1)
- (39) Write the cell reaction and calculate E° cell of the following electrochemical cell:
 $\text{Al}_{(s)} | \text{Al}^{3+}_{(\text{aq})} (1 \text{ M}) || \text{Zn}^{2+}_{(\text{aq})} (1 \text{ M}) | \text{Zn}_{(s)}$
 $E^\circ_{\text{Al}} = -1.66 \text{ V}, E^\circ_{\text{Zn}} = -0.76 \text{ V}$. [Ans. $E^\circ_{\text{cell}} = 0.90 \text{ V}$] (March 2020) (2)
- (40) Define terms: (a) Electrochemical series (b) Corrosion. Write two applications of electrochemical series. (March 2020) (3)
- (41) Write the value of $\frac{2.303RT}{F}$ in Nernst equation. (Sept. 2021) (1)
- (42) The molar conductivity of 0.01 M acetic acid at 25°C is $18 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$. Calculate its degree of dissociation in 0.01 M solution and dissociation constant, if the molar conductivity of acetic acid at zero concentration is $400 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$. [Ans. $\alpha = 0.015$; $K_a = 2.025 \times 10^{-5}$] (Sept. 2021) (2)
- (43) State Kohlrausch law of independent migration of ions. Write and explain two applications of electrochemical series. Write unit of cell constant. (Sept. 2021) (4)
- (44) How many moles of electrons are required for reduction of 2 moles of Zn^{2+} to Zn ? How many faraday of electricity will be required? [Ans. 4 moles ; 4 faraday] (March 2022) (2)
- (45) Define reference electrode. Write the functions of salt bridge. Draw neat, labelled diagram of standard hydrogen electrode (SHE). (March 2022) (4)
- (46) Write relation between molar conductivity and conductivity of solution. (July 2022) (1)

- (47) Write cell representation of standard hydrogen electrode. (July 2022) (1)
- (48) State Kohlrausch Law of independent migration of ions. Write one application of Kohlrausch Law of independent migration of ions. (July 2022) (1)
- (49) What is reference electrode? (March 2023) (1)
- (50) Calculate the molar conductivity for 0.5 M BaCl_2 if its conductivity at 298 K is $0.01 \Omega^{-1} \text{cm}^{-1}$.
[Ans. $\Lambda_m = 20 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$] (March 2023) (1)
- (50) Calculate standard Gibbs energy change at 25°C for the cell reaction:
 $\text{Cd}_{(s)} + \text{Sn}^{2+}_{(aq)} \longrightarrow \text{Cd}^{2+}_{(aq)} + \text{Sn}_{(s)}$; $E^\circ_{\text{Cd}} = -0.403 \text{ V}$, $E^\circ_{\text{Sn}} = -0.136 \text{ V}$. [Ans. $\Delta G^\circ = -51.53 \text{ kJ}$] (March 2023) (2)
- (52) Draw labelled diagram of H_2 - O_2 fuel cell. Write two applications of fuel cell. (March 2023) (3)

6

CHEMICAL KINETICS

- (1) Distinguish between molecularity and order of the reaction.
(March 2008, 2009, 2011, 2020; Oct. 2008, 2009, 2010, 2013, 2014) (2)
- (2) Consider the reaction:
 $3\text{I}^-_{(aq)} + \text{S}_2\text{O}_8^{2-}_{(aq)} \longrightarrow \text{I}_3^-_{(aq)} + 2\text{SO}_4^{2-}_{(aq)}$ at particular time t , $\frac{d[\text{SO}_4^{2-}]}{dt} = 2.2 \times 10^{-2} \text{ M/s}$.
What are the values of the following at the same time?
(a) $-\frac{d[\text{I}^-]}{dt}$ (b) $-\frac{d[\text{S}_2\text{O}_8^{2-}]}{dt}$ (c) $-\frac{d[\text{I}_3^-]}{dt}$
[Ans. (a) $3.3 \times 10^{-2} \text{ M/s}$ (b) $1.1 \times 10^{-2} \text{ M/s}$ (c) $1.1 \times 10^{-2} \text{ M/s}$] (March 2013) (3)
- (3) Define activation energy. Calculate activation energy for a reaction of which rate constant becomes four times when temperature changes from 30°C to 50°C. (Given $R = 8.314 \text{ JK}^{-1} \text{mol}^{-1}$).
[Ans. $E_a = 56.4 \text{ kJ mol}^{-1}$] (Oct. 2013) (3)
- (4) Write molecularity of the following reaction:
 $2\text{NO}_{(g)} + \text{O}_{2(g)} \longrightarrow 2\text{NO}_{2(g)}$ (March 2014) (1)
- (5) The decomposition of $\text{N}_2\text{O}_{5(g)}$ at 320K according to the following equation follows first order reaction:
 $\text{N}_2\text{O}_{5(g)} \longrightarrow 2\text{NO}_{2(g)} + \frac{1}{2}\text{O}_{2(g)}$
The initial concentration of $\text{N}_2\text{O}_{5(g)}$ is $1.24 \times 10^{-2} \text{ mol L}^{-1}$ and after 60 minutes, $0.20 \times 10^{-2} \text{ mol L}^{-1}$.
Calculate the rate constant of the reaction at 320 K. [Ans. $k = 0.0304 \text{ min}^{-1}$] (March 2014) (3)
- (6) Derive the relation between half-life period and rate constant for first order reaction. (March 2014) (2)
- (7) Sucrose decomposes in acid solution to give glucose and fructose according to the first order rate law. The half life of the reaction is 3 hours. Calculate fraction of sucrose which will remain after 8 hours.
[Ans. 0.1576] (Oct. 2014; March 2015) (3)
- (8) Derive the relation between half life and rate constant for a first order reaction. (March 2015, 2017) (2)
- (9) Define: (a) Average rate of reaction (b) Instantaneous rate of reaction. (Oct. 2015) (2)
- (10) Ammonia and oxygen react at high temperature as:
 $4\text{NH}_{3(g)} + 5\text{O}_{2(g)} \longrightarrow 4\text{NO}_{(g)} + 6\text{H}_2\text{O}_{(g)}$
In an experiment, rate of formation of $\text{NO}_{(g)}$ is $3.6 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$.
Calculate: (a) Rate of disappearance of ammonia, (b) Rate of formation of water.
[Ans. (a) $3.6 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$ (b) $5.4 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$] (Oct. 2015) (3)
- (11) Define Zero order reaction. (March 2016) (1)
- (12) Explain graphical method to determine activation energy of a reaction. (March 2016) (2)
- (13) In a first order reaction $x \rightarrow y$, 40% of the given sample of compound remains unreacted in 45 minutes. Calculate rate constant of the reaction. [Ans. 0.02036 min^{-1}] (March 2016) (2)
- (14) The rate constant of a first order reaction are 0.58 s^{-1} at 313 K and 0.045 s^{-1} at 293 K. What is the energy of activation for the reaction? [Ans. $96.85 \text{ kJ mol}^{-1}$] (July 2016) (3)
- (15) Write the Nernst equation and explain the terms involve. (July 2016) (2)
- (16) In the Arrhenius equation for a first order reaction, the values of 'A' and E_a are $4 \times 10^{13} \text{ sec}^{-1}$ and 98.6 kJ mol^{-1} respectively. At what temperature will its half life period be 10 minutes?
[$R = 8.314 \text{ JK}^{-1} \text{mol}^{-1}$] [Ans. $T = 311.5 \text{ K}$] (March 2017) (3)
- (17) The rate law for the reaction
 $2\text{H}_{2(g)} + 2\text{NO}_{(g)} \longrightarrow \text{N}_{2(g)} + 2\text{H}_2\text{O}_{(g)}$ is given by $\text{rate} = k[\text{H}_2][\text{NO}]^2$
The reaction occurs in the following two steps:
(a) $\text{H}_{2(g)} + 2\text{NO}_{(g)} \longrightarrow \text{N}_2\text{O}_{(g)} + \text{H}_2\text{O}_{(g)}$



What is the rate of N_2O in the mechanism? What is the molecularity of the elementary steps? (July 2017) (2)

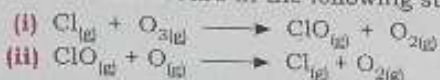
- (18) From the following data for the liquid phase reaction $\text{A} \rightarrow \text{B}$, determine the order of reaction and calculate its rate constant:

t/s	0	600	1200	1800
[A]/mol L ⁻¹	0.624	0.446	0.318	0.226

[Ans. First order; $5.6 \times 10^{-4} \text{ s}^{-1}$]

(July 2017) (3)

- (19) A certain reaction occurs in the following steps:



(a) What is the molecularity of each of the elementary steps?

(b) Identify the reaction intermediate and write the chemical equation for overall reaction. (March 2018) (2)

- (20) The reaction $\text{A} + \text{B} \longrightarrow \text{products}$ is first order in each of the reactants.

(a) How does the rate of reaction change if the concentration of A is increased by factor 3?

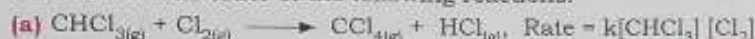
(b) What is the change in the rate of reaction if the concentration of A is halved and concentration of B is doubled? [Ans. (a) The rate of reaction is increased by factor 3

(b) The rate of reaction remains unchanged.]

(March 2018) (2)

- (21) Define the order of chemical reaction.

Find the overall order of the following reactions:



(July 2018) (2)

- (22) In a first order reaction $\text{A} \longrightarrow \text{product}$, 80 % of the given sample of compound decomposes in 40 min. What is the half life period of the reaction? [Ans. 17.22 min⁻¹]

(July 2018) (3)

- (23) Write Arrhenius equation. Derive an expression for temperature variations. (March 2019) (3)

- (24) The rate of a first order reaction, $\text{A} \longrightarrow \text{B}$ is $5.4 \times 10^{-6} \text{ Ms}^{-1}$ when [A] is 0.3M. Calculate the rate constant of the reaction. [Ans. $1.8 \times 10^{-5} \text{ s}^{-1}$]

(March 2019) (1)

- (25) The half life period of a first order reaction is 6.0 h. Calculate the rate constant. (March 2019) (1)

- (26) The half life of first order reaction is 6.0 hours. How long it will take for the concentration of reactant to decrease from 0.8M to 0.25M. [Ans. t = 10.07 hours]

(July 2019) (3)

- (27) For a certain second order reaction energy of activation is 240 kJ mol⁻¹. Calculate its rate constant at 1023 K if the rate constant at 923 is 0.0113 m⁻¹ s⁻¹. [R = 8.314 JK⁻¹ mol⁻¹]

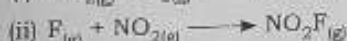
[Ans. 0.24 M⁻¹ s⁻¹]

(July 2019) (3)

- (28) Define elementary reaction.

(July 2019) (1)

- (29) A reaction occurs by the following mechanism:



Identify the intermediate and write net reaction. (July 2019) (1)

- (30) Write the mathematical relation between half life of zero order reaction and its rate constant. (March 2020) (1)

- (31) Define instantaneous rate of reaction. Explain pseudo first order reaction with suitable example. (March 2020) (3)

- (32) Define isomorphism. Derive integrated law expression for first order reaction. (Sept. 2021) (4)

- (33) What is pseudo-first order reaction? Explain with suitable example. (Sept. 2021) (2)

- (34) Write the value of $\frac{2.303RT}{F}$ in Nernst equation. (Sept. 2021) (2)

- (35) Define half life of first order reaction. Obtain the expression for half life and rate constant of the first order reaction. (March 2022) (3)

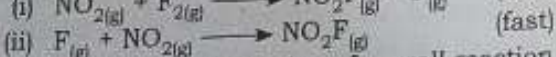
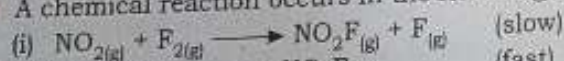
- (36) Identify the molecularity of following elementary reaction:

(September 2021) (1)



- (37) Show that time required for 99.9% completion of a first order reaction is three times the time required for 90% completion. (July 2022) (1)

- (38) A chemical reaction occurs in the following steps:



(a) Write the equation of overall reaction.

(b) Write down rate law.

(c) Identify the reaction intermediate. (July 2022) (3)

- (39) What is Pseudo first order reaction? Derive integrated rate law equation for zero order reaction. (March 2023) (3)
 (40) Show that time required for 99.9% completion of a first order reaction is three times the time required for 90% completion. (March 2023) (2)

7

ELEMENTS OF GROUPS 16, 17 AND 18

- (1) What is the action of the following reagents on ammonia?
 (a) Excess of air (b) Excess of chlorine (c) Na metal (March 2013) (3)
- (2) Explain the trends in the following properties with reference to group 16:
 (a) Atomic radii and ionic radii (b) Density
 (c) Ionisation enthalpy (d) Electronegativity (March 2013) (4)
- (3) What is the action of chlorine (Cl) on the following:
 (a) Cold and dilute caustic soda. (b) Hot and concentrated caustic soda.
 (c) Potassium bromide solution. (Oct. 2013) (3)
- (4) Write electronic configuration and two uses of neon ($Z = 10$). (Oct. 2013) (2)
- (5) Write resonating structures of ozone. (March 2014) (1)
- (6) Describe anomalous behaviour of fluorine with the other elements of group 17 with reference to:
 (a) Hydrogen bonding (b) Oxidation state (c) Polyhalide ions. (March 2014) (3)
- (7) Describe anomalous behaviour of oxygen as compared with other elements of group 16 with reference to-
 (a) Magnetic property (b) Oxidation state (c) Hydrides (Oct. 2014) (3)
- (8) Draw the structure of:
 (a) Orthophosphoric acid (b) Pyrophosphoric acid (Oct. 2014) (2)
- (9) Explain the structure of sulphur dioxide. (March 2015) (2)
- (10) Write molecular formulae and structures of the following compounds:
 (a) Dithionic acid (b) Peroxy monosulphuric acid
 (c) Pyrosulphuric acid (d) Dithionous acid (March 2015) (4)
- (11) Draw structures of: (a) Chlorine trifluoride (b) Chlorine pentafluoride. (2)
- (12) What is the action of dioxygen on:
 (a) Calcium (b) Iron (c) Carbon disulphide? (Oct. 2015) (3)
- (13) Write 'four' uses of hydrochloric acid.
 Write chemical formula of the following oxoacids of chlorine:
 (a) Hypochlorous acid (b) Chlorous acid (c) Chloric acid (d) Perchloric acid. (Oct. 2015) (4)
- (14) What happens when dilute sulphuric acid is treated with (a) Fe (b) CaF_2 ? (July 2016) (2)
- (15) What happens when thin copper leaves are thrown in jar containing chlorine? (July 2016) (2)
- (16) H_2O is liquid while H_2S is gas at room temperature. Explain. (July 2016) (2)
- (17) Write the electronic configuration of the following elements:
 (a) Sulphur ($Z = 16$) (b) Krypton ($Z = 36$) (March 2017) (2)
- (18) Write any 'two' uses of each of the following: (a) H_2SO_4 (b) Chlorine (March 2017) (2)
- (19) What is the action of concentrated sulphuric acid on the following:
 (a) Phosphorous pentachloride (b) Copper (c) Potassium chlorate. (July 2017) (3)
- (20) Arrange the following oxyacids of chlorine: HClO , HClO_2 , HClO_3 and HClO_4 with respect to:
 (a) Increasing order of thermal stability (b) Increasing order of oxidising power. (July 2017) (2)
- (21) Write balanced chemical equations for the following:
 Action of ozone on hydrogen peroxide. (March 2018) (1)
- (22) Write the molecular and structural formulae of:
 (a) Thiosulphuric acid (b) Dithionous acid (March 2018) (2)
- (23) Draw the structure of IF_7 . Write its geometry and the type of hybridization. (March 2018) (2)
- (24) Explain the following with the help of balanced chemical equation:
 (a) Bleaching action of SO_2 .
 (b) Dehydration of formic acid by concentrated H_2SO_4 .
 (c) Burning of benzene in presence of excess of dioxygen. (July 2018) (3)
- (25) Write structure and molecular formula for sulphurous acid. (July 2018) (1)
- (26) Write any four points of difference between fluorine and other halogens. (July 2018) (2)
- (27) Explain the following properties of group 16 elements:
 (i) Electronegativity (ii) Melting and boiling points
 (iii) Metallic character (iv) Allotropy (March 2019) (4)

- (28) What are oxides? Write different types of oxides with one example each. (March 2019) (4)
- (29) Write the name of an inert gas element used in the treatment of cancer by radiotherapy. (July 2019) (1)
- (30) The layer of ozone acts as a protective umbrella. Explain. (July 2019) (2)
- (31) Write two uses of each of the following: (a) Helium (b) Neon. (March 2020) (2)
- (32) Draw the structure of sulphurous acid. Explain why nitrogen does not form pentahalides. (March 2020) (3)
- (33) Explain interhalogen compounds.
How is oxygen prepared from the following compounds?
(a) KClO_4 (b) PbO_2 . (March 2020) (4)
- (34) Write the name of interhalogen compound of chlorine which has square pyramidal structure. (Sept. 2021) (1)
- (35) Draw the structure of sulphurous acid. Write two uses of helium. (Sept. 2021) (2)
- (36) Write chemical equations involved during manufacture of sulphuric acid by contact process. Write two uses of sulphur dioxide. (Sept. 2021) (3)
- (37) What is the action of concentrated H_2SO_4 on: (i) CaF_2 (ii) Cane sugar.
What is nucleotide? Write reaction for the preparation of polyacrylonitrile (PAN). (Sept. 2021) (4)
- (38) What is the action of selenium on magnesium metal? (March 2022) (1)
- (39) Explain the trends in the following atomic properties of group 16 elements:
(i) Atomic radii (ii) Ionisation enthalpy (iii) Electronegativity (iv) Electron gain enthalpy. (March 2022) (2)
- (40) Write chemical composition of haematite. Write the names and electronic configurations of first two elements of group 17. (March 2022) (3)
- (41) Write chemical equation for preparation of sulphur dioxide from sulphur. Write uses of sulphur. (March 2022) (2)
- (42) What is the action of chlorine on the following:
(i) NH_3 (excess) (ii) phosphorus? (July 2022) (2)
- (43) What happens when:
(i) Ethene reacts with iodine monochloride
(ii) Sulphur dioxide is oxidised in presence of V_2O_5
(iii) Cu heated with concentrated H_2SO_4 . (July 2022) (3)
- (44) What are interhalogen compounds? Write two uses of neon. (July 2022) (2)
- (45) Write the chemical composition of cryolite. (March 2023) (1)
- (46) Give reason: Group 16th elements have lower ionisation enthalpy compared to group 15th elements.
Write two uses of dioxygen. (March 2023) (2)
- (47) Give reason: Bleaching action of ozone is also called dry bleach. (March 2023) (1)
- (48) Draw structures of the following compounds:
(a) Chloric acid (b) Peroxy disulphuric acid. (March 2023) (2)
- (49) Explain anomalous behaviour of oxygen in group 16 with respect to:
(i) Atomicity (ii) Magnetic property (iii) Oxidation state. (March 2023) (3)

8

TRANSITION AND INNER TRANSITION ELEMENTS

- (1) Write the different oxidation states of manganese. Why +2 oxidation state of manganese is more stable? (March 2013) (3)
- (2) Explain the following terms: (i) Smelting (ii) Flux. (March 2013) (2)
- (3) Write observed electronic configuration of elements from first transition series having half filled d-orbitals. (Oct. 2013) (2)
- (4) What is lanthanoid contraction? Explain the cause and effects of lanthanoid contraction. (Oct. 2013) (3)
- (5) What are lanthanoids? What is the position of actinoids in periodic table? (March 2014) (2)
- (6) What is 'calcination'? How does it differ from 'roasting'? (March 2014) (2)
- (7) Write chemical formula of the following ores:
(a) Calamine (b) Haematite (c) Magnetite (d) Corundum. (Oct. 2014) (2)
- (8) What are interstitial compounds? Why do these compounds have higher melting points than corresponding pure metals? (March 2015) (2)
- (9) Define lanthanoid contraction. Explain its effects. (March 2015) (3)
- (10) Write the reactions involved in the zone of reduction in blast furnace during extraction of iron. (March 2015) (2)
- (11) What is the position of iron ($Z = 26$) in periodic table?

- Explain why is Fe^{3+} more stable than Fe^{2+} ? (Oct. 2015) (3)
- (12) Distinguish between Lanthanoids and Actinoids. (March 2008, 2010; Oct. 2015; July 2016, 2019) (2)
- (13) Define: (a) Hydrometallurgy (b) Electrometallurgy. (Oct 2015) (2)
- (14) Write the names and chemical formulae of any one ore of iron and zinc each. (March 2016) (2)
- (15) Why is Sc^{3+} colourless while Ti^{3+} coloured? (Atomic number Sc = 21, Ti = 22). (March 2016) (2)
- (16) What are f-block elements? Distinguish between lanthanoids and actinoids. (March 2016) (3)
- (17) Explain the term - Interstitial compounds. (March 2016) (1)
- (18) Write the factors which are related to the colour of transition metal ions. (March 2017) (2)
- (19) Write the different oxidation states of iron. Why oxidation state of manganese is more stable? (Given: Z of Mn = 25.) (March 2017) (3)
- (20) What is lanthanoid contraction? Explain, why lanthanum (Z = 57) forms La^{3+} ion, while cerium (Z = 58) forms Ce^{4+} ion? (July 2017) (3)
- (21) Mention the names of various steps involved in the extraction of pure metals from their ores. (July 2017) (2)
- (22) What is the action of carbon on the following metal oxide:
 Fe_2O_3 in blast furnace. (March 2018) (1)
- (23) What are 'd' and 'f' block elements? (July 2018) (2)
- (24) What is the action of the following on lanthanoids?
(a) Water (b) Sulphur, heat (c) Nitrogen, heat. (July 2018) (3)
- (25) Explain the position of actinoids in the periodic table. What is the action of sulphur on lanthanoids? Calculate the magnetic moment of divalent ion in aqueous solution if its atomic number is 24. (March 2019) (4)
- (26) Write a note on Lanthanoid contraction. Write two uses of KMnO_4 . (July 2019) (3)
- (27) Explain Bessemerization process. (July 2019) (3)
- (28) What is electrometallurgy? (March 2020) (1)
- (29) Write the name and chemical formula of one ore of zinc. (March 2020) (2)
- (30) Define flux. Write a note on leaching process. (March 2020) (3)
- (31) Write the general electronic configuration of lanthanoids. Why are most of the compounds of transition metals coloured? (March 2020) (3)
- (32) Iron exhibits +2 and +3 oxidation states. Write their electronic configuration. Which will be more stable? Why? (Sept. 2021) (2)
- (33) Why $\text{La}(\text{OH})_3$ is the strongest base, while $\text{Lu}(\text{OH})_3$ is the weakest base? Write two applications of catalytic properties of transition metals and compounds. (Sept. 2021) (3)
- (34) Write the chemical formula of Haematite. (Sept. 2021) (1)
- (35) Define mineral. (Sept. 2021) (1)
- (36) Calculate spin only magnetic moment of divalent cation of transition metal with atomic number 25. Salts of Ti^{4+} are colourless. Give reason. (March 2022) (4)
- (37) What is a Lanthanoid contraction? (March 2022) (1)
- (38) Write the molecular formula of the following minerals:
(i) Chalcopyrite (ii) Calamine. (July 2022) (2)
- (39) What is a Lanthanoid contraction? Write similarities between lanthanoids and actinoids. (July 2022) (3)
- (40) Give electronic configuration of Gd (Z = 64). (March 2023) (1)
- (41) Distinguish between lanthanides and actinides. (March 2023) (2)
- (42) What are interstitial compounds? Give the classification of alloys with examples. (March 2023) (3)

9

COORDINATION COMPOUNDS

- (1) Write the formulae of the following compounds:
(a) Sodium hexanitro-N-cobaltate (III)
(b) Tetraaquadichlorochromium (III) chloride.
(c) Potassium tetracyanoaurate (III) ion. (March 2013) (3)
- (2) Write applications of co-ordination compounds in medicine and electroplating. (Oct. 2013) (2)
- (3) What is effective atomic number (EAN)?
Calculate EAN of cobalt (Z = 27) in $[\text{Co}(\text{NH}_3)_6]^{+3}$ and of zinc (Z = 30) in $[\text{Zn}(\text{NH}_3)_4] \text{SO}_4$. (March 2014) (3)
- (4) Classify the following ligands into monodentate and polydentate -
(a) Ammonia (b) Carbon monoxide
(c) Ethylene diamine (d) Ethylene diamine tetra acetate ion. (Oct. 2014) (2)

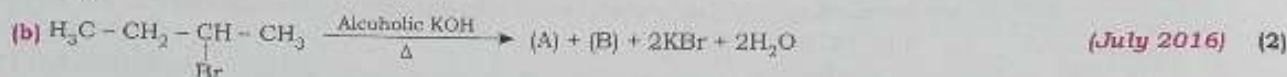
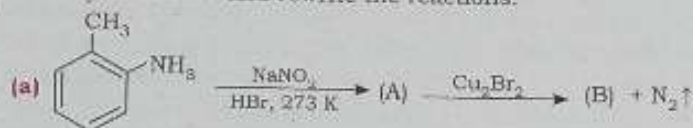
- (5) On the basis of valence bond theory explain the nature of bonding in $[\text{CoF}_6]^{3-}$ ion. Write the IUPAC name of $[\text{Co}(\text{NO}_2)_3(\text{NH}_3)_3]$. (March 2015) (3)
- (6) Explain cationic complexes and anionic complexes of co-ordination compounds. (Oct. 2015) (2)
- (7) Illustrate with example, the difference between a double salt and a co-ordination compound. (March 2016) (2)
- (8) Explain the terms: Ligand. (March 2016) (1)
- (9) Write the formula of Tetraminodichloroplatinum (IV) chloride. (March 2016) (1)
- (10) Define ligand. Write four postulates of Werner's theory. (July 2016) (3)
- (11) What is 'effective atomic number' (EAN)? Calculate the effective atomic number of the central metal atom in the following compounds :
 (a) $\text{K}_4\text{Fe}(\text{CN})_6$ (b) $\text{Cr}(\text{CO})_6$
 Fe (Z = 26) Cr (Z = 24) (March 2017) (3)
- (12) How ligands are classified? Explain with suitable examples. (July 2017) (3)
- (13) Explain the geometry of $[\text{Co}(\text{NH}_3)_6]^{3+}$ on the basis of hybridisation. (Z of Co = 27) (March 2018) (2)
- (14) Write the formula of the complex Copper (II) hexacyanoferrate(II). (March 2018) (1)
- (15) Write the formula for pentaammine chlorocobalt (II) sulphate. (July 2018) (2)
- (16) Explain the geometry of $[\text{Cu}(\text{NH}_3)_4]^{2+}$ on the basis of hybridisation [At. No. Cu = 29]. (July 2018) (2)
- (17) What is effective atomic number? Calculate effective atomic number of copper (Z = 29) in $[\text{Cu}(\text{NH}_3)_4]^{2+}$. (March 2019) (3)
- (18) What is Nessler's reagent. (March 2019) (1)
- (19) Write IUPAC name of $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ complex. (July 2019) (1)
- (20) Calculate the effective atomic number (E.A.N.) of copper in $[\text{Cu}(\text{NH}_3)_4]^{2+}$. (Z of Cu = 29) (March 2020) (2)
- (21) What are bidentate Ligands? Give one example. (Sept. 2021) (2)
- (22) Write two applications of coordinate compounds. (Sept. 2021) (1)
- (23) Write IUPAC name of $[\text{Fe}(\text{CO})_5]$ complex. (Sept. 2021) (1)
- (24) Write the name of isomerism in the following complexes:
 $[\text{Cu}(\text{NH}_3)_4][\text{PtCl}_4]$ and $\text{Pt}[(\text{NH}_3)_4][\text{CuCl}_4]$ (March 2022) (1)
- (25) Explain monodentate and ambidentate ligands with example. (March 2022) (2)
- (26) Explain cationic, anionic and neutral sphere complexes with example. (March 2022) (3)
- (27) Calculate effective atomic number of Co^{+3} in $[\text{Co}(\text{NH}_3)_6]^{3+}$ complex. (July 2022) (1)
- (28) Explain homoleptic and heteroleptic complexes with examples. (July 2022) (2)
- (29) Write two postulates of Werner theory of coordinate complexes. (July 2022) (2)
- (30) Write the name of platinum complex used in the treatment of cancer. (March 2023) (1)
- (31) Define: Distereoisomers. (March 2023) (1)
- (32) Explain formation of $[\text{CoF}_6]^{3-}$ complex with respect to:
 (i) Hybridisation (ii) Magnetic properties (iii) Inner / outer complex (iv) Geometry. (March 2023) (3)
- (33) Give cis and trans isomers of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^{\oplus}$. (March 2023) (2)

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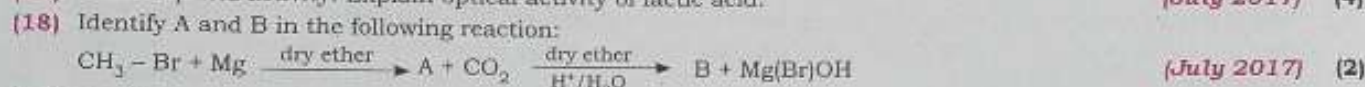
HALOGEN DERIVATIVES

- (1) Why does p-nitrochlorobenzene undergo displacement reactions readily with attack of nucleophilic OH^- ion? (March 2013) (2)
- (2) Write balanced chemical equations for the action of-
 (a) Phosphorus trichloride on propan-2-ol.
 (b) Hydrogen bromide on styrene in the presence of a peroxide.
 (c) Methyl bromide on silver propanoate. (March 2013) (3)
- (3) Explain optical activity of lactic acid. Draw a neat, labelled energy profile diagram for SN^1 reaction mechanism. (Oct. 2013) (4)
- (4) Discuss the optical activity of lactic acid. (March 2014) (3)
- (5) Distinguish between SN^1 and SN^2 mechanisms. (March 2014) (2)
- (6) Write the structures of -
 (a) 3-Chloro-3-ethylhex-1-ene (b) 1-Iodo-2, 3-dimethylbutane (c) 1, 3, 5-Tribromobenzene. (Oct. 2014) (3)
- (7) Draw structure of DDT. Write its environmental effects. (March 2015) (2)
- (8) Identify 'A' and 'B' in the following reaction :
 $\text{CH}_3-\text{CH}=\text{CH}_2 \xrightarrow{\text{HBr}} \text{'A'} \xrightarrow{\text{alc. KOH}} \text{'B'}$ (Oct. 2015) (2)
- (9) Discuss the mechanism of alkaline hydrolysis of bromomethane. (Oct. 2015) (4)
- (10) How is chlorobenzene prepared from aniline? How is chlorobenzene converted into diphenyl? (March 2016) (2)

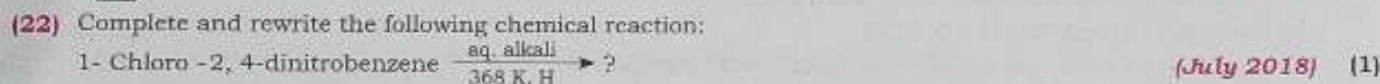
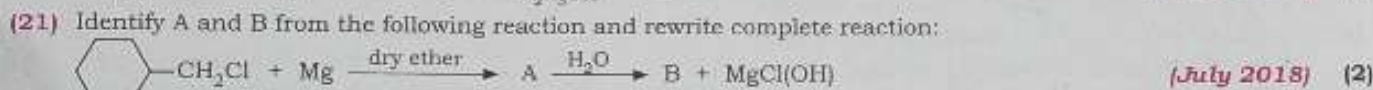
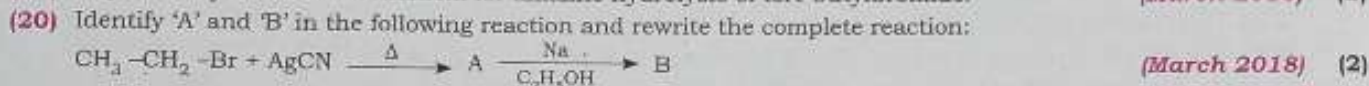
- (11) Explain the term - Optical activity. (March 2016) (1)
 (12) How is propene converted into 1-bromopropane and 2-bromopropane? (March 2016) (2)
 (13) Write a note on Sandmeyer's reaction. (July 2016, 2018) (2)
 (14) Identify 'A' and 'B' and rewrite the reactions.



- (15) Define racemic mixture. (March 2017) (1)
 (16) Explain the mechanism of alkaline hydrolysis of tert-butyl bromide with energy profile diagram. (March 2017) (3)
 (17) Define optical activity. Explain optical activity of lactic acid. (July 2017) (4)



- (19) Explain only reaction mechanism for alkaline hydrolysis of tert-butylbromide. (March 2018) (2)



- (23) What is the action of the following on ethyl bromide:
 (i) Alcoholic solution of potassium hydroxide
 (ii) Moist silver oxide
 (iii) Silver acetate? (March 2019) (3)

- (24) Define Enantiomers. (March 2019) (1)

- (25) What is Grignard reagent? (March 2019) (1)

- (26) Explain the role of iodic acid in the preparation of ethyl iodide from ethane. Dilactic acid is optically inactive. Why? (July 2019) (3)

- (27) Write the reaction for preparation of Grignard's reagent. (July 2019) (1)

- (28) Write conversion of 2-bromobutane into unsaturated hydrocarbon by using alcoholic KOH. (July 2019) (1)

- (29) Define optical activity. How many optical isomers are possible for glucose? (March 2020) (2)

- (30) Write the chemical reactions of chlorobenzene with respect to:
 (a) Sulphonation (b) Acetylation (c) Nitration. (March 2020) (3)

- (31) What is the action of the following on chlorobenzene?
 (i) Methyl chloride in presence of anhydrous AlCl₃
 (ii) Fuming H₂SO₄. (Sept. 2021) (2)

- (32) Explain S_N² reaction mechanism for alkaline hydrolysis of bromomethane. (Sept. 2021) (3)

- (33) Write the product formed when alkyl halide reacts with silver nitrite. (March 2022) (1)

- (34) What is the action of the following on ethyl bromide?
 (i) Na in dry ether (ii) Mg in dry ether. (March 2022) (2)

- (35) Write chemical reactions for the following conversions:
 (i) Ethyl bromide to ethyl methyl ether (ii) Ethyl bromide to ethene
 (iii) Bromobenzene to toluene. (iv) Chlorobenzene to biphenyl. (March 2022) (4)

- (36) Convert ethyl bromide to: (i) Ethyl iodide (ii) Ethyl fluoride. (July 2022) (2)

- (37) Write four salient features of S_N1 mechanism. (July 2022) (2)

- (38) Write the structure of the product formed when chlorobenzene is treated with sodium metal in the presence of dry ether. (March 2023) (1)

- (39) Write the chemical reactions for the following:
 (a) Chlorobenzene is heated with fuming H_2SO_4
 (b) Ethyl bromide is heated with silver acetate.
- (40) Explain dehydrohalogenation reaction of 2-chlorobutane. Write use and environmental effect of CFC.

(March 2023) (2)

(March 2023) (3)

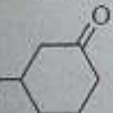
11 ALCOHOLS, PHENOLS AND ETHERS

- (1) How is ethanol prepared from methanal by using Grignard reagent? (March 2013) (2)
- (2) Explain the mechanism of action of hydroiodic acid on 3-methylbutan-2-ol. (March 2013) (3)
- (3) How is phenol converted into the following?
 (a) Benzene (b) Benzoquinone (c) Picric acid. (Oct. 2013) (3)
- (4) How is methoxy benzene prepared from carbolic acid? (Oct. 2013) (2)
- (5) Write the structural formula and IUPAC names of all possible isomers of the compound with molecular formula $\text{C}_3\text{H}_8\text{O}$. Write 'two' uses of phenol. (March 2014) (4)
- (6) How is methoxyethane prepared from methyl iodide. (March 2014) (1)
- (7) What is the action of the following reagents on phenol -
 (a) Bromine in CS_2 at low temperature (b) Conc. H_2SO_4 at room temperature. (Oct. 2014) (2)
- (8) Write the structure and IUPAC name of all the metamerism represented by formula $\text{C}_4\text{H}_{10}\text{O}$. (Oct. 2014) (3)
- (9) How is carbolic acid prepared from the following compounds:
 (i) Aniline (ii) Chlorobenzene and steam at 698K? (March 2015) (2)
- (10) Mention 'two' physical properties of carbolic acid. (March 2015) (1)
- (11) How are the following compounds prepared?
 (a) Benzyl alcohol from benzyl chloride. (b) Propan-1-ol from propanal. (Oct. 2015) (2)
- (12) How is carbolic acid prepared from chlorobenzene? What is the action of bromine water on carbolic acids? Write chemical test to distinguish between carbolic acid and alcohol. (Oct. 2015) (3)
- (13) Write the reactions involved in dehydration of 1°, 2° and 3° alcohols. (March 2016) (2)
- (14) What is metamerism? Explain metamerism with suitable examples of ethers. (March 2016) (2)
- (15) What is metamerism? Write the structure and IUPAC name of 'methyl-n-propyl ether'. What is the action of hot HI on it? (July 2016) (3)
- (16) How are the following conversions carried out?
 (i) 2-Methylbutan-1-ol into 2-methylbutanoic acid.
 (ii) Phenylethene into Benzoic acid
 (iii) Benzoic acid into metanitrobenzoic acid. (July 2016) (3)
- (17) Define carbolic acid. How carbolic acid is prepared from benzene sulphonic acid? (March 2017) (2)
- (18) How is diethyl ether prepared by continuous esterification process? (March 2017) (2)
- (19) How will you prepare ethanol, propan-2-ol and 2-methylpropan-2-ol from Grignard's reagent? (July 2017) (3)
- (20) How is phenol prepared from cumene? (July 2017) (2)
- (21) How will you prepare carbolic acid from benzene sulphonic acid? Write a chemical equation for the action of neutral ferric chloride on phenol. (March 2018) (3)
- (22) Why ethanol has higher boiling point than ethane? (March 2018) (2)
- (23) Write a preparation of phenol from cumene? What happens when phenol is heated with zinc dust? (July 2018) (3)
- (24) What is the action of the following on isopropyl methyl ether? (a) cold HI (b) hot HI (July 2018) (2)
- (25) What are ethers? (March 2019) (1)
- (26) Write balanced chemical equations for the following:
 (a) Action of sodium metal on ethanol
 (b) Action of zinc dust on phenol. (March 2019) (2)
- (27) Give IUPAC name of $(\text{CH}_3)_3\text{C}-\overset{\text{OH}}{\underset{|}{\text{CH}}}-\text{C}_2\text{H}_5$. (July 2019) (1)
- (28) Write the following conversion: Ethoxyethane into ethanol. (July 2019) (1)
- (29) Give two uses of ethanol. (July 2019) (1)
- (30) Write IUPAC name of pyrogallol. (July 2019) (1)
- (31) Write structural formula of the alcohol that results when acetaldehyde is reacted with CH_3MgBr in the presence of dry ether and the product is hydrolysed. (March 2020) (1)

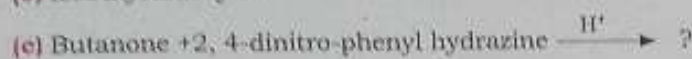
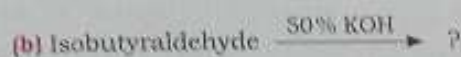
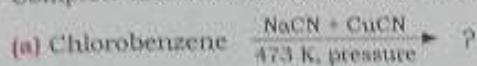
- (32) Explain the continuous etherification process for the preparation of diethyl ether. (March 2020) (2)
- (33) How is ethanol prepared from the following compounds:
(a) Ethanal (b) Ethene (c) Bromoethane. (March 2020) (3)
- (34) Write a note on Kolbe reaction. (Sept. 2021) (2)
- (35) Convert the following:
(i) Chlorobenzene to phenol (ii) Ethanal to ethanol (iii) Iodomethane to methoxy methane. (Sept. 2021) (3)
- (36) Write the preparation of phenol from aniline. (March 2022) (2)
- (37) Write chemical reactions of following reagents on methoxyethane:
(i) Hot HI (ii) PCl_5 (iii) Dilute H_2SO_4 . (March 2022) (3)
- (38) Write the name of reaction during conversion of phenol to salicylic acid. (July 2022) (1)
- (39) Write balanced chemical reactions of the following reagents on carbolic acid:
(i) Br_2 water (ii) Concentrated HNO_3 . (July 2022) (2)
- (40) What happens when vapours of 1° and 2° alcohols are passed over hot Cu metal? (July 2022) (2)
- (41) Write chemical reactions for the following conversion: Acetic acid into ethyl alcohol. (March 2023) (1)
- (42) Convert the following:
(i) Ethyl alcohol into ethyl acetate
(ii) Phenol into benzene
(iii) Diethyl ether into ethyl chloride. (March 2023) (3)
- (43) Write Dow process for preparation of Phenol. What is the action of bromine water on phenol? (March 2023) (2)

12

ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

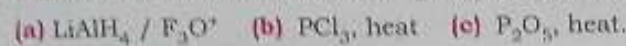
- (1) How is 4-methylpent-3-en-2-one obtained from propan-2-one? (March 2013) (2)
- (2) How are the following compounds prepared?
(a) Benzaldehyde from benzene.
(b) Acetophenone from benzene.
(c) Benzaldehyde from benzoyl chloride. (March 2013) (3)
- (3) Mention 'two' uses of propan-2-one. (March 2013) (1)
- (4) Explain the mechanism of aldol condensation. (Oct. 2013; March 2015) (3)
- (5) How is benzophenone prepared from benzonitrile? (Oct. 2013; July 2016; March 2018) (2)
- (6) Write a note on aldol condensation. (March 2014, 2017; July 2022) (2)
- (7) Write a note on self oxidation-reduction reaction of aldehyde with suitable example. (March 2014) (2)
- (8) Identify 'A' and 'B' in the following reaction: $\text{C}_6\text{H}_5\text{MgBr} + \text{CO}_2 \xrightarrow[\text{H}^+/\text{H}_2\text{O}]{\text{Dry ether}}$ 'A' $\xrightarrow{\text{PCl}_5}$ 'B' (Oct. 2014) (2)
- (9) Write the structure and IUPAC names of all the metamers represented by formula $\text{C}_4\text{H}_{10}\text{O}$. (Oct. 2014) (3)
- (10) Write balanced chemical equations for action of ammonia on -
(a) Formaldehyde (b) Acetaldehyde (c) Acetone. (Oct. 2014) (3)
- (11) Write a note on Friedel Craft's acylation. (March 2015) (2)
- (12) Explain, why are boiling points of carboxylic acids higher than corresponding alcohols. (March 2015) (2)
- (13) Write the structures and IUPAC names of the following compounds:
(a) Adipic acid (b) α -methyl butyraldehyde (March 2015) (2)
- (14) What is Stephen reaction? (Oct. 2015) (2)
- (15) Write the structure and IUPAC names of isomeric aldehydes having molecular formula $\text{C}_5\text{H}_{10}\text{O}$. (Oct. 2015) (4)
- (16) What are ketones? How are ketones classified? (March 2016) (2)
- (17) Explain the mechanism of esterification. (March 2016) (4)
- (18) Write IUPAC names of the following compounds:
(a)  (b) $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_3$ (July 2016) (2)
- (19) How is ethanoic acid prepared from dry ice? (March 2017) (2)
- (20) Give IUPAC name of $\text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CHO}$. (March 2017) (1)
- (21) What is the action of the following reagents on propanone?
(a) Phenyl hydrazine (b) $\text{Zn-Hg}/\text{conc. HCl}$ (c) Sodium bisulphite. (July 2017) (3)
- (22) Write a note on self oxidation-reduction reaction of aldehyde with suitable example. (July 2017) (2)

(23) Complete and rewrite the balanced chemical equations:



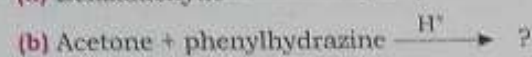
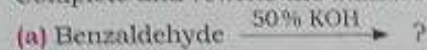
(March 2018) (3)

(24) What is the action of the following reagents on ethanoic acid?



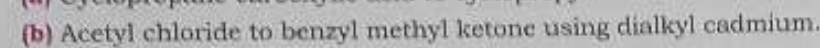
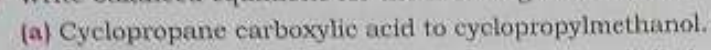
(March 2018) (3)

(25) Complete and rewrite the balanced chemical equation for the following reactions:



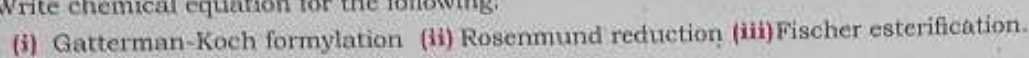
(July 2018) (2)

(26) Write balanced equations for the following conversions:



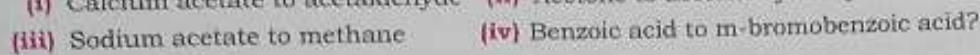
(July 2018) (2)

(27) Write chemical equation for the following:



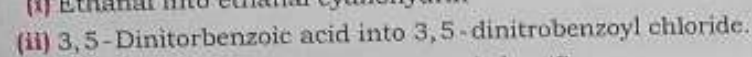
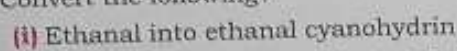
(March 2019) (3)

(28) How will you convert:



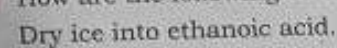
(March 2019) (4)

(29) Convert the following:



(July 2019) (2)

(30) How are the following conversion carried out?



(July 2019) (1)

(31) Write aldol condensation reaction between ethanal and propanal.

(July 2019) (2)

(32) Write balanced chemical reaction for preparation of acetic anhydride using acetic acid.

(March 2020) (1)

(33) Identify 'A' and 'B' in the following reaction:



(March 2020) (1)

(34) Explain the mechanism of aldol addition reaction. Mention two uses of carboxylic acids.

(March 2020) (4)

(35) Write the name of reagent used during conversion of acetaldehyde to acetaldehyde cyanohydrin.

(Sept. 2021) (1)

(36) How is benzophenone prepared from benzonitrile?

(Sept. 2021) (2)

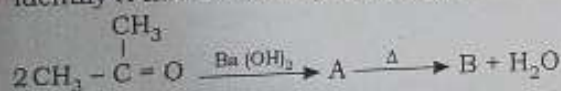
(37) Write a note on 'aldol' condensation reaction of ethanal. Write chemical reaction involved when benzaldehyde is treated with concentrated caustic potash.

(Sept. 2021) (4)

(38) Write the name of product formed, when acetone is treated with 2, 4-dinitrophenyl hydrazine.

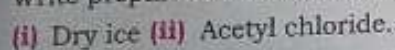
(March 2022) (1)

(39) Identify A and B from the following reaction:



(March 2022) (2)

(40) Write preparation of acetic acid from:



(March 2022) (2)

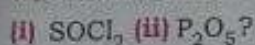
(41) Write the classification of aliphatic ketones with example. What is the action of sodium hypiodite on acetone?

(March 2022) (2)

(42) Write the IUPAC name of α -methylpropionic acid.

(July 2022) (1)

(43) What is the action of the following on carboxylic acid:



(July 2022) (2)

(44) Convert carboxylic acids to: (i) Ester (ii) Acid amide.

(March 2023) (3)

(45) Explain Aldol condensation of ethanal.

(March 2023) (2)

(46) Write a note on Haloform reaction.

13 AMINES

- (1) What is the action of bromine in alkaline medium on:
 (a) $\text{CH}_3\text{CH}_2\text{NO}_2$ (b) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{NO}_2$ (March 2013) (2)
- (2) Write a short note on Hoffmann bromamide degradation. (March 2013) (3)
- (3) How is nitromethane prepared from the following?
 (a) Alkyl halide (b) α -Halogen carboxylic acid (c) α -Nitroalkene. (Oct. 2013) (3)
- (4) Explain Hoffmann bromamide degradation reaction. (Oct. 2013; March 2017, 2018) (2)
- (5) What is the action of the following reagents on aniline?
 (a) Bromine water (b) Acetic anhydride (c) Hot and conc. sulphuric acid. (March 2014) (3)
- (6) Identify the compound 'A' and 'B' in the following equation:

$$\text{CH}_3 - \text{CH}_3 + \text{HNO}_3 \xrightarrow{423-600 \text{ K}} \text{'A'} \xrightarrow{\text{Sn/conc. HCl}} \text{'B'} + \text{H}_2\text{O}$$
 (March 2014) (2)
- (7) What will be the action of the mixture of sodium nitrite and dilute hydrochloric acid on:
 (a) Ethyl amine (b) Aniline (c) Triethyl amine? (Oct. 2014) (3)
- (8) How are propan-1-amine and propan-2-amine prepared from oxime? (Oct. 2014) (2)
- (9) How is ethyl amine prepared from methyl iodide? (March 2015) (2)
- (10) Write a note on Gabriel phthalimide synthesis. (March 2015) (3)
- (11) What is the action of acetic anhydride on:
 (a) Ethyl amine (b) Diethyl amine. (Oct 2015) (2)
- (12) What is the action of nitrous acid on:
 (a) Primary nitroalkane (b) Secondary nitroalkane (c) Tertiary nitroalkane. (Oct. 2015) (3)
- (13) How are: (a) 1-Nitropropane and
 (b) 2-Nitropropane prepared from suitable oxime? (March 2016) (2)
- (14) How are 1-nitropropane, 2-nitropropane and 2-methyl-2-nitropropane are distinguished from each other using nitrous acid? (March 2016) (3)
- (15) What is the action of benzene diazonium chloride on:
 (a) Phenol in alkaline medium (b) Aniline. (July 2016) (2)
- (16) Identify 'A' and 'B' and rewrite the reactions:

$$\text{C}_2\text{H}_5 - \text{N}^+(\text{CH}_3)_3\text{I}^- \xrightarrow[\Delta]{\text{Ag}_2\text{O}/\text{H}_2\text{O}} \text{A} \xrightarrow{\text{H}^+} \text{B} + (\text{CH}_3)_3\text{N} + \text{H}_2\text{O}$$
 (July 2016) (1)
- (17) What is the action of mixture of NaNO_2 and dil. HCl on:
 (a) Ethylamine (b) Aniline (c) Diethylamine (March 2017) (3)
- (18) How is nitroethane converted into:
 (a) Ethyl amine (b) N-ethylhydroxyl amine (c) Acetic acid? (July 2017) (3)
- (19) How is ethylamine prepared from (a) Nitro-alkane (b) Oxime?
 Explain basic nature of amines. (March 2010; Oct. 2009; July 2017) (4)
- (20) What is the action of p-toluenesulphonyl chloride on ethylamine and diethylamine? (March 2018) (2)
- (21) What is the action of lithium aluminium hydride in the presence of ether on the following compounds?
 (a) Nitroethane (b) 2-Methyl-1-nitropropane. (July 2018) (2)
- (22) Write resonance structures of aniline. What is the action of benzene diazonium chloride on ethanol? (July 2018) (2)
- (23) Write the structure of Phenylmethanamine. (March 2019) (1)
- (24) Write a short note on Hoffmann elimination. (March 2019) (3)
- (25) What are amines? (March 2019) (1)
- (26) Write the following conversion: Acetaldoxime into ethylamine. (July 2019) (1)
- (27) Amines are basic in nature. Explain. (July 2019) (2)
- (28) Convert benzene diazonium halide into aryl iodide. (July 2019) (1)
- (29) What is the action of benzene sulphonyl chloride on ethanamine? (July 2019) (1)
- (30) Define: Quaternary ammonium salt. (March 2020) (1)
- (31) Write the chemical reaction involved in the formation of ethyl amine using acetaldoxime. (March 2020) (3)
- (32) Write reactions to prepare ethanamine from:
 (i) Acetonitrile (ii) Nitroethane (iii) Propionamide. (Sept. 2021) (3)
- (33) How will you convert -
 (i) Methyl iodide to methyl isocyanide.
 (ii) Methyl cyanide to ethanoic acid? (Sept. 2021) (3)

- (34) Write chemical reactions to prepare ethanamine from:
(i) Acetonitrile (ii) Nitroethane. (March 2022) (2)
- (35) Write the formula of Hinsberg's reagent. (July 2022) (1)
- (36) Write chemical reaction for carbylamine test. (July 2022) (1)
- (37) Complete the following reaction and identify A and B.
Isopropyl alcohol $\xrightarrow{\text{PBr}_3}$ A $\xrightarrow[\text{excess}]{\text{NH}_3}$ B (July 2022) (2)
- (38) Write the name of the product formed by the action of LiAlH_4 /ether on acetamide. (March 2023) (1)
- (39) Write chemical reactions for the following conversion:
Acetic acid into acetic anhydride. (March 2023) (1)
- (40) Write IUPAC name and structure of methylphenylamine. (March 2023) (1)
- (41) What is the action of the following reagents on ethyl amine.
(i) Chloroform and caustic potash (ii) Nitrous acid. (March 2023) (3)

14

BIOMOLECULES

- (1) Write the structures of nucleotide and nucleoside. (March 2013) (2)
- (2) Enlist the properties of glucose that cannot be explained on the basis of open chain structure of it. (Oct. 2013) (3)
- (3) What happens when glucose is treated with:
(a) Bromine water (b) Dilute nitric acid (c) Hydrogen cyanide (HCN). (March 2014) (3)
- (4) Describe laboratory method for preparation of glucose. Write the reaction that indicates the presence of -CHO group in glucose. (Oct. 2014) (3)
- (5) Draw the simple Fischer projection formulae of D-(+)-glucose and D-(-)-fructose. (Oct. 2014) (2)
- (6) How are proteins classified on the basis of molecular shapes? (March 2015) (2)
- (7) Define carbohydrates. What are reducing and non-reducing sugars? (March 2015) (3)
- (8) What are monosaccharides? Draw ring structure of α -D-(+)-glucopyranose? (Oct. 2015) (2)
- (9) What is peptide linkage? How is tripeptide formed? (Oct. 2015) (3)
- (10) What are carbohydrates? (March 2016) (1)
- (11) What is the action of following reagents on glucose?
(a) Bromine water (b) Dilute HNO_3 (c) Hydroxyl amine. (July 2016, 2018) (3)
- (12) How is the glucose prepared from sucrose? (March 2009, 2017; July 2022) (2)
- (13) Define enzymes. How is peptide linkage formed? (July 2017) (3)
- (14) What happens when glucose is treated with:
(a) Hydroxylamine (b) Hydrogen cyanide. (July 2017) (2)
- (15) How glucose is prepared from cane sugar? (March 2018) (2)
- (16) What are amino acids? Write the correct reaction for formation of peptide bond between amino acids. (July 2018) (2)
- (17) How is glucose prepared from starch? (July 2018) (1)
- (18) Draw the structure of Thymine. (March 2019) (1)
- (19) Write the number of hydroxyl groups present in α -D-(+)-Glucopyranose (trans). (March 2019) (3)
- (20) How is glucose prepared by commercial method? How is peptide linkage formed? (July 2019) (3)
- (21) Define enzyme.
- (22) How are the following conversion carried out?
(i) Glucose into n-hexane (ii) Glucose into glucoxime? (July 2019) (2)
- (23) Write Haworth projection formula of α -D-(+)-glucopyranose. Define hormones. (March 2020) (2)
- (24) What are monosaccharides? Explain denaturation of proteins. (March 2020) (3)
- (25) Write the name of sugar present in RNA. (Sept. 2021) (1)
- (26) Write classification of proteins on the basis of molecular shapes with examples. (Sept. 2021) (2)
- (27) Explain formation of peptide linkage in protein with an example. (March 2022) (2)
- (28) Write commercial method of preparation of glucose. Write structure of adipic acid. (March 2022) (3)
- (29) What is denaturation of protein? (July 2022) (1)
- (30) Write chemical reaction for the preparation of glucose from sucrose. (March 2023) (2)
- Write structure of D-ribose. (March 2023) (1)
- (31) What is peptide bond.

15 INTRODUCTION TO POLYMER CHEMISTRY

- (1) Explain the following terms:
(i) Homopolymers (ii) Elastomers. (March 2013) (2)
- (2) Write the chemical reaction to prepare novolac polymer. (March 2013) (2)
- (3) How are polymers classified on the basis of polymerisation process? (Oct. 2013) (2)
- (4) Write the structure of melamine. (Oct. 2013) (1)
- (5) Write names and chemical formulae of monomers used in preparing Buna-S. (March 2014) (2)
- (6) What are thermoplastic polymers? (March 2014) (1)
- (7) How is Nylon 6, 6 prepared? Write any 'two' uses of terylene. (Oct. 2014) (3)
- (8) Explain with examples, branched and linear polymers. (March 2015) (2)
- (9) What are biodegradable polymers and non-biodegradable polymers? Write 'one example' of each. (March 2015) (2)
- (10) Write the reactions involved in the preparation of - (a) Teflon (b) Orlon (c) PVC. (Oct. 2015) (3)
- (11) Write the reaction for the preparation of Nylon-6. (March 2016) (1)
- (12) How are polythene and neoprene prepared? (March 2016) (2)
- (13) Write the formulae of the raw materials used for preparation of Buna-S. (July 2016) (1)
- (14) How are the following polymers prepared?
(a) Orlon (b) Teflon (July 2016) (2)
- (15) Explain the term: Homopolymers (March 2017) (2)
- (16) How is nylon 6,6 prepared? (March 2017) (1)
- (17) How is Terylene prepared? (July 2017) (2)
- (18) Write the names and chemical formulae of monomers used in preparing Buna-N. (July 2017) (2)
- (19) Explain the preparation and uses of nylon-2-nylon-6. (March 2018) (3)
- (20) What are elastomers?
Distinguish between thermoplastic polymers and thermosetting polymers. (July 2018) (3)
- (21) Write chemical reactions to prepare the following polymers:
(i) Teflon (ii) Nylon-6 (March 2019) (3)
- (22) Write the reactions for the preparation of polymers by using the following monomers:
(i) Vinyl chloride (ii) Tetrafluoroethane. (July 2019) (2)
- (23) Define: (i) Condensation polymer (ii) Homopolymer. (July 2019) (2)
- (24) Define non-biodegradable polymer. Write the preparation of terylene. (March 2020) (2)
- (25) Write names and structure of monomers used in the preparation of Nylon 6, 6 polymer. (Sept. 2021) (2)
- (26) Write classification of polymers on the basis of structure. (March 2022) (3)
- (27) Write the name of biodegradable polyamide copolymer. (March 2022) (1)
- (28) Write the name of monomer used for preparation of Nylon 6. (July 2022) (1)
- (29) Write chemical composition of Ziegler-Natta catalyst. (July 2022) (1)
- (30) Define: Elastomer. (July 2022) (1)
- (31) Write the reactions for the formation of nylon 6, 6 polymer. (March 2023) (3)
- (32) Define: Vulcanization. (March 2023) (1)

16 GREEN CHEMISTRY AND NANO CHEMISTRY

- (1) Write the name of nanostructural material used in tyres to increase their life. (Sept. 2021) (1)
- (2) Explain three principles of green chemistry. (Sept. 2021) (2)
- (3) Write the name of the alloy used in Fischer Tropsch process in the synthesis of gasoline. (March 2022) (1)
- (4) Define green chemistry. Write two disadvantages of nanotechnology. (March 2022) (2)
- (5) Define: Nanochemistry. (July 2022) (1)
- (6) Define: Nanotechnology. (July 2022) (1)
- (7) Define: Green chemistry. (July 2022) (1)
- (8) Write the name of the technique used to know geometry of nanoparticles. (March 2023) (1)
- (9) Define: Green chemistry. Write two advantages of nanoparticle and nanotechnology. (March 2023) (2)
- (10) Write the name of nano structured material used in car tyres to increase the life of tyres. (March 2023) (1)