

# Question bank

## Chapter-1 Topic 1 Periodic Table

- Q-1 **Nitrogen has a larger atomic radius than oxygen.**
- Q-2 **Lithium and magnesium have many similarities in their chemistry.**  
a) Why do we sometimes refer to this similarity as an example of a diagonal relationship?  
b) Name another pair of elements from Group I and Group II that should be similar according to this relationship.
- Q-3 **Which element has a higher melting point: chlorine (Cl) or bromine (Br)?**
- Q-4 **Which element is more electronegative, sulphur (S) or selenium (Se)?**
- Q-5 **Why is the electronegativity value of most noble gases zero?**
- Q-6 **The Group II elements are shown below: Be, Mg, Ca, Sr, Ba**  
a) Which Group II element has the lowest first ionisation energy?  
b) Which Group II element has the highest melting point?  
c) Which Group II element has the lowest density?  
d) Which Group II element is most reactive?  
e) Which Group II element has an electronic configuration that ends in  $4s^2$ ?
- Q-7 **Rewrite the following list in order of increasing electron affinity: fluorine (F), phosphorus (P), sulphur (S), boron (B).**
- Q-8 **A non-metal has a smaller ionic radius compared with a metal of the same period.**

### Multiple Choice Questions

- Q-1 **Which of the following periodic properties decreases down a group?**  
(a) A. Atomic radius  
(b) B. Electron affinity  
(c) C. Electronegativity  
(d) D. Ionic size

- Q-2 **Based on the periodic trends for ionisation energy, which element has the highest ionisation energy?**
- (a) A. Fluorine (F)
  - (b) B. Nitrogen (N)
  - (c) C. Helium (He)
- Q-3 **Which of the following atoms has an atomic radius smaller than that of sulphur (S)?**
- (a) A. Oxygen (O)
  - (b) B. Chlorine (Cl)
  - (c) C. Calcium (Ca)
  - (d) D. Lithium (Li)

## Chapter-2 Topic 2 Chemical reactions

- Q-1 **Match the terms in Column B with the descriptions in Column A.**
- a) Collision frequency
  - b) Activated complex
  - c) Reaction rate
  - d) Activation energy
  - e) Collision theory
- Q-2 **Zinc pieces (3.0 g) react with 50 cm<sup>3</sup> of 0.2 mol·dm<sup>-3</sup> hydrochloric acid according to the equation  $\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{(g)}$ . How would the rate of reaction compare to the reaction above if:**
- a) 3.0 g of zinc powder were used, instead of 3.0 g of zinc pieces?
  - b) the concentration of hydrochloric acid used were changed to 0.1 mol·dm<sup>-3</sup>?
  - c) a suitable catalyst were used?
  - d) the temperature were increased?
  - e) 100 cm<sup>3</sup> of the 0.2 mol·dm<sup>-3</sup> hydrochloric acid were used?
- Q-3 **The following chemical reaction has reached dynamic equilibrium in a closed container:  $\text{N}_2\text{(g)} + 3\text{H}_2\text{(g)} \rightleftharpoons 2\text{NH}_3\text{(g)} + \text{heat}$ .**
- a) What does  $\Delta H$  mean?
  - b) What does the symbol  $\rightleftharpoons$  mean?
  - c) What is chemical equilibrium?
  - d) Is the forward reaction exothermic or endothermic?
  - e) Is the reverse reaction exothermic or endothermic?

f) Explain why a closed container is used for this chemical reaction.

Q-4 Write down the  $K_c$  expressions for each of the following equilibria:



Q-5 When hydrogen reacts with iodine at 700 K in a closed container, the following equilibrium is established:  $\text{H}_2(g) + \text{I}_2(g) \rightleftharpoons 2\text{HI}(g)$ . Analysis of the equilibrium mixture at 700 K showed that:  $[\text{H}_2] = 1.84 \times 10^{-3} \text{ mol-dm}^{-3}$ ,  $[\text{I}_2] = 3.13 \times 10^{-3} \text{ mol-dm}^{-3}$ ,  $[\text{HI}] = 17.7 \times 10^{-3} \text{ mol-dm}^{-3}$ .

a) Is this a homogeneous or heterogeneous equilibrium? Explain.

b) Calculate the equilibrium constant ( $K_c$ ) for this reaction at 700 K.

c) The pressure on the system is increased. Explain the effect that this change in pressure would have on the equilibrium position and rate of reaction.

Q-6 Three moles of  $\text{N}_2(g)$  are placed in a  $2 \text{ dm}^3$  container with 8 mol  $\text{H}_2(g)$  and the reaction proceeds until equilibrium is reached at  $450 \text{ }^\circ\text{C}$ :  $\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g)$   $\Delta H < 0$ . At equilibrium, 4 mol  $\text{NH}_3(g)$  is present. Calculate the  $K_c$  value.

Q-7 Consider the following equilibrium situation:  $\text{CO}(g) + \text{H}_2(g) \rightleftharpoons \text{H}_2\text{O}(g) + \text{CO}(g)$   $\Delta H > 0$ .

a) State Le Châtelier's Principle.

b) What would the effect on the equilibrium position be if the temperature in the container were decreased? Explain.

c) What would the effect on the equilibrium position be if the concentration of  $\text{CO}(g)$  in the container were increased? Explain.

## Multiple Choice Questions

Q-1 Which of the following factors would not affect the rate of a chemical reaction?

(a) A. Physical states of reactants

(b) B. Change in temperature of the reaction system

(c) C. Density of the reactants

(d) D. Addition of a catalyst

Q-2 This factor will affect the equilibrium constant value:

(a) A. Concentration

(b) B. Pressure

- (c) C. Temperature
- (d) D. Catalyst

**Q-3 Which factor will not affect the chemical equilibrium?**

- (a) A. Temperature
- (b) B. Catalyst
- (c) C. Pressure
- (d) D. Concentration

### **Chapter-3 Topic 3 Mass, volume relationships**

**Q-1 Give one word for each of the following descriptions.**

- a) A solution of known concentration.
- b) The SI unit for the amount of substance.
- c) The mass of one mole of a compound.
- d) Water contained around ions of certain salts.
- e) The amount of solute present in a given volume of solvent.
- f) Volume of one mole of gas.

**Q-2 Oxygen gas and hydrogen gas react to form water.**

- a) Write a balanced equation for the reaction.
- b) Calculate the volume of water that is formed, if 30 cm<sup>3</sup> of oxygen reacts with an excess of hydrogen gas at STP.
- c) Calculate how many moles of oxygen gas there are in 30 cm<sup>3</sup> of oxygen gas at STP.
- d) Calculate the mass of oxygen that is used in the reaction at STP.

**Q-3 Determine the molal concentration of:**

- a) 3 moles of potassium chloride (KCl) dissolved in 500 ml of water
- b) 12 g of barium hydroxide (Ba(OH)<sub>2</sub>) dissolved in 2 dm<sup>3</sup> of water
- c) 6.0 moles of hydrogen bromide (HBr) dissolved in 0.200 kg of water

**Q-4 You want to prepare a standard solution of LiCl with a molar concentration of 2 mol·dm<sup>-3</sup>. The volume of the volumetric flask is 250 ml.**

- a) Convert 250 ml to dm<sup>3</sup>.
- b) What is meant by the term "standard solution"?
- c) How many grams of crystals do you need to make this standard solution?

- Q-5 The density of various substances are listed in the table below.**
- Name all the substances that will float on water.
  - Name all the substances that will sink in water.
  - When ethanol and methanol are mixed, which substance will float on top?
  - Calculate the relative density of ice, if the density of water is  $1\,000\text{ kg}\cdot\text{m}^{-3}$ .
- Q-6 Calculate the molar mass of the following substances:**
- $\text{H}_2\text{SO}_4$
  - Ammonia gas ( $\text{NH}_3$ )
  - $\text{KMnO}_4$
  - Iron(III) chloride ( $\text{FeCl}_3$ )
  - $\text{Mg}(\text{OH})_2$
- Q-7 Calcium reacts with hydrochloric acid to form calcium chloride and hydrogen gas. How many grams of calcium chloride are formed, when 15 g of calcium metal reacts with hydrochloric acid?**
- Q-8 How many grams of  $\text{CaCO}_3$  are needed to react with 15.2 g of HCl, according to the following equation?  $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$**
- Q-9 What volume of oxygen will react with carbon monoxide, to produce 20  $\text{dm}^3$  of carbon dioxide at STP?**
- Q-10 Calcium carbonate decomposes to produce calcium oxide and carbon dioxide. How many grams of calcium carbonate decompose to produce 11.2  $\text{dm}^3$  of carbon dioxide at STP?**

## **Chapter-4 Topic 4 Acid-base reactions**

- Q-1 Distinguish between strong and weak alkalis, and concentrated and dilute alkalis.**
- Q-2 What is an indicator? Name four indicators often used in the laboratory.**
- Q-3 Explain the meaning of equivalence point and titration.**

- Q-4 **70 cm<sup>3</sup> of a solution of sodium hydroxide (concentration 5 0.18 mol-dm<sup>-3</sup>) reacts completely with 30 cm<sup>3</sup> of a solution of sulphuric acid.**
- Write a balanced equation for the reaction.
  - Calculate the concentration of the sulphuric acid solution.
  - Calculate the mass of the sodium hydroxide used in the titration.
- Q-5 **In preparing a standard basic solution, a student dissolves 14 g potassium hydroxide in 1.0 dm<sup>3</sup> of water. In a titration, 30 cm<sup>3</sup> of KOH(aq) is neutralised by a sulphuric acid solution with a concentration of 0.10 mol-dm<sup>-3</sup>.**
- Calculate the concentration of the basic solution.
  - Calculate the volume of H<sub>2</sub>SO<sub>4</sub>(aq) used in the titration.
  - Is the pH of the end point in this titration acid, basic or neutral?
- Q-6 **Calculate the mass of MgO needed to neutralise 40.0 ml of a 0.25 mol-dm<sup>-3</sup> HCl solution.**

## Chapter-5 Topic 5 Water

- Q-1 **Give one word/term for each of the following descriptions.**
- A type of mixture in which particles are uniformly distributed
  - A substance that does not dissolve in water
  - The graph we use to show how soluble a solid is at a specific temperature
  - The physical process we use to soften temporary hard water
  - The water obtained when impure water is boiled and condensed
- Q-2 **The structure of the water molecule is responsible for its unique properties.**
- Draw two water molecules by using the ball and stick method (use circles for atoms and lines for bonds)
  - Indicate the following features: its shape, polarity, interatomic bonds and intermolecular forces
  - Explain why water is such a good solvent
  - Name three substances that dissolve in water
  - Name three substances that do not dissolve in water
  - Explain why ice floats on water

- Q-3 A spoonful of table salt is added to a beaker of water and stirred.**
- Name the solute
  - Name the solvent
  - What is this process called
  - Name the resulting liquid
  - Is this a physical or chemical change? Explain your answer
- Q-4 Look at the two beakers below and answer the questions.**
- In which beaker will sugar dissolve the quickest, A or B? Give a reason for your answer
  - Will a saturated solution of sugar contain more solute (sugar) in A or B? Give a reason for your answer
  - Will a saturated solution of table salt contain more solute (salt) in A or B? Give a reason for your answer
  - In which beaker is the substance more soluble: C or D? Give a reason for your answer
- Q-5 Use the solubility curves below to answer the questions.**
- Which compound has the lowest solubility?
  - Which compound becomes less soluble with an increase in temperature?
  - Which compound shows the largest increase in solubility as the temperature increases?
  - How many grams of  $K_2SO_4$  will dissolve to form a saturated solution at  $10\text{ }^\circ\text{C}$ ?
  - How many grams of  $NH_4Cl$  will dissolve to form a saturated solution at  $44\text{ }^\circ\text{C}$ ?
  - Will 34 g of  $KNO_3$  and 100 g of water at  $20\text{ }^\circ\text{C}$  form a saturated solution? Explain your answer
- Q-6 Water treatment plants treat raw water to make it palatable to humans.**
- Draw a flow diagram to show all the processes in a standard water treatment plant
  - Name three chemicals that are added during coagulation and give their functions
  - Which process is used to get rid of the floc that forms?
  - Why is activated charcoal sometimes added?
  - Why is it necessary to test the water again before it is stored in reservoirs?

## Chapter-6 Topic 6 Air

- Q-1 Air is a mixture of gases.**
- Draw a table and list the main constituents of air and their percentages.
  - Name four trace gases.
  - Why does water vapour not form part of the percentage composition of air?
- Q-2 List the properties of air.**
- Q-3 Make a drawing of a Bunsen burner and list the parts and their functions.**
- Q-4 Distinguish between a luminous and non-luminous flame.**
- Q-5 Draw and label the regions in a luminous and non-luminous flame.**

## **Chapter-7 Topic 7 Hydrogen**

- Q-1 List the number of electrons, protons and neutrons in the isotopes of hydrogen. Name the isotopes.**
- Q-2 Name the oxidation numbers of hydrogen in the following compounds.**
- Sodium hydride
  - Ammonia
  - Magnesium hydride
  - Methane
- Q-3 Write balanced equations for the following reactions.**
- Lithium with water
  - Magnesium with steam
  - Magnesium with sulphuric acid
  - Zinc with hydrochloric acid
  - Iron and steam
- Q-4 Prepare hydrogen:**
- Name one way to prepare hydrogen in the laboratory
  - Name four ways of preparing hydrogen in industry
- Q-5 Electrolysis can be used to produce hydrogen. Name one advantage and one disadvantage of using this process.**

- Q-6 **Write balanced equations for the reactions between hydrogen and ...**
- nitrogen
  - oxygen
  - chlorine

- Q-7 **List the uses of hydrogen.**

## Chapter-8 Topic 8 Oxygen

- Q-1 **Give one term for each description.**

- The product of an oxidation reaction
- The decomposition of water by using electricity
- The industrial process to produce oxygen
- The allotrope of oxygen with three atoms
- The chemical process in which oxygen is used in the cells of living organisms

- Q-2 **The following questions involve the elements in Group 16 of the Periodic Table.**

- Name the elements in Group 16, giving their chemical symbols and their atomic numbers.
- Classify the Group 16 elements as metals, non-metals or metalloids.
- How many electrons do Group 16 elements have in their outer energy shell?
- What is the main oxidation state of Group 16 elements?
- Name the main uses of selenium, tellurium and polonium

- Q-3 **Give the electron configuration for oxygen.**

- Give the electron configuration for oxygen.
- Name the isotopes of oxygen and give their chemical formulae.
- Explain how ozone is formed in the upper atmosphere.
- Give the oxidation numbers of oxygen in: i)  $O_3$  ii)  $MgO$  iii)  $H_2SO_4$  iv)  $H_2O_2$
- $KO_2$  vi)  $F_2O$

- Q-4 **Name two ways in which oxygen is produced in the atmosphere.**

- Method 1 – and give the associated chemical equation.
- Method 2 – and give the associated chemical equation.

- Q-5 **Name two methods that can be used to prepare oxygen in the laboratory and give balanced equations for the reactions.**
- Laboratory method 1 – equation.
  - Laboratory method 2 – equation.
- Q-6 **Oxygen can be prepared by the electrolysis of water.**
- What must be added to the water to be able to conduct a current?
  - Give a balanced equation for the reaction.
  - At what electrode will the oxygen be produced?
- Q-7 **Oxygen can be prepared by the decomposition of  $\text{H}_2\text{O}_2$ .**
- Make a labelled drawing of the apparatus that is used to produce oxygen in the laboratory.
  - How would you test that the gas is oxygen?
- Q-8 **Oxygen can react with most elements.**
- Give one example of a non-metal and one example of a metal that will react with oxygen.
  - Write balanced equations for the examples in (a).
  - State if the products in (a) are soluble in water and if the solutions will be acidic or basic.
- Q-9 **Methane combusts in oxygen in the air. Write a balanced equation for the reaction.**
- Q-10 **Write balanced equations for the reactions of oxygen with:**
- Aluminium
  - Magnesium
  - Fluorine to form  $\text{F}_2\text{O}$
  - Chlorine to form  $\text{Cl}_2\text{O}$
  - Iron to form  $\text{Fe}_3\text{O}_4$
  - Lithium
  - Carbon to form CO
  - Nitrogen to form  $\text{N}_2\text{O}$

## Chapter-9 Topic 9 Halogens

**Q-1 Give one word for each statement.**

- a) The electron distribution of an atom
- b) Group 17 elements of the Periodic Table of elements
- c) The ability of a neutral atom to attract a bonding electron pair
- d) The process used in industry to prepare chlorine
- e) An oxidising agent that can be used in the laboratory preparation of chlorine

**Q-2 The halogens are found in Group 17 of the Periodic Table.**

- a) How many valence electrons does a halogen have?
- b) How many unpaired electrons does a halogen have?
- c) Give the electron configuration for chlorine.
- d) What is the normal valency of the halogens?

**Q-3 Why don't we find elemental chlorine in nature?**

**Q-4 Complete the table below.**

- | Name         |
|--------------|
| Formula      |
| State at STP |
| Appearance   |
| a) Fluorine  |
| b) Chlorine  |
| c) Bromine   |
| d) Iodine    |

**Q-5 How does the magnitude of reactivity change within the group of the halogens?**

- a) Magnitude of reactivity
- b) Colour intensity change within Group 17

**Q-6 Write balanced equations for the following reactions:**

- a) Bromine with hydrogen
- b) Fluorine with sodium
- c) Chlorine with magnesium
- d) Boron with fluorine
- e) Iodine with nitrogen

- Q-7 When iron reacts with chlorine gas, a yellow glow can be seen. Dark brown vapours of iron(III) chloride are formed.**
- Is this reaction exothermic or endothermic? Give a reason for your answer.
  - Write a balanced equation for the reaction.
- Q-8 Magnesium and iodine powders are mixed on a heat-resisting plate.**
- What would you do to initiate the reaction? Give a reason for your answer.
  - Describe what you would see during the reaction.
  - Write a balanced equation for the reaction.
- Q-9 Chlorine water is added to an unknown halide solution. The solution turns brown. When tetrachloromethane is added to the solution, the solution turns purple.**
- Name the unknown halide, and explain your choice.
  - Write a balanced equation for the displacement reaction that took place.
  - Explain why halogens dissolve better in tetrachloromethane than in water.
  - Give the activity series for the halogens.

## **Chapter-10 Topic 10 Nitrogen**

- Q-1 Give one word for each of the following descriptions.**
- The industrial process that is used to produce ammonia
  - The process that is used to extract nitrogen from liquid air
  - The natural cycle that circulates nitrogen compounds through the air, soil and living organisms
- Q-2 Do These**
- In which group will you find the nitrogen family?
  - Name the elements in the nitrogen group.
  - What is the normal valency of these elements?
  - Classify the elements in this group as metals, non-metals or metalloids.
- Q-3 Do research about the method to determine the percentage of oxygen in air. Explain how this experiment can be used to prepare nitrogen in the laboratory.**
- Q-4 List the physical and chemical properties of nitrogen.**

**Q-5 Name the uses of nitrogen.**

**Q-6 Do These**

- What is the nitrogen cycle?
- The air contains 78% nitrogen. Why can we not use the nitrogen in the air directly?
- Name two nitrogen compounds that plants can use.
- What is the difference between the water cycle and nitrogen cycle?
- Make a simplified drawing of the nitrogen cycle.

**Q-7 Do These**

- How would you prepare ammonia in the laboratory?
- Give a balanced equation for the laboratory preparation.
- How would you collect the ammonia gas? Give a reason for your answer.

**Q-8 Do These**

- Write down a balanced equation for the reaction that takes place in the Haber Process.
- How is the nitrogen for the Haber Process obtained?
- How is the ammonia separated from the other gases in the converter?

**Q-9 Nitric acid is made from ammonia using the Ostwald Process. There are three stages in the process. Complete and balance the reactions for the three stages: a) Step 1:  $4\text{NH}_3(\text{g}) + \dots \rightarrow \dots + 6\text{H}_2\text{O}(\text{g})$  Step 2:  $\dots + \text{O}_2(\text{g}) \rightarrow \dots$  Step 3:  $\dots + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{HNO}_3(\text{aq}) + \dots$  b) Name the catalyst used during Step 1. c) Which of the reactions in a) are redox reactions? Explain by referring to oxidation states of nitrogen.**

**Q-10 Study the following flow diagram and answer the questions that follow:  $\text{N}_2 + \text{H}_2 \rightarrow \text{process A} \rightarrow \text{process B} \rightarrow \text{process C} \rightarrow \text{product D}$ ;  $\text{D} + \text{O}_2 \rightarrow \text{NO}_2 \rightarrow \text{HNO}_3$ .**

- Name process A.
- Give the name of product D.
- Name process B.
- Which catalyst is used in process B?
- Write a balanced chemical equation for the catalytic step of process B.
- Give the formula of the compound added before process C.
- When nitric acid and product D react, a new compound F forms. Give the formula of F.
- Name two uses of F.

## Chapter-11 Topic 11 Sulphur

Q-1 **Name the general properties of elements in Group 16 of the Periodic Table.**

Q-2 **Do These**

- Give the electron structure of sulphur.
- How many valence electrons does sulphur have?
- Give the oxidation numbers of sulphur in each of the following compounds: i)  $\text{SO}_2$  ii)  $\text{HSO}_4^-$  iii)  $\text{Na}_2\text{SO}_3$  iv)  $\text{Na}_2\text{S}_2\text{O}_3$  v)  $\text{H}_2\text{S}$  vi)  $\text{H}_2\text{SO}_4$  vii)  $\text{S}$  viii)  $\text{SO}_2$

Q-3 **Do These**

- Name three sources where sulphur can be found on Earth.
- Explain how sulphur is extracted from the earth and name the process.

Q-4 **Name the physical properties of sulphur.**

Q-5 **Sulphur forms allotropes.**

- What are allotropes?
- Name the allotropes of sulphur and state how they are similar and in which ways they differ.
- Name an allotrope of sulphur that occurs in the liquid state.

Q-6 **Sulphur has two oxides.**

- One oxide forms when sulphur burns in air. Give a balanced equation for the reaction.
- The product of reaction (a) has distinctive properties. Mention some of these properties.

Q-7 **A hydrogen compound of sulphur is  $\text{H}_2\text{S}$ .**

- Give the name of  $\text{H}_2\text{S}$ .
- Name its distinctive physical property.
- Give a balanced equation for the laboratory preparation of  $\text{H}_2\text{S}$ .

## Chapter-12 Topic 12 Oxidation-reduction reactions

Q-1 **Give one word for each of these descriptions.**

- The chemical process in which there is a transfer of electrons
- The chemical process that occurs when the oxidation number of an atom decreases

- c) The chemical process that occurs when an atom loses electrons
  - d) The substance that loses electrons in a redox reaction
  - e) The state that indicates the relative richness in electrons of a substance.
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**Q-2 Choose the correct words: A reducing agent is (a) oxidised/reduced and (b) gains/loses electrons during a reaction. An oxidising agent is (c) oxidised/reduced and (d) gains/loses electrons during a reaction. Oxidation occurs when the atom (e) loses/gains electrons and when the oxidation number (f) increases/decreases.**

**Q-3 Explain the meaning of oxidation numbers.**

**Q-4 Assign oxidation numbers to the atoms in the following molecules:**

- a) Iron in FeO; FeCl<sub>2</sub>; Fe; FeBr<sub>2</sub>
- b) Copper in Cu<sub>2</sub>O; CuCl<sub>2</sub>; Cu; CuO; CuCl
- c) Carbon in C; CO; CO<sub>2</sub>; HCO<sub>3</sub><sup>-</sup>
- d) Chlorine in Cl<sub>2</sub>; ClF; Cl<sub>2</sub>O; ClO<sub>2</sub>; HCl; HOCl

**Q-5 A student prepares sulphur dioxide gas by adding concentrated sulphuric acid to copper metal filings. The balanced equation for the reaction is:  $\text{Cu(s)} + 2\text{H}_2\text{SO}_4(\text{l}) \rightarrow \text{SO}_2(\text{g}) + \text{CuSO}_4(\text{aq}) + 2\text{H}_2\text{O(l)}$**

- a) Using oxidation numbers, identify the oxidising and reducing agents in this reaction. Show your working.
- b) Write down the oxidation half-reaction.

**Q-6 Use the following redox reactions to answer the questions:  $\text{Cu(s)} + 2\text{KBr(aq)} \rightarrow \text{Br}_2(\text{l}) + \text{CuBr}_2(\text{aq})$ ;  $\text{CuSO}_4(\text{aq}) + \text{Zn(s)} \rightarrow \text{Cu(s)} + \text{ZnSO}_4(\text{aq})$ ;  $\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2(\text{g})$**

- a) Identify the oxidising and reducing agents in each reaction.
- b) Name the spectator ions in each reaction.
- c) Describe what happens at each electrode during the reactions.

## Chapter-13 Topic 13 The ionic theory

**Q-1 Give one term for the following descriptions:**

- a) Solutions that conduct electricity
- b) Negative ions
- c) The particles in a non-electrolyte

- d) The table that contain reduction half-reactions
- e) The reference electrode that is used to measure electrode potential.

**Q-2 Study the following list of substances: kerosene, fused lead(II) bromide, carbonic acid, copper(II) sulphate solution, sugar solution, molten table salt, cooking oil, ammonia solution**

- a) Define the terms strong electrolyte, weak electrolyte and non-electrolyte
- b) Name all the strong electrolytes in the list
- c) Name all the weak electrolytes in the list
- d) Name all the non-electrolytes in the list

**Q-3 Why does tap water conduct electric current, but distilled water does not?**

**Q-4 A student conducts an experiment to determine if sodium chloride is a conductor.**

- a) Will a solid salt crystal conduct an electric current? Explain your answer.
- b) What should he do to make an electrolyte from sodium chloride?
- c) Make a labelled sketch of the apparatus that he will use to determine how good an electrolyte a sodium chloride solution is. Use the following labels: battery, light bulb, ammeter, cathode, anode, electrolyte, connecting wires.
- d) Show the polarity of the battery

**Q-5 Which of the reactions will happen? Give a reason for your answer.**

- a)  $2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2$
- b)  $2\text{AgNO}_3 + \text{Cu} \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}$
- c)  $\text{Hg} + \text{H}_2\text{SO}_4 \rightarrow \text{HgSO}_4 + \text{H}_2$
- d)  $\text{Fe} + \text{ZnCl}_2 \rightarrow \text{FeCl}_2 + \text{Zn}$

## Chapter-14 Topic 14 Electrolysis

**Q-1 Give one term for each of the following descriptions.**

- a) An ionic solution that conducts electricity
- b) An electrochemical cell that supports self-sustaining electrode reactions
- c) An electrochemical cell in which electrical energy is converted to chemical energy
- d) The process in which electrons are gained during a chemical reaction
- e) The reaction type in which electrons are transferred
- f) The chemical species that undergoes oxidation in a chemical reaction

- g) The half-reaction that happens at the anode of an electrochemical cell
- h) The U-shaped tube that connects two half-cells in a galvanic cell.

**Q-2 Choose the correct word in column B for each statement in column A.**

- a) Electrode where oxidation occurs — A. zero B. maximum C. positive D. negative
- E. anode F. cathode G. oxidation H. reduction I. oxidising agent J. reducing agent
- K. galvanic cell L. electrolytic cell

**Q-3 Define the term electrolysis and answer the following.**

- a) Define electrolysis.
- b) Which electrode, Fe or C, is the anode?
- c) At which electrode does reduction occur?
- d) Write the half-reaction that takes place at electrode C.
- e) Explain why Ca metal will not form.
- f) Explain why Na metal collects at the top of the cell.
- g) Why is it necessary to place a screen between the electrodes?
- h) If a current of 5 A flows for 2 h, what mass of sodium will form?

**Q-4 Hydrogen peroxide is commonly used as a bleaching agent. When manganese dioxide is added to  $\text{H}_2\text{O}_2$ , water and oxygen are formed while  $\text{MnO}_2$  is not consumed. Use the table of standard reduction potentials to answer the questions.**

- a) Give the equation for the oxidation half-reaction.
- b) Give the equation for the reduction half-reaction.
- c) Give the balanced equation for the net reaction.
- d) What is the function of  $\text{MnO}_2$  in this reaction?
- e) What property of hydrogen peroxide is responsible for its bleaching action?

**Q-5 A zinc bar is attached to a buried iron pipe. Use standard potentials to explain corrosion protection.**

**Q-6 Two half-cells  $\text{Pb}^{2+}/\text{Pb}$  and  $\text{O}_2/\text{H}^+$  in acid are used to set up a cell under standard conditions.**

- a) Give the standard conditions.
- b) Which half-cell is the anode?
- c) Write the oxidation half-reaction.
- d) Write the reduction half-reaction.
- e) Give the balanced net reaction.
- f) Calculate the emf of the cell.

- Q-7 **The following half-reactions occur in a nickel-cadmium battery:**  
 $\text{Cd}(\text{OH})_2 + 2 \text{e}^- \rightarrow \text{Cd} + 2 \text{OH}^-$  ( $E^\circ = -0.82 \text{ V}$ );  $\text{NiO}(\text{OH}) + \text{H}_2\text{O} + \text{e}^- \rightarrow \text{Ni}(\text{OH})_2 + \text{OH}^-$  ( $E^\circ = +0.48 \text{ V}$ ).
- Which electrode is the anode?
  - Write the oxidation half-reaction.
  - Write the balanced cell reaction.
  - Calculate the emf.
  - In which direction do electrons flow when recharging?
- Q-8 **What current must be supplied to deposit 5.00 g of gold from  $\text{AuCl}_3$  in 20 min?**
- Q-9 **Electrolysis is an important industrial process used to decompose compounds, extract metals from their ores and to purify metals like gold and copper. The simplified diagram below represents the Downs cell used to produce sodium metal. The cell is filled with a molten mixture of  $\text{NaCl}$  and  $\text{CaCl}_2$ . The  $\text{CaCl}_2$  lowers the melting point of the mixture from  $801^\circ \text{C}$  (for pure  $\text{NaCl}$ ) to  $580^\circ \text{C}$ .**
- Define the term electrolysis.
  - Which electrode, Fe or C, will be the anode?
  - At which electrode does reduction occur?
  - Write down the half-reaction that takes place at electrode C.
  - Explain why Ca metal will not form.
  - Explain why Na metal collects at the top of the cell.
  - Why is it necessary to place a screen between the electrodes?
  - If a current of 5 A flows for 2 h, what mass of sodium will form?
- Q-10 **The chlor-alkali industry is the second largest consumer of electricity among electrolytic industries. It makes use of brine as electrolyte to produce chlorine gas, hydrogen gas and sodium hydroxide. The overall reaction can be represented by the following equation:  $2 \text{NaCl}(\text{aq}) + 2 \text{H}_2\text{O}(\text{l}) \rightarrow 2 \text{NaOH}(\text{aq}) + \text{Cl}_2(\text{g}) + \text{H}_2(\text{g})$**
- Define the term electrolyte.
  - Give a reason why brine conducts electricity.
  - Write down the name of the reducing agent in the above reaction; give a reason for your choice.
  - Write down a half-reaction to explain how hydroxide ions are formed.
  - At which electrode (anode or cathode) is chlorine gas formed? Give a reason.

f) Give one reason why it is not advisable to build a chlor-alkali plant close to a residential area.

## Chapter-15 Topic 15 Hydrocarbons

**Q-1 Give one term for each of the following descriptions.**

- Compounds that contain carbon and hydrogen atoms only
- The distinctive group of atoms that is responsible for the characteristic chemical reactions of that compound
- A family of organic molecules with the same functional group
- The property of compounds that contain double and triple bonds, allowing them to undergo addition reactions
- The homologous series where the prefix is the active site
- The general formula for the alkanes
- Compounds with the same molecular formula, but different structural formulae
- The system that we use to name organic compounds in a systematic way
- The group of compounds that is our main fuel source
- The type of reaction in which a water molecule is added to an alkene

**Q-2 Explain the following terms used in organic chemistry and give examples of each:**

- general formula
- homologous series
- isomerism

**Q-3 The following diagrams show the structures of isomers of C<sub>4</sub>H<sub>10</sub>:**

- To which homologous series do the isomers belong?
- Compound A reacts with bromine. i) Draw the full structural formula of the product and give its IUPAC name. ii) What type of reaction has taken place? iii) What do you observe during the reaction?
- Compound B is mixed with hydrogen gas and passed over a Pd catalyst. i) Draw the full structural formula of the product and give its IUPAC name. ii) What is this type of reaction called? iii) How is this reaction used in industry?
- Compound C is reacted with steam in the presence of phosphoric acid. i) Name the type of reaction that occurs. ii) Draw the full structural formula of the product that forms.
- Give the IUPAC names for structures C, D and E.

Q-4 **Consider the following compounds:**

- a) A
- b) B

Q-5 **A saturated carbon with 8 carbon atoms is cracked to produce two products with four carbon atoms each.**

- a) Why are saturated carbon compounds cracked?
- b) Give the formula of the original hydrocarbon.
- c) Use condensed structural formulae to write a balanced equation for the above reaction. Show structural isomers.
- d) Give the IUPAC names of the products.
- e) Explain the two different types of cracking.

## Chapter-16 Topic 16 Alkanols

Q-1 **Some organic reactions can be classified as elimination, substitution, addition or oxidation. Write down to which group each reaction belongs.**

- a)  $2\text{CH}_3\text{O} + 3\text{O} \rightarrow 2\text{CO} + 4\text{H}_2\text{O}$
- b)  $\text{C}_2\text{H}_5\text{O} + \text{CH}_3 \rightarrow \text{H}_2\text{O}$
- c)  $2\text{C}_2\text{H}_5 + \text{O} \rightarrow 2\text{CO} + \text{H}_2\text{O}$
- d)  $\text{C}_2\text{H}_5\text{O} \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}$
- e)  $\text{C}_2\text{H}_5\text{NH}_2 + \text{HBr} \rightarrow \text{C}_2\text{H}_5\text{NH}_3^+ + \text{Br}^-$

Q-2 **Explain why ethanol is very soluble in water, but hexan-1-ol is only slightly soluble.**

Q-3 **Look at the list below. Explain why the boiling points of the following compounds differ.**

- a) ethane and ethanol
- b) methanol and ethanal
- c) propan-1-ol and ethan-1,2-diol

Q-4 **1-bromopropane is dissolved in ethanol. The solution is allowed to react with aqueous sodium hydroxide. Write a balanced equation for the reaction that occurs. Use condensed structural formula.**

**Q-5 Give the IUPAC names for the following molecules:**

a) [structure a]

b) [structure b]

c) [structure c]

d) [structure d]

e) [structure e]

**Q-6 Draw condensed structural formulae for the following compounds.**

a) phenol

b) 2-methylpentan-3-ol

**Q-7 Draw structural formulae for the following compounds.**

a) propan-2-ol

b) butan-2,3-diol

**Q-8 When an alkanol reacts with excess concentrated sulfuric acid: at 180 °C it undergoes an elimination reaction to form an alkene; at 140 °C it forms an ether.**

a) Using this pattern, write equations for i) 2-pentanol + H $\blacksquare$ SO $\blacksquare$  at 180 °C; ii) methanol + H $\blacksquare$ SO $\blacksquare$  at 140 °C

b) Name the organic products in both cases

c) What types of intermolecular forces are there between the molecules in the reactants and the products?

d) Ethanol is a liquid at room temperature and pressure. In what state would you expect the products to be? Support your answer with a reason.

**Q-9 In the diagram of a molecule shown below, the red atoms are oxygen, black atoms are carbon and white atoms are hydrogen.**

a) Write down the molecular and structural formula of the substance represented in the diagram

b) The common name of this substance is glycerine. What is its IUPAC name?

c) Which hydrocarbon is glycerine derived from?

d) To which class of organic compounds does glycerine belong?

e) The boiling points of some compounds are given in the table: propene  $-42$  °C; propan-1-ol  $-97$  °C; propan-1,2-diol  $187$  °C; glycerine  $290$  °C. i) Why is there such a large increase from propene to propan-1-ol? ii) Why is there an increase from propan-1-ol to propan-1,2-diol to glycerine?