NCERT BOOK QUESTIONS AND EXERCISES (with answers)

Chapter : CHEMICAL REACTIONS AND EQUATIONS

NCERT Book, Page 6

Q. 1. Why should a magnesium ribbon be cleaned before burning in air ?

Ans. A magnesium ribbon is cleaned to remove the protective layer of basic magnesium carbonate from its surface so that it may readily combine with the oxygen of air (on heating).

Q. 2. Write the balanced equations for the following chemical reactions :

(*i*) Hydrogen + Chlorine ⟶ Hydrogen chloride

(*ii*) Barium chloride + Aluminium sulphate ⟶ Barium sulphate + Aluminium chloride

(*iii*) Sodium + Water ⟶ Sodium hydroxide + Hydrogen

Ans. (*i*) $H_2 + Cl_2 \longrightarrow 2HCl$

(*ii*) $3BaCl_2 + Al_2(SO_4)_3 \longrightarrow 3BaSO_4 + 2AlCl_3$

(*iii*) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Q.3. Write balanced chemical equations with state symbols for the following reactions :

(*i*) Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and the solution of sodium chloride.

(*ii*) Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.

Ans. (*i*) $BaCl_2\,(aq) + Na_2SO_4\,(aq) \longrightarrow BaSO_4\,(s) + 2NaCl\,(aq)$

(*ii*) $NaOH\,(aq) + HCl\,(aq) \longrightarrow NaCl\,(aq) + H_2O\,(l)$

NCERT Book, Page 10

Q. 1. A solution of substance X is used for white washing.

(*i*) Name the substance X and write its formula.

(*ii*) Write the reaction of the substance X named in (*i*) above with water.

Ans. See Sample Problem 1 on page 32 of this book.

Q.2. Why is double the amount of a gas collected in one of the test-tubes in the electrolysis of water activity ? Name this gas.

Ans. See Sample problem 2 on page 33 of this book.

NCERT Book, Page 13

Q.1. Why does the colour of copper sulphate solution change when an iron nail is dipped in it ?

Ans. When an iron nail is dipped in copper sulphate solution, then the blue colour of copper sulphate solution changes because iron displaces copper from copper sulphate solution to form a light green solution of iron sulphate (For equation of this reaction, see Example 3 on page 33 of this book).

Q.2. Give an example of a double displacement reaction.

Ans. When silver nitrate solution is added to sodium chloride solution, then a double displacement reaction takes place in which a white precipitate of silver chloride is formed alongwith sodium nitrate solution (For equation of this reaction, see Example 1 on page 35 of this book)

Q.3. Identify the substances that are oxidised and the substances that are reduced in the following reactions :

(*i*) $4Na\,(s) + O_2\,(g) \longrightarrow 2Na_2O\,(s)$

(*ii*) $CuO\,(s) + H_2\,(g) \longrightarrow Cu\,(s) + H_2O\,(l)$

Ans. (*i*) Substance oxidised : Na ; Substance reduced : O_2
(*ii*) Substance oxidised : H_2 ; Substance reduced : CuO

NCERT Book, Pages 14, 15 and 16

Q.1. Which of the statements about the reaction below are incorrect ?

$$2PbO\,(s) + C\,(s) \longrightarrow 2Pb\,(s) + CO_2\,(g)$$

(*a*) Lead is getting reduced
(*b*) Carbon dioxide is getting oxidised
(*c*) Carbon is getting oxidised
(*d*) Lead oxide is getting reduced
(*i*) (*a*) and (*b*) (*ii*) (*a*) and (*c*) (*iii*) (*a*), (*b*) and (*c*) (*iv*) all

Ans. (*i*) (*a*) and (*b*)

Q.2. $Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$

The above reaction is an example of a :
(*a*) combination reaction (*b*) double displacement reaction
(*c*) decomposition reaction (*d*) displacement reaction

Ans. (*d*) displacement reaction

Q.3. What happens when dilute hydrochloric acid is added to iron filings ? Tick the correct answer.
(*a*) Hydrogen gas and iron chloride are produced
(*b*) Chlorine gas and iron hydroxide are produced
(*c*) No reaction takes place
(*d*) Iron salt and water are produced

Ans. (*a*) Hydrogen gas and iron chloride are produced

Q.4. What is a balanced chemical equation ? Why should chemical equations be balanced ?

Ans. A chemical equation having an equal number of atoms of different elements in the reactants and products is called a balanced chemical equation. Here is an example. Zinc reacts with dilute sulphuric acid to form zinc sulphate and hydrogen :

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + \underset{\text{Hydrogen}}{H_2}$$

Now, this equation has an equal number of Zn atoms (1 each), H atoms (2 each), S atoms (1 each), and O atoms (4 each) in reactants and products, so it is a balanced chemical equation.

The chemical equations are balanced to satisfy the law of conservation of mass which says that 'matter (or atoms) can neither be created nor destroyed in a chemical reaction'. So, the total mass of all the elements present in the products of a chemical reaction should be equal to the total mass of all the elements present in the reactants. In other words, the number of atoms of each element in the products must be equal to the number of atoms of these elements in the reactants.

Q.5. Translate the following statements into chemical equations and then balance them :
(*a*) Hydrogen gas combines with nitrogen to form ammonia.
(*b*) Hydrogen sulphide gas burns in air to give water and sulphur dioxide
(*c*) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.
(*d*) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Ans. (*a*) $3H_2 + N_2 \longrightarrow 2NH_3$

(*b*) $2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2$

(*c*) $3BaCl_2 + Al_2(SO_4)_3 \longrightarrow 2AlCl_3 + 3BaSO_4$

(*d*) $2K + 2H_2O \longrightarrow 2KOH + H_2$

Q.6. Balance the following chemical equations :

(*a*) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$
(*b*) $NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$
(*c*) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$
(*d*) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$

Ans. (*a*) $2HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + 2H_2O$
(*b*) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$
(*c*) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$
(*d*) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

Q.7. Write the balanced chemical equations for the following reactions :

(*a*) Calcium hydroxide + Carbon dioxide ⟶ Calcium carbonate + Water
(*b*) Zinc + Silver nitrate ⟶ Zinc nitrate + Silver
(*c*) Aluminium + Copper chloride ⟶ Aluminium chloride + Copper
(*d*) Barium chloride + Potassium sulphate ⟶ Barium sulphate + Potassium chloride

Ans. (*a*) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$
(*b*) $Zn + 2AgNO_3 \longrightarrow Zn(NO_3)_2 + 2Ag$
(*c*) $2Al + 3CuCl_2 \longrightarrow 2AlCl_3 + 3Cu$
(*d*) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 + 2KCl$

Q.8. Write the balanced chemical equations for the following and identify the type of reaction in each case :

(*a*) Potassium bromide (aq) + Barium iodide (aq) ⟶ Potassium iodide (aq) + Barium bromide (s)
(*b*) Zinc carbonate (s) ⟶ Zinc oxide (s) + Carbon dioxide (g)
(*c*) Hydrogen (g) + Chlorine (g) ⟶ Hydrogen chloride (g)
(*d*) Magnesium (s) + Hydrochloric acid (aq) ⟶ Magnesium chloride (aq) + Hydrogen (g)

Ans. (*a*) $2KBr\,(aq) + BaI_2\,(aq) \longrightarrow 2KI\,(aq) + BaBr_2\,(s)$
This is a double displacement reaction (which is also a precipitation reaction).

(*b*) $ZnCO_3\,(s) \longrightarrow ZnO\,(s) + CO_2\,(g)$
This is a decomposition reaction.

(*c*) $H_2\,(g) + Cl_2\,(g) \longrightarrow 2HCl\,(g)$
This is a combination reaction.

(*d*) $Mg\,(s) + 2HCl\,(aq) \longrightarrow MgCl_2\,(aq) + H_2\,(g)$
This is a displacement reaction.

Q.9. What does one mean by exothermic and endothermic reactions ? Give examples.

Ans. See page 10 of this book.

Q.10. Why is respiration considered an exothermic reaction ? Explain.

Ans. Respiration is considered an exothermic reaction because energy is released in this process. During respiration, glucose (obtained from the digestion of food) combines with oxygen of air in the cells of our body to form carbon dioxide and water, and energy is released :

$$\underset{\text{Glucose}}{C_6H_{12}O_6\,(aq)} + \underset{\text{Oxygen}}{6O_2\,(g)} \longrightarrow \underset{\text{Carbon dioxide}}{6CO_2\,(g)} + \underset{\text{Water}}{6H_2O\,(l)} + \text{Energy}$$

Q.11. Why are decomposition reactions called the opposite of combination reactions ? Write equations for these reactions.

Ans. The decomposition reactions are called the opposite of combination reactions because in a combination reaction two or more substances combine to form a single substance whereas in a decomposition reaction, a single substance splits up to form two or more simpler substances.

(*a*) When hydrogen burns in oxygen, it forms water :

$$2H_2\,(g) + O_2\,(g) \longrightarrow 2H_2O\,(l)$$

In this reaction, two substances hydrogen and oxygen combine to form a single substance water, so this is a combination reaction.

(*b*) When acidified water is electrolysed, hydrogen and oxygen are formed :

$$2H_2O\ (l) \xrightarrow{\text{Electricity}} 2H_2\ (g) + O_2\ (g)$$

Here a single substance water breaks up into two simpler substances, hydrogen and oxygen. So, this is a decomposition reaction. We can see from the above examples that a decomposition reaction is opposite of a combination reaction.

Q.12. Write one equation each for decomposition reactions where energy is supplied in the form of (*a*) heat (*b*) light, and (*c*) electricity.

Ans. (*a*) When calcium carbonate is heated, it decomposes to form calcium oxide and carbon dioxide :

$$CaCO_3\ (s) \xrightarrow{\text{Heat}} CaO\ (s) + CO_2\ (g)$$

In this reaction, energy is supplied in the form of heat.

(*b*) When silver chloride is exposed to sunlight, it decomposes to form silver metal and chlorine gas :

$$2AgCl\ (s) \xrightarrow{\text{Sunlight}} 2Ag\ (s) + Cl_2\ (g)$$

Here energy is supplied in the form of sunlight.

(*c*) When acidified water is electrolysed, it decomposes to form hydrogen and oxygen :

$$2H_2O\ (l) \xrightarrow{\text{Electricity}} 2H_2\ (g) + O_2\ (g)$$

In this case, energy is supplied in the form of electricity.

Q.13. What is the difference between displacement and double displacement reactions ? Write equations for these reactions.

Ans. In a displacement reaction, a more reactive element displaces a less reactive element from its compound whereas in a double displacement reaction, two compounds combine by an exchange of ions to form two new compounds.

(*i*) A displacement reaction takes place between copper sulphate solution and zinc to form zinc sulphate solution and copper :

$$CuSO_4\ (aq) + Zn\ (s) \longrightarrow ZnSO_4\ (aq) + Cu\ (s)$$

(*ii*) A double displacement reaction takes place between barium chloride solution and sodium sulphate solution to form a white precipitate of barium sulphate and sodium chloride solution :

$$BaCl_2\ (aq) + Na_2SO_4\ (aq) \longrightarrow BaSO_4\ (s) + 2NaCl\ (aq)$$

Q.14. In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Ans.

$2AgNO_3\ (aq)$	+	$Cu\ (s)$	$\longrightarrow$	$Cu(NO_3)_2\ (aq)$	+	$2Ag\ (s)$
Silver nitrate (solution)		Copper		Copper nitrate (solution)		Silver

Q.15. What do you mean by a precipitation reaction ? Explain by giving example.

Ans. Any reaction in which an insoluble solid (called precipitate) is formed that suddenly separates from the solution, is called a precipitation reaction. The reaction between silver nitrate solution and sodium chloride solution to form silver chloride precipitate is an example of a precipitation reaction :

$AgNO_3\ (aq)$	+	$NaCl\ (aq)$	$\longrightarrow$	$AgCl\ (s)$	+	$NaNO_3\ (aq)$
Silver nitrate		Sodium chloride		Silver chloride (White ppt.)		Sodium nitrate

In this reaction, silver chloride is formed as a white, insoluble solid (called precipitate) which separates out suddenly from the solution.

Q.16. Explain the following in terms of gain or loss of oxygen with two examples each :
(*a*) Oxidation (*b*) Reduction

Ans. **(*a*) *Oxidation* :** The gain of oxygen by a substance in a reaction is called oxidation.

(*i*) When magnesium is burned in air, then magnesium oxide is formed :

$$\underset{\text{Magnesium}}{2Mg} + \underset{\substack{\text{Oxygen}\\(\text{From air})}}{O_2} \longrightarrow \underset{\text{Magnesium oxide}}{2MgO}$$

In this reaction, magnesium (Mg) has gained oxygen to form magnesium oxide (MgO), so magnesium is oxidised to magnesium oxide.

(*ii*) When copper oxide is heated with hydrogen, then copper metal and water are formed :

$$\underset{\text{Copper oxide}}{CuO} + \underset{\text{Hydrogen}}{H_2} \longrightarrow \underset{\text{Copper}}{Cu} + \underset{\text{Water}}{H_2O}$$

In this case, hydrogen (H_2) is gaining oxygen to form water (H_2O), so hydrogen is getting oxidised to water.

(*b*) ***Reduction*** **:** The loss of oxygen by a substance in a reaction, is called reduction.

(*i*) When zinc oxide is heated with carbon, then zinc metal and carbon monoxide are formed :

$$\underset{\text{Zinc oxide}}{ZnO} + \underset{\text{Carbon}}{C} \longrightarrow \underset{\text{Zinc}}{Zn} + \underset{\text{Carbon monoxide}}{CO}$$

In this reaction, Zinc oxide (ZnO) is losing oxygen to form zinc metal (Zn), therefore, zinc oxide is reduced to zinc.

(*ii*) When iron (III) oxide is heated with aluminium powder, then aluminium oxide and iron metal are formed :

$$\underset{\text{Iron (III) oxide}}{Fe_2O_3} + \underset{\text{Aluminium}}{2Al} \longrightarrow \underset{\text{Aluminium oxide}}{Al_2O_3} + \underset{\text{Iron}}{2Fe}$$

In this case, iron (III) oxide (Fe_2O_3) is losing oxygen to form iron metal (Fe), therefore, iron (III) oxide is reduced to iron.

Q.17. A shiny brown coloured element X on heating in air becomes black in colour. Name the element X and the black coloured compound formed.

Ans. See Sample Problem 5 on page 43 of this book.

Q.18. Why do we apply paint on iron articles ?

Ans. Paint is applied on iron articles to prevent their rusting. When a coat of paint is applied to the surface of an iron article, then air and moisture cannot come in contact with the iron metal of the article and hence no rusting takes place.

Q.19. Oil and fat containing food items are flushed with nitrogen. Why ?

Ans. The plastic bags containing oil and fat containing food items (such as potato chips) are flushed with an unreactive gas nitrogen so as to prevent them from getting oxidised and turn rancid. This is because in the presence of oxygen of air, the fats and oils present in food items get oxidised forming products having unpleasant smell and taste which turn the foods rancid (making them unfit for eating). When air containing oxygen is replaced by unreactive nitrogen gas, the packed food items do not get spoiled. They remain fresh for a much longer time.

Q.20. Explain the following terms with one example each :

(*a*) Corrosion (*b*) Rancidity

Ans. **(*a*)** ***Corrosion.*** The process in which metals are eaten up gradually by the action of air, moisture or a chemical (such as an acid) on their surface, is called corrosion. Rusting of iron is the most common example of corrosion. Rusting involves unwanted oxidation of iron metal which occurs in nature on its own. When an iron object is left in damp air for a considerable time, it gets covered with a red-brown flaky substance called 'rust'. The corrosion (or rusting) of iron is a continuous process which, if not prevented in time, eats up the whole iron object.

(*b*) ***Rancidity.*** Oxidation has damaging effect on foods containing fats and oils. When the food materials prepared in fats and oil are kept for a long time, they start giving unpleasant smell and taste. The condition produced by the aerial oxidation of fats and oil in foods marked by unpleasant smell and taste is called rancidity. Rancidity spoils the food materials prepared in fats and oil which have been kept for a considerable time and makes them unfit for eating. For example, if potato chips prepared in oil are kept exposed to air for a long time, they start giving unpleasant smell and taste due to the oxidation of oil present in them. The potato chips turn rancid and become unfit for eating.

Chapter : ACIDS, BASES AND SALTS

NCERT Book, Page 18

Q.1. You have been provided with three test-tubes. One of them contains distilled water and the other two contain an acidic solution and a basic solution, respectively. If you are given only red litmus paper, how will you identify the contents of each test-tube ?

Ans. See Sample Problem on page 54 of this book.

NCERT Book, Page 22

Q. 1 Why should curd and sour substances not be kept in brass and copper vessels ?

Ans. Curd and other sour substances contain acids which can react with the metals of brass and copper vessels to form toxic (poisonous) metal compounds which can cause food poisoning and damage our health.

Q.2. Which gas is usually liberated when an acid reacts with a metal ? Illustrate with the help of an example. How will you test the presence of this gas ?

Ans. When an acid reacts with a metal, then hydrogen gas is liberated. For example, when dilute sulphuric acid reacts with zinc granules, then hydrogen gas is liberated and zinc sulphate solution is formed :

$$\underset{\text{Zinc}}{Zn\,(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4\,(aq)} \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4\,(aq)} + \underset{\text{Hydrogen}}{H_2\,(g)}$$

The presence of hydrogen gas is tested by burning it. When a lighted match stick is brought near a gas jar containing hydrogen gas, it burns with a 'pop' sound making a little explosion.

Q.3. Metal compound A reacts with dilute hydrochloric acid to produce effervescence. The gas evolved extinguishes a burning candle. Write a balanced chemical equation for the reaction if one of the compounds formed is calcium chloride.

Ans. See Sample Problem 1 on page 61 of this book.

NCERT Book, Page 25

Q.1. Why do HCl, HNO_3, etc., show acidic character in aqueous solutions while solutions of compounds like alcohol and glucose do not show acidic character ?

Ans. The acidic character of a substance is due to the presence of hydrogen ions [H^+ (aq) ions] in its aqueous solution (water solution). HCl and HNO_3 show acidic properties because they produce hydrogen ions when dissolved in water. The solutions of compounds like alcohol and glucose do not show acidic character because they do not ionise (or dissociate) in water to produce hydrogen ions.

Q.2. Why does an aqueous solution of an acid conduct electricity ?

Ans. The aqueous solution of an acid conducts electricity due to the presence of charged particles called 'ions' in it. For example, when hydrochloric acid (HCl) is dissolved in water, then its aqueous solution contains hydrogen ions [H^+ (aq)] and chloride ions [Cl^- (aq)]. These ions carry electric current. So, due to the presence of H^+ (aq) ions and Cl^- (aq) ions, a water solution of hydrochloric acid conducts electricity.

Q.3. Why does dry HCl gas not change the colour of dry litmus paper ?

Ans. Dry HCl gas does not change the colour of dry litmus paper because it has no hydrogen ions, H^+ (aq) ions, in it which can impart acidic properties to it.

Q.4. While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid ?

Ans. A concentrated acid is diluted by adding water to it. The process of mixing water to a concentrated acid is highly exothermic in which a large amount of heat is evolved.

(*i*) When the concentrated acid is added to water, then the heat is evolved gradually and easily absorbed by the large amount of water.

(*ii*) If water is added to concentrated acid, then a large amount of heat is evolved at once. This heat changes some of the water to steam explosively which can splash the acid on our face or clothes and cause acid burns.

Q.5. How is the concentration of hydronium ions (H_3O^+) affected when the solution of an acid is diluted ?

Ans. On diluting an acid, the concentration of hydronium ions (H_3O^+) in it decreases.

Q.6. How is the concentration of hydroxide ions (OH^-) affected when excess of base is dissolved in a solution of sodium hydroxide ?

Ans. On dissolving more sodium hydroxide base in the same solution, the concentration of hydroxide ions (OH^-) increases.

NCERT Book, Page 28

Q.1. You have two solutions A and B. The pH of solution A is 6 and pH of solution B is 8. Which solution has more hydrogen ion concentration ? Which of these is acidic and which one basic ?

Ans. See Sample Problem 1 on page 75 of this book.

Q.2. What effect does the concentration of H^+ (aq) ions have on the nature of the solution ?

Ans. Higher the concentration of H^+(aq) ions in a solution, more acidic the solution will be.

Q.3. Do basic solutions also have H^+ (aq) ions ? If yes, then why are these basic ?

Ans. Even the basic solutions have hydrogen ions [H^+ (aq) ions] in them which come from the ionisation of water in which the base is dissolved. They are basic because the concentration of hydroxide ions [OH^- ions] in them is much more than the concentration of hydrogen ions.

Q.4. Under what soil condition do you think a farmer would treat the soil of his fields with quicklime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate) ?

Ans. A farmer would treat the soil of his fields with quicklime (calcium oxide), or slaked lime (calcium hydroxide) or chalk (calcium carbonate) if the soil is too acidic having a low pH value. All these materials are bases and hence react with the excess acid present in the soil and reduce its acidity.

NCERT Book, Page 33

Q.1. What is the common name of the compound $CaOCl_2$?

Ans. Bleaching powder.

Q.2. Name the substance which on treatment with chlorine yields bleaching powder.

Ans. Slaked lime.

Q.3. Name the sodium compound which is used for softening hard water.

Ans. Sodium carbonate (Washing soda).

Q.4. What will happen if a solution of sodium hydrogencarbonate is heated ? Give the equation of the reaction involved.

Ans. When a solution of sodium hydrogencarbonate is heated, it decomposes to form sodium carbonate with the evolution of carbon dioxide gas. The equation of the reaction involved is :

$$\underset{\text{Sodium hydrogencarbonate}}{2NaHCO_3} \xrightarrow{\text{Heat}} \underset{\text{Sodium carbonate}}{Na_2CO_3} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O}$$

Q.5. Write an equation to show the reaction between Plaster of Paris and water.

Ans.

$$\underset{\text{Plaster of Paris}}{CaSO_4.\tfrac{1}{2}H_2O} + \underset{\text{Water}}{1\tfrac{1}{2}H_2O} \longrightarrow \underset{\substack{\text{Gypsum}\\ \text{(sets as hard mass)}}}{CaSO_4.2H_2O}$$

NCERT Book, Pages 34 and 35

Q.1. A solution turns red litmus blue, its pH is likely to be :

(*a*) 1 (*b*) 4 (*c*) 5 (*d*) 10

Ans. (*d*) 10

Q.2. A solution reacts with crushed egg-shells to give a gas that turns lime water milky. The solution contains :

(*a*) NaCl (*b*) HCl (*c*) LiCl (*d*) KCl

Ans. (*b*) HCl

Q.3. 10 mL of a solution of NaOH is found to be completely neutralised by 8 mL of a given solution of HCl. If we take 20 mL of the same solution of NaOH, the amount of HCl solution (the same solution as before) required to neutralise it will be :

(*a*) 4 mL (*b*) 8 mL (*c*) 12 mL (*d*) 16 mL

Ans. (*d*) 16 mL

Q.4. Which one of the following types of medicines is used for treating indigestion ?

(*a*) Antibiotic (*b*) Analgesic (*c*) Antacid (*d*) Antiseptic

Ans. (*c*) Antacid

Q.5. Write word equations and then balanced equations for the reactions taking place when :

(*a*) dilute sulphuric acid reacts with zinc granules

(*b*) dilute hydrochloric acid reacts with magnesium ribbon

(*c*) dilute sulphuric acid reacts with aluminium powder

(*d*) dilute hydrochloric acid reacts with iron filings

Ans. (*a*) Sulphuric acid + Zinc ⟶ Zinc sulphate + Hydrogen

H_2SO_4 + Zn ⟶ $ZnSO_4$ + H_2

(*b*) Hydrochloric acid + Magnesium ⟶ Magnesium chloride + Hydrogen

2HCl + Mg ⟶ $MgCl_2$ + H_2

(*c*) Sulphuric acid + Aluminium ⟶ Aluminium sulphate + Hydrogen

$3H_2SO_4$ + 2Al ⟶ $Al_2(SO_4)_3$ + $3H_2$

(*d*) Hydrochloric acid + Iron ⟶ Iron (II) chloride + Hydrogen

2HCl + Fe ⟶ $FeCl_2$ + H_2

Q.6. Compounds such as alcohol and glucose also contain hydrogen but are not categorised as acids. Why ? Describe an activity to prove it.

Ans. Only those compounds containing hydrogen are considered to be acids which dissolve in water to produce hydrogen ions, H^+ (aq). The hydrogen containing compounds such as alcohol and glucose are not categorised as acids because they do not ionize to produce hydrogen ions, H^+ (aq), when dissolved in water. This is proved by the fact that the aqueous solutions of alcohol and glucose do not conduct electricity (For activity, see page 63 of this book).

Q.7. Why does distilled water not conduct electricity whereas rain water does ?

Ans. Distilled water does not conduct electricity because it does not contain any ionic compounds (like acids, bases or salts) dissolved in it,. When rain water falls to the earth through the atmosphere, it dissolves an acidic gas 'carbon dioxide' from the air and forms some carbonic acid (H_2CO_3). Carbonic acid (H_2CO_3) provides some hydrogen ions [H^+ (aq) ions] and carbonate ions [CO_3^{2-} (aq) ions] to rain water. Due to the presence of these ions, rain water conducts electricity.

Q.8. Why do acids not show acidic behaviour in the absence of water ?

Ans. The acidic behaviour of acids is due to the presence of hydrogen ions, H^+ (aq) ions. The acids produce hydrogen ions only on dissolving in water. In the absence of water, acids do not produce hydrogen ions and hence do not show acidic behaviour.

Q.9. Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9 respectively.

(*a*) Which solution is (*i*) neutral (*ii*) strongly alkaline (*iii*) strongly acidic (*iv*) weakly acidic, and (*v*) weakly alkaline ?

(*b*) Arrange the pH values in the increasing order of hydrogen ion concentration.

Ans. See Sample Problem 2 on page 75 of this book.

Q.10. Equal lengths of magnesium ribbons are taken in test-tubes A and B. Hydrochloric acid (HCl) is added to test-tube A while acetic acid (CH_3COOH) is added to test-tube B. In which test-tube will the fizzing occur more vigorously and why ?

Ans. See Sample Problem on page 66 of this book.

Q.11. Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd ? Explain your answer.

Ans. As the milk turns into curd, its pH will fall below 6 (it will become more acidic). This is because an acid (lactic acid) is produced when milk turns into curd.

Q.12. A milkman adds a very small amount of baking soda to fresh milk.
(*a*) Why does he shift the pH of the fresh milk from 6 to slightly alkaline ?
(*b*) Why does this milk take a longer time to set as curd ?

Ans. (*a*) Fresh milk is slightly acidic naturally. Fresh milk is made slightly alkaline by adding a little of baking soda so that it may not get sour easily due to the formation of lactic acid in it.

(*b*) The slightly alkaline milk takes a longer time to set into curd because the lactic acid being formed during curdling has to first neutralise the alkali present in it.

Q.13. Plaster of Paris should be stored in a moisture-proof container. Explain why ?

Ans. Plaster of Paris should be stored in a moisture-proof container because the presence of moisture (or water) can cause its slow setting by bringing about its hydration. This will make the plaster of Paris useless after some time.

Q.14. What is a neutralisation reaction ? Give two examples.

Ans. The reaction between an acid and a base to form salt and water is called a neutralisation reaction. That is :

$$\text{Acid} + \text{Base} \longrightarrow \text{Salt} + \text{Water}$$

The examples of neutralisation reactions are as follows :

(*i*) Sodium hydroxide reacts with sulphuric acid to form sodium sulphate and water :

$$\underset{\text{Sodium hydroxide (Base)}}{2NaOH\,(aq)} + \underset{\text{Sulphuric acid (Acid)}}{H_2SO_4\,(aq)} \longrightarrow \underset{\text{Sodium sulphate (Salt)}}{Na_2SO_4\,(aq)} + \underset{\text{Water}}{2H_2O\,(l)}$$

(*ii*) Magnesium hydroxide reacts with hydrochloric acid to form magnesium chloride and water :

$$\underset{\text{Magnesium hydroxide (Base)}}{Mg(OH)_2\,(aq)} + \underset{\text{Hydrochloric acid (Acid)}}{2HCl\,(aq)} \longrightarrow \underset{\text{Magnesium chloride (Salt)}}{MgCl_2\,(aq)} + \underset{\text{Water}}{2H_2O\,(l)}$$

Q.15. Give two important uses each of washing soda and baking soda.

Ans. **(*a*) *Uses of washing soda* :**

(*i*) Washing soda is used as a cleansing agent for domestic purposes like washing clothes.

(*ii*) Washing soda is used for removing permanent hardness of water.

(*b*) *Uses of baking soda* :

(*i*) Baking soda is used as an antacid in medicine to remove acidity of the stomach.

(*ii*) Baking soda is used in making baking powder (which is used in making cakes, bread, etc.).

Chapter : METALS AND NON-METALS

NCERT Book, Page 40

Q.1. Give an example of a metal which :

(*i*) is a liquid at room temperature

(*ii*) can be easily cut with a knife

(*iii*) is the best conductor of heat

(*iv*) is a poor conductor of heat

Ans. (*i*) Mercury (*ii*) Sodium (*iii*) Silver (*iv*) Lead

Q.2. Explain the meanings of malleable and ductile.

Ans. (*a*) A material which can be turned into thin sheets on hammering, is said to be malleable. Metals are malleable because metals can be beaten with a hammer to form thin sheets.

(*b*) A material which can be turned into thin wires by stretching, is said to be ductile. Metals are ductile because they can be stretched (or drawn) to form thin wires.

NCERT Book, Page 46

Q.1. Why is sodium kept immersed in kerosene oil ?

Ans. Sodium is a very reactive metal. Sodium reacts so vigorously with the oxygen of air that it catches fire if kept in the open. Sodium is kept immersed in kerosene oil to protect it from the action of air (and moisture) and to prevent accidental fires.

Q.2. Write equations for the reactions of :

(*i*) iron with steam

(*ii*) calcium with water

(*iii*) potassium with water

Ans. (*i*) Equation for the reaction of iron with steam is given below :

$$\underset{\text{Iron}}{3Fe\ (s)} + \underset{\text{Steam}}{4H_2O\ (g)} \longrightarrow \underset{\text{Iron (II, III) oxide}}{Fe_3O_4\ (s)} + \underset{\text{Hydrogen}}{4H_2\ (g)}$$

(*ii*) Equation for the reaction of calcium with water is as follows :

$$\underset{\text{Calcium}}{Ca\ (s)} + \underset{\text{Water}}{2H_2O\ (l)} \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2\ (aq)} + \underset{\text{Hydrogen}}{H_2\ (g)}$$

(*iii*) Equation for the reaction of potassium with water can be written as :

$$\underset{\text{Potassium}}{2K\ (s)} + \underset{\text{Water}}{2H_2O\ (l)} \longrightarrow \underset{\text{Potassium hydroxide}}{2KOH\ (aq)} + \underset{\text{Hydrogen}}{H_2\ (g)}$$

Q.3. Samples of four metals *A*, *B*, *C* and *D* were taken and added to the solutions given in the following table, one by one. The results obtained are as follows :

Metal	Iron (II) sulphate	Copper (II) sulphate	Zinc sulphate	Silver nitrate
A	No reaction	*Displacement*		
B	*Displacement*		No reaction	
C	No reaction	No reaction	No reaction	*Displacement*
D	No reaction	No reaction	No reaction	No reaction

Use the above table to answer the following questions about metals *A*, *B*, *C* and *D* :

(*i*) Which is the most reactive metal ?

(*ii*) What would you observe when metal *B* is added to a solution of copper (II) sulphate ?

(*iii*) Arrange the metals *A*, *B*, *C* and *D* in the order of decreasing reactivity.

Ans. See Sample Problem 6 on page 123 of this book.

Q.4. Which gas is produced when dilute hydrochloric acid is added to a reactive metal ? Write the chemical reaction when iron reacts with dilute sulphuric acid.

Ans. (*a*) When dilute hydrochloric acid is added to a reactive metal, then hydrogen gas is produced.

(*b*) When iron reacts with dilute sulphuric acid, then iron (II) sulphate and hydrogen gas are produced. This chemical reaction can be represented by an equation as follows :

$$\underset{\text{Iron}}{Fe\,(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4\,(aq)} \longrightarrow \underset{\text{Iron (II) sulphate}}{FeSO_4\,(aq)} + \underset{\text{Hydrogen}}{H_2\,(g)}$$

Q.5. What would you observe when zinc is added to a solution of iron (II) sulphate ? Write the chemical reaction that takes place.

Ans. See Sample Problem 3 on page 122 of this book.

NCERT Book, Page 49

Q.1. (*i*) Write the electron-dot structures for sodium, oxygen and magnesium.

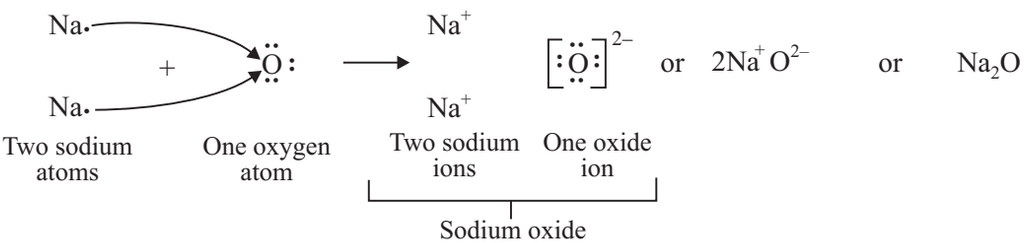
(*ii*) Show the formation of Na_2O and MgO by the transfer of electrons.

(*iii*) What are the ions present in these compounds ?

Ans. (*i*) The sodium atom (Na) has 1 outermost electron (or 1 valence electron), so its electron-dot structure is Na·, the oxygen atom (O) has 6 outermost electrons (or 6 valence electrons), so its electron-dot structure is $:\ddot{O}:$ and the magnesium atom (Mg) has 2 outermost electrons (or 2 valence electrons), so its electron-dot structure is Mg :

(*ii*) (*a*) **Formation of Na_2O**

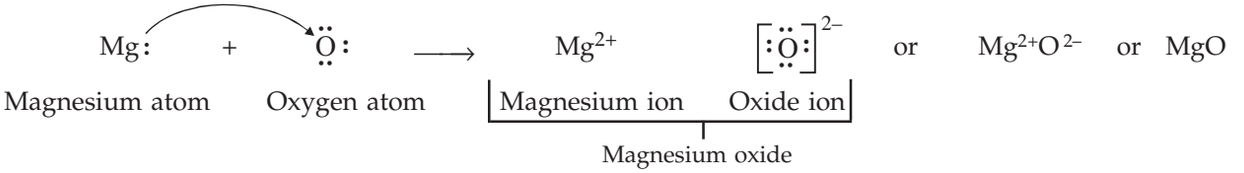
Na_2O is sodium oxide. In the formation of sodium oxide, two sodium atoms transfer their 2 outermost electrons to an oxygen atom. By losing 2 electrons, the two sodium atoms form two sodium ions ($2Na^+$). And by gaining 2 electrons, the oxygen atom forms an oxide ion (O^{2-}) :



The oppositely charged sodium ions and oxide ion are held together by strong electrostatic forces of attraction to form the ionic sodium oxide compound $2Na^+O^{2-}$ or Na_2O.

(*b*) **Formation of MgO**

MgO is magnesium oxide. In the formation of magnesium oxide, a magnesium atom transfers its 2 outermost electrons to an oxygen atom. By losing 2 electrons, a magnesium atom forms magnesium ion (Mg^{2+}) and by gaining 2 electrons, the oxygen atom forms an oxide ion (O^{2-}) :



The oppositely charged magnesium ions and oxide ions are held together by strong electrostatic forces of attraction to form the ionic magnesium oxide compound $Mg^{2+}O^{2-}$ or MgO.

(*iii*) (*a*) The ions present in sodium oxide (Na_2O) compound are sodium ions (Na^+) and oxide ions (O^{2-}).

(*b*) The ions present in magnesium oxide (MgO) compound are magnesium ions (Mg^{2+}) and oxide ions (O^{2-}).

Q.2. Why do ionic compounds have high melting points ?

Ans. Ionic compounds are made up of positive and negative ions. There is a strong force of electrostatic attraction between the oppositely charged ions of an ionic compound, so a lot of heat energy is required to break this force of attraction and melt the ionic compound. Due to this, ionic compounds have high melting points.

NCERT Book, Page 53

Q.1. Define the terms : (*i*) mineral (*ii*) ore, and (*iii*) gangue.

Ans. (*i*) The natural materials in which the metals or their compounds are found in the earth are called minerals. Different minerals contain varying percentage of metal. Minerals may or may not contain objectionable impurities which hamper the extraction of metals.

(*ii*) Those minerals from which the metals can be extracted conveniently and profitably are called ores. An ore contains a good percentage of metal and there are no objectionable impurities in it.

(*iii*) The ores mined from the earth are usually contaminated with large number of impurities. The unwanted impurities like sand, rocky material, earthy particles, limestone, mica, etc., present in an ore are called gangue.

Q.2. Name two metals which are found in nature in the free state.

Ans. Gold and Platinum.

Q.3. What chemical process is used for obtaining a metal from its oxide ?

Ans. Reduction

NCERT Book, Page 55

Q.1. Zinc oxide, magnesium oxide and copper oxide were heated, turn by turn, with zinc, magnesium and copper metals as shown in the following table :

Metal oxide	Zinc	Magnesium	Copper
1. Zinc oxide 2. Magnesium oxide 3. Copper oxide			

In which cases will you find displacement reactions taking place ?

Ans. See Sample Problem 5 on page 122 of this book.

Q.2. Which metals do not corrode easily ?

Ans. Those metals which are at the bottom of the 'reactivity series' are highly unreactive and do not corrode easily (because they are not affected by air, moisture or ordinary chemicals). The two examples of metals which do not corrode easily are gold and platinum.

Q.3. What are alloys ?

Ans. Alloys are a homogeneous mixture of two or more metals (or a metal and small amounts of non-metals). For example, *brass* is an alloy of two metals : *copper* and *zinc*, whereas *steel* is an alloy of a metal and a small amount of a non-metal : *iron* and *carbon.* An alloy is prepared by mixing the various metals in molten state in required proportions, and then cooling their mixture to the room temperature. The alloy of a metal and a non-metal can be prepared by first melting the metal and then dissolving the non-metal in it, followed by cooling to the room temperature.

NCERT Book, Pages 56 and 57

Q.1. Which of the following pairs will give displacement reactions ?

(*a*) NaCl solution and copper metal

(*b*) $MgCl_2$ solution and aluminium metal

(*c*) $FeSO_4$ solution and silver metal

(*d*) $AgNO_3$ solution and copper metal

Ans. (*d*) $AgNO_3$ solution and copper metal (For details, see Sample Problem 4 on page 122 of this book).

Q.2. Which of the following methods is suitable for preventing an iron frying pan from rusting ?

(*a*) Applying grease **(*b*) Applying paint**

(*c*) Applying a coat of zinc **(*d*) All of the above**

Ans. (*c*) Applying a coat of zinc (For details, see Sample Problem 1 on page 188 of this book).

Q.3. An element reacts with oxygen to give a compound with a high melting point. This compound is also soluble in water. The element is likely to be :

(*a*) calcium **(*b*) carbon** **(*c*) silicon** **(*d*) iron**

Ans. (*a*) calcium

(***Explanation*** **:** Calcium reacts with oxygen to give an ionic compound, calcium oxide, having a high melting point. This calcium oxide compound is soluble in water. Carbon reacts with oxygen to form carbon dioxide, which is a gas. Silicon reacts with oxygen to form a compound silicon dioxide which has high melting point but insoluble in water. Similarly, iron reacts with oxygen to form iron (III) oxide compound which has a high melting point but insoluble in water)

Q.4. Food cans are coated with tin and not with zinc because :

(*a*) zinc is costlier than tin **(*b*) zinc has a higher melting point than tin**

(*c*) zinc is more reactive than tin **(*d*) zinc is less reactive than tin.**

Ans. (*c*) zinc is more reactive than tin

(Being more reactive, zinc may react with acidic foods to form toxic products)

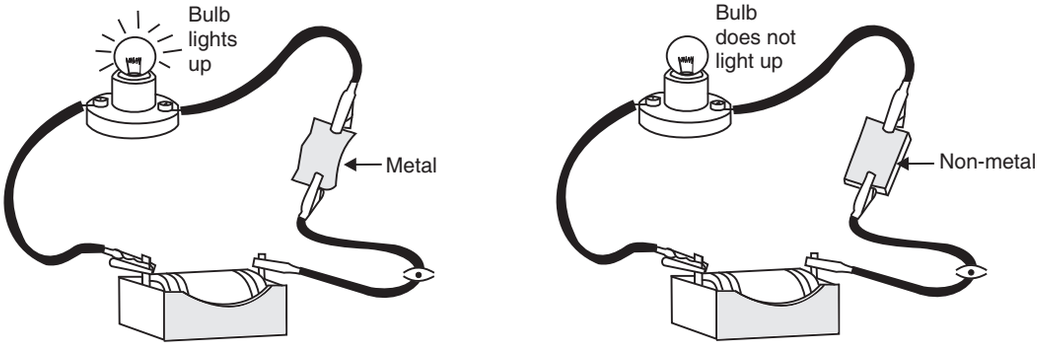
Q.5. You are given a hammer, a battery, a bulb, wires and a switch.

(*a*) How could you use them to distinguish between samples of metals and non-metals ?

(*b*) Assess the usefulness of metals based on properties shown by these tests.

Ans. (*a*) (*i*) We take the given samples of metal and non-metal, place them on a block of iron and beat them with a hammer four or five times, turn by turn. The sample which changes into a thin sheet on hammering will be a metal. On the other hand, the sample which breaks into pieces on hammering (and does not form a thin sheet) will be a non-metal. We say that metals are malleable whereas non-metals are brittle.

(*ii*) Take a battery, a torch bulb fitted in a holder, some wires with crocodile clips and a switch and connect them to make an electric circuit. Insert the given samples of the metal and non-metal between the free ends of the crocodile clips in the circuit, one by one. The sample which allows the current to pass through it making the bulb to light up, will be a metal [as shown in Figure (*i*)]. On the other



(*i*) (*ii*)

hand, the sample which does not allow the current to pass through it and hence does not make the bulb to light up, will be a non-metal [as shown in Figure (*ii*)]. We say that metals are good conductors of electricity whereas non-metals do not conduct electricity

(*b*) Since metals are malleable, they can be turned into sheets and these metal sheets can then be used for various purposes. For example, iron sheets are used for making boxes (trunks), buckets and roofing material. And because metals are good conductors of electricity, therefore, metal wires are used as electric wires for various purposes. For example, copper wires are used in domestic electric wiring for carrying electricity.

Q.6. What are amphoteric oxides ? Give two examples of amphoteric oxides.

Ans. Those metal oxides which show basic as well as acidic behaviour are known as amphoteric oxides. Amphoteric oxides react with both acids as well as bases to form salts and water. The two examples of amphoteric oxides are : aluminium oxide (Al_2O_3) and zinc oxide (ZnO). (For details, see page 112 of this book).

Q.7. Name two metals which will displace hydrogen from dilute acids, and two metals which will not.

Ans. (*a*) The two metals which will displace hydrogen from dilute acids are : Zinc and Iron.

(*b*) The two metals which will not displace hydrogen from dilute acids are : Copper and Silver.

Q.8. In the electrolytic refining of a metal M, what would you take as the anode, the cathode, and the electrolyte ?

Ans. In the electrolytic refining of metal M :

(*a*) a thick block of the impure metal M is made anode. It is connected to the positive terminal of the battery.

(*b*) a thin strip of pure metal M is made cathode. It is connected to the negative terminal of the battery.

(*c*) a water soluble salt of metal M is taken as electrolyte.

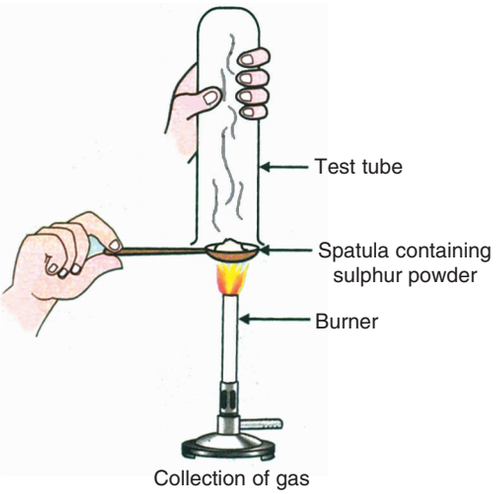
Q.9. Pratyush took sulphur powder on a spatula and heated it. He collected the gas evolved by inverting a test tube over it as shown in the figure here.

(*a*) What will be the action of gas on :

(*i*) dry litmus paper ?

(*ii*) moist litmus paper ?

(*b*) Write a balanced chemical equation for the reaction taking place.



Ans. See Sample Problem 5 on page 130 of this book.

Q.10. State two ways to prevent the rusting of iron.

Ans. (*i*) Rusting of iron can be prevented by painting. In this process, a coat of paint is applied all over the surface of iron object to keep the air and moisture away.

(*ii*) Rusting of iron can be prevented by galvanisation. In this process, a thin layer of zinc metal is deposited over the surface of iron object to prevent the air and moisture from coming in contact with it.

Q.11. What type of oxides are formed when non-metals combine with oxygen ?

Ans. Non-metals combine with oxygen to form acidic oxides or neutral oxides. For example, carbon is a non-metal. When carbon burns in air, it combines with the oxygen of air to form an acidic oxide called carbon dioxide (CO_2) (For equation of this reaction, see page 125 of this book). Again, hydrogen is a non-metal. When hydrogen burns in air, it combines with the oxygen of air to form a neutral oxide called hydrogen oxide or water (H_2O) (For equation of this reaction, see page 127 of this book).

Q.12. Give reasons :

(*a*) Platinum, gold and silver are used to make jewellery

(*b*) Sodium, potassium and lithium are stored under oil

(*c*) Aluminium is a highly reactive metal, yet it is used to make utensils for cooking.

(*d*) Carbonate and sulphide ores are usually converted into oxides during the process of extraction.

Ans. (*a*) Platinum, gold and silver are used to make jewellery because :

(*i*) they have bright and shiny surface

(*ii*) they are highly resistant to corrosion

(*iii*) they are highly malleable and ductile

(*b*) Sodium, potassium and lithium are very reactive metals. They react so vigorously with the oxygen of air that they catch fire if kept in the open. Sodium, potassium and lithium are stored under oil to protect them from the action of air (and moisture), and to prevent accidental fires.

(*c*) When highly reactive aluminium metal is exposed to air, the oxygen of air reacts with aluminium to form a thin but tough protective layer of aluminium oxide on its surface. The presence of aluminium oxide layer makes the aluminium metal resistant to the action of air and water. Due to its high resistance to corrosion and high heat conductivity, aluminium metal is used for making cooking utensils.

(*d*) The direct reduction of carbonate and sulphide ores to obtain metals is usually not possible. The carbonate and sulphide ores are first converted into metal oxides because it is much easier to reduce metal oxides to obtain metals.

Q.13. You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why these sour substances are effective in cleaning the vessels.

Ans. See Sample Problem 3 on page 188 of this book.

Q.14. Differentiate between metals and non-metals on the basis of their chemical properties.

Ans. See Table at the top of page 129 in this book.

Q.15. A man went from door to door posing as a goldsmith. He promised to bring back the glitter of old and dull gold ornaments. An unsuspecting lady gave a set of gold bangles to him which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was upset but after a futile argument the man beat a hasty retreat. Can you play the detective to find out the nature of the solution he had used ?

Ans. See Sample Problem 4 on page 189 of this book.

Q.16. Give reasons why copper is used to make hot water tanks and not steel (an alloy of iron).

Ans. (*i*) Copper is fairly resistant to corrosion but steel rusts quite easily.
(*ii*) Copper is a very good conductor of heat but steel is not such a good conductor of heat.

Chapter : CARBON AND ITS COMPOUNDS

NCERT Book, Page 61

Q.1. What would be the electron-dot structure of carbon dioxide which has the formula CO_2 ?

Ans. The electron-dot structure for carbon dioxide (CO_2 or O═C═O) is :

$$:\ddot{O}::C::\ddot{O}:$$

(For details, see page 159 of this book)

Q.2. What would be the electron-dot structure of a molecule of sulphur which is made up of eight atoms of sulphur ? (*Hint*. The eight atoms of sulphur are joined together in the form of a ring).

Ans. See Sample Problem 3 on page 162 of this book.

NCERT Book, Pages 68 and 69

Q.1. How many structural isomers can you draw for pentane ?

Ans. We can draw 3 structural isomers for pentane (See Sample Problem 1 on page 220 of this book).

Q.2. What are the two properties of carbon which lead to the huge number of carbon compounds we see around us ?

Ans. The two properties of carbon which lead to the formation of huge number of carbon compounds are :

(*i*) Catenation (Self-linking of carbon atoms to form long chains of carbon atoms).

(*ii*) Tetravalency (or 4 valency) (Carbon atom having a large valency of 4 can form covalent bonds with a number of carbon atoms as well as with a large number of other atoms such as hydrogen, oxygen, nitrogen, sulphur, chlorine, and many more atoms).

Q.3. What will be the formula and electron-dot structure of cyclopentane ?

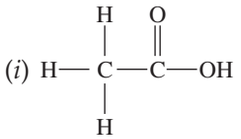
Ans. See Sample Problem on page 212 of this book.

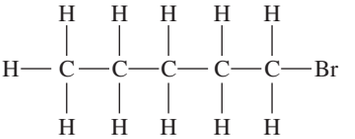
Q.4. Draw the structures for the following compounds :

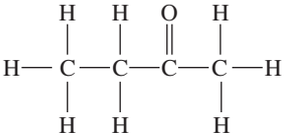
(*i*) Ethanoic acid **(*ii*) Bromopentane**
(*iii*) Butanone **(*iv*) Hexanal**

Are structural isomers possible for bromopentane ?

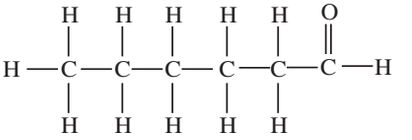
Ans. The structures for ethanoic acid, bromopentane, butanone and hexanal are given below :

(*i*)

Ethanoic acid

(*ii*)

Bromopentane

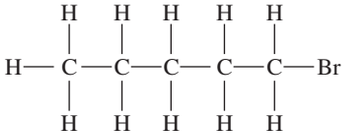
(*iii*) 

Butanone

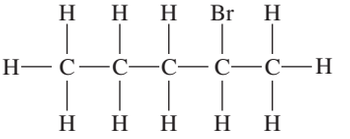
(*iv*) 

Hexanal

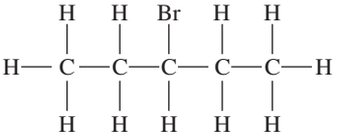
Yes, structural isomers are possible for bromopentane. Depending upon whether bromine atom is attached to carbon atom number 1, 2 or 3, bromopentane can have three structural isomers : 1-bromopentane, 2-bromopentane and 3-bromopentane. These isomers are shown below :



1-bromopentane

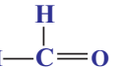
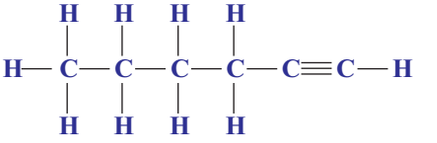


2-bromopentane

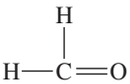
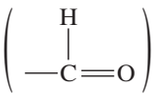


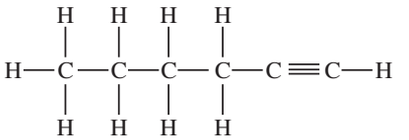
3-bromopentane

Q.5. How would you name the following compounds ?

(*i*) $CH_3—CH_2—Br$ (*ii*)  (*iii*) 

Ans. (*i*) The compound $CH_3—CH_2—Br$ has 2 carbon atoms, so its parent hydrocarbon is ethane. This compound also has a bromo group (Br) attached to one carbon atom. So, the name of this compound will be bromoethane.

(*ii*) The compound  has 1 carbon atom, so its parent alkane is methane. It has also an aldehyde group  which is represented by the ending 'al '. Now, replacing the last 'e' of methane by 'al', the name of this compound becomes 'methanal'.

(*iii*) The compound  has 6 carbon atoms in it, so its parent alkane is hexane. It has also a triple bond (—C≡C—) in it which is indicated by the suffix 'yne'. Now, replacing the 'ane' of hexane by 'yne', the name of above compound becomes 'hexyne'.

NCERT Book, Page 71

Q.1. Why is the conversion of ethanol to ethanoic acid an oxidation reaction ?

Ans. The formula of ethanol is CH_3CH_2OH whereas that of ethanoic acid is CH_3COOH. These formulae show that a molecule of ethanol contains only 1 oxygen atom (O) whereas a molecule of ethanoic acid contains 2 oxygen atoms (OO). This means that oxygen is added during the conversion of ethanol into ethanoic acid. Now, by definition, addition of oxygen to a substance is called oxidation. So, the conversion of ethanol into ethanoic acid is an oxidation reaction because oxygen is added to ethanol during this reaction.

Q.2. A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used ?

Ans. Ethyne is an unsaturated hydrocarbon containing high percentage of carbon in it.

(*i*) When a mixture of ethyne and pure oxygen is burnt, then ethyne burns completely producing an extremely hot blue flame which can be used for welding metals.

(*ii*) If, however, a mixture of ethyne and air is burnt, then incomplete combustion of ethyne takes place

(because of insufficient oxygen of air), producing a yellow, sooty flame which is not hot enough to weld metals.

NCERT Book, Page 74

Q.1. How would you distinguish experimentally between an alcohol and a carboxylic acid ?

Ans. An alcohol is a neutral organic compound whereas a carboxylic acid is acidic in nature. We can distinguish between an alcohol and a carboxylic acid by using sodium hydrogencarbonate as follows.

We take the alcohol and the carboxylic acid in two separate test-tubes and add some sodium hydrogencarbonate solution to each test-tube.

(*a*) The organic compound which produces brisk effervescence on adding sodium hydrogencarbonate due to the evolution of carbon dioxide gas will be a carboxylic acid.

(*b*) The organic compound which has no effect on sodium hydrogencarbonate will be an alcohol.

Q.2. What are oxidising agents ?

Ans. The substances which give oxygen (for oxidation) are called oxidising agents. Alkaline potassium permanganate and acidified potassium dichromate are oxidising agents because they provide oxygen for oxidising other substances. For example, when ethanol is heated with alkaline potassium permanganate solution (or acidified potassium dichromate solution), it gets oxidised to ethanoic acid :

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\substack{\text{Nascent oxygen}\\ \text{(From oxidising agent)}}}{2[O]} \xrightarrow[(\text{or Acidified } K_2Cr_2O_7)]{\text{Alkaline } KMnO_4\,;\,\text{Heat}} \underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Water}}{H_2O}$$

Since the oxygen required for the oxidation of ethanol to ethanoic acid has been given by alkaline potassium permanganate (alkaline $KMnO_4$) or acidified potassium dichromate (acidified $K_2Cr_2O_7$), so both these substances are oxidising agents.

NCERT Book, Page 76

Q.1. Would you be able to check if water is hard by using a detergent ?

Ans. No, we would not be able check if water is hard by using a detergent because a detergent forms lather (or foam) easily even with hard water. Unlike a soap, the detergent does not form a scum (or curdy precipitate) with hard water.

Q.2. People use a variety of methods to wash clothes. Usually after adding the soap, they beat the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes ?

Ans. See Sample Problem on page 262 of this book.

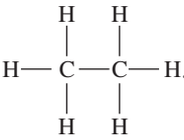
NCERT Book, Pages 77 and 78

Q.1. Ethane, with the molecular formula C_2H_6 has :

(*a*) 6 covalent bonds (*b*) 7 covalent bonds

(*c*) 8 covalent bonds (*d*) 9 covalent bonds

Ans. (*b*) 7 covalent bonds

(***Hint.*** The structural formula of ethane is :  It has 6 C—H covalent bonds and 1 C—C covalent bond. So, the total number of covalent bonds is 6 + 1 = 7).

Q.2. Butanone is a four-carbon compound with the functional group :

(*a*) carboxylic acid (*b*) aldehyde (*c*) ketone (*d*) alcohol

Ans. (*c*) ketone

Q.3. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that :

(*a*) the food is not cooked completely

(*b*) the fuel is not burning completely

(*c*) the fuel is wet

(*d*) the fuel is burning completely

Ans. (*b*) the fuel is not burning completely.

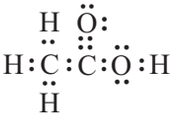
Q.4. Explain the nature of the covalent bond by using the bond formation in CH_3Cl.

Ans. See Sample Problem 1 on page 162 of this book.

Q.5. Draw the electron-dot structures for :

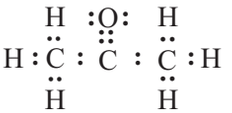
(*a*) ethanoic acid (*b*) H_2S (*c*) propanone (*d*) F_2

Ans. (*a*) The electron-dot structure for ethanoic acid CH_3COOH or $CH_3—\overset{\overset{O}{\|}}{C}—O—H$ is :



(*b*) The electron-dot structure for hydrogen sulphide H_2S or H—S—H is :

(*c*) The electron–dot structure for propanone CH_3COCH_3 or $CH_3—\overset{\overset{O}{\|}}{C}—CH_3$ is :



(*d*) The electron–dot structure for fluorine F_2 or F–F is :

Q.6. What is a homologous series ? Explain with an example.

Ans. A homologous series is a group of organic compounds having similar structures and similar chemical properties in which the successive compounds differ by CH_2 group. The various organic compounds of a homologous series are called homologues. All the homologues of a series contain the same functional group. An example of homologous series is given below.

The compounds called alcohols form a homologous series. Methanol CH_3OH, ethanol C_2H_5OH, propanol C_3H_7OH and butanol C_4H_9OH are the first four members of the homologous series of alcohols :

Methanol	CH_3OH
Ethanol	C_2H_5OH
Propanol	C_3H_7OH
Butanol	C_4H_9OH

All these alcohols have similar structures having the same functional group (alcohol group : — OH) and show similar chemical properties. The formulae of the successive members of this homologous series of alcohols differ from each other by CH_2 group (1 carbon atom and 2 hydrogen atoms). If we calculate the molecular masses of the above members of the homologous series of alcohols, we will find that they differ from each other by 14 u.

Q.7. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties ?

Ans. (*a*) *Differences in physical properties* **:**

(*i*) Smell. Ethanol has a pleasant smell whereas ethanoic acid has a pungent smell (like that of vinegar).

(*ii*) Taste. Ethanol has a burning taste whereas ethanoic acid has a sour taste.

(*iii*) Boiling points. The boiling point of ethanol is low (being only 78°C) whereas that of ethanoic acid is comparatively high (being 118°C).

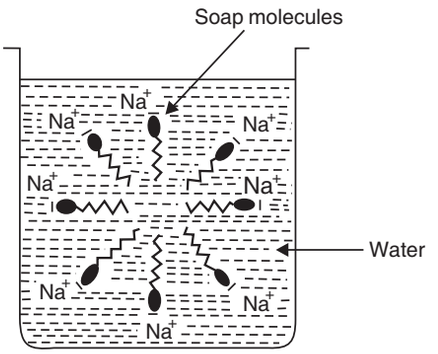
(*b*) *Differences in chemical properties* :

(*i*) Action on litmus. Ethanol has no action on any litmus (so it is a neutral compound) but ethanoic acid turns blue litmus to red (so it is an acidic compound).

(*ii*) Action on sodium hydrogencarbonate. Ethanol has no reaction with sodium hydrogencarbonate but ethanoic acid gives brisk effervescence of carbon dioxide with sodium hydrogencarbonate.

Q.8. Why does micelle formation take place when soap is added to water ? Will a micelle be formed in other solvents such as ethanol also ?

Ans. The micelle formation takes place when soap is added to water because the hydrocarbon chains of soap molecules are hydrophobic (water repelling) which are insoluble in water but the ionic ends of the soap molecules are hydrophilic (water attracting) and hence soluble in water. In a soap micelle, the uncharged ends of the hydrocarbon chains are on the inside whereas the charged ionic ends are on the outside.A micelle will not be formed in other solvents such as ethanol because the hydrocarbon chains of soap molecules are soluble in organic solvents like ethanol.



Soap micelle

Q.9. Why are carbon and its compounds used as fuels for most applications ?

Ans. Carbon and its compounds are used as fuels because they burn in air releasing a lot of heat energy. For example :

(*i*) When carbon (in the form of coal) is burned in air, it forms carbon dioxide gas and releases a lot of heat :

$$\underset{\text{Carbon (Coal)}}{C} + \underset{\text{Oxygen (From air)}}{O_2} \xrightarrow{\text{Burning}} \underset{\text{Carbon dioxide}}{CO_2} + \text{Heat}$$

(*ii*) When a carbon compound methane (in the form of natural gas) is burned in air, it forms carbon dioxide and water vapour, and releases a lot of heat :

$$\underset{\text{Methane (Natural gas)}}{CH_4} + \underset{\text{Oxygen (From air)}}{2O_2} \xrightarrow{\text{Burning}} \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{2H_2O} + \text{Heat}$$

Q.10. Explain the formation of scum when hard water is treated with soap.

Ans. Hard water contains calcium and magnesium salts. When soap is treated with hard water, then the calcium and magnesium ions of hard water react with soap to form an insoluble precipitate called 'scum'. The scum is formed because the calcium and magnesium salts of soap are insoluble in water.

Q.11. What change will you observe if you test soap with litmus paper (red and blue) ?

Ans. Soap solution is basic in nature so it will turn red litmus paper to blue but it will have no effect on blue litmus paper.

Q.12. What is hydrogenation ? What is its industrial application ?

Ans. The addition of hydrogen to an unsaturated compound in the presence of nickel (or palladium) catalyst to obtain a saturated compound is called hydrogenation. Hydrogenation is used in industry to prepare vegetable *ghee* from vegetable oils. The vegetable oils (like groundnut oil) are unsaturated compounds. When the liquid vegetable oil is heated with hydrogen in the presence of finely divided nickel as catalyst, then a saturated solid fat called vegetable *ghee* is formed. This reaction is called hydrogenation of oils and it can be represented as follows :

Vegetable oil (Unsaturated fat) (Liquid state) + Hydrogen → Vegetable *ghee* (Saturated fat) (Solid state)

Q.13. Which of the following hydrocarbons undergo addition reactions ?

C_2H_6, C_3H_8, C_3H_6, C_2H_2 and CH_4

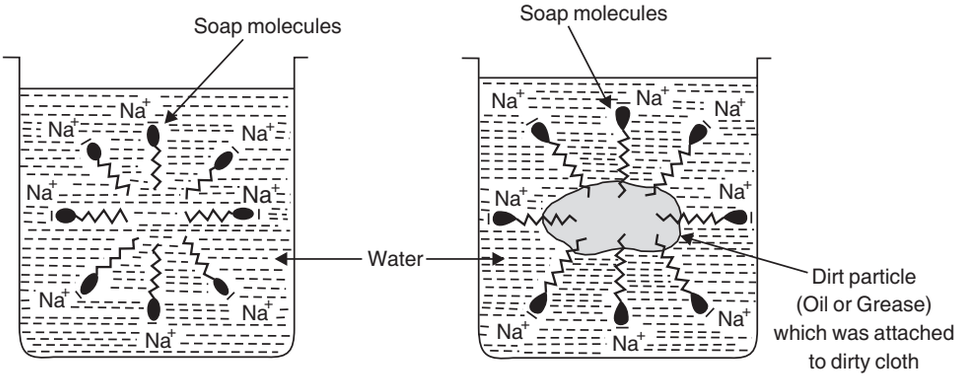
Ans. See Sample Problem on page 248 of this book.

Q.14. Give a test that can be used to differentiate chemically between butter and cooking oil.

Ans. Butter is an animal fat which contains saturated fatty acids. On the other hand, cooking oil is a vegetable oil which contains unsaturated fatty acids. Now, unsaturated compounds decolourise bromine water whereas saturated compounds do not. So, we can distinguish between butter and cooking oil by the bromine water test. We take a little of butter and cooking oil in two separate test-tubes and add some red-brown coloured bromine water to them. The test-tube in which the bromine water gets decolourised contains cooking oil. The test-tube in which the bromine water does not get decolourised contains butter.

Q.15. Explain the mechanism of the cleaning action of soap.

Ans. When soap is dissolved in water, it forms a colloidal suspension in water in which the soap molecules cluster together to form spherical micelles [see Figure (*i*)]. In a soap micelle, the soap molecules are arranged



Soap micelle (*i*) Soap micelle entraps the dirt particle (*ii*)

radially with hydrocarbon ends directed towards the centre and ionic ends directed outwards (The ionic ends are directed outwards because negative charges at the ends repel one another) [see Figure (*i*)].

When a dirty cloth is put in water containing dissolved soap, then the hydrocarbon ends of the soap molecules in the micelle attach to the oil or grease particles present on the surface of dirty cloth. In this way the soap micelle entraps the oily or greasy particles by using its hydrocarbon ends [as shown in Figure (*ii*)]. The ionic ends of the soap molecules in the micelles, however, remain attached to water [see Figure (*ii*)]. When the dirty cloth is agitated in soap solution, the oily and greasy particles present on its surface and entrapped by soap micelles get dispersed in water due to which the soap water becomes dirty but the cloth gets cleaned. The cloth is cleaned thoroughly by rinsing in clean water a number of times.

Chapter : PERIODIC CLASSIFICATION OF ELEMENTS

NCERT Book, Page 81

Q.1. Did Dobereiner's triads also exist in the columns of Newlands' octaves ? Compare and find out.

Ans. Yes, Dobereiner's triads also exist in the columns of Newlands' classification of elements based on the law of octaves. Consider the elements lithium (Li), sodium (Na) and potassium (K) which are present in the second column of Newlands' classification of elements. Now, if we start with lithium as the 1st element, then the 8th element from it is sodium, and according to Newlands' law of octaves, the properties of 8th element sodium should be similar to those of the first element lithium. Again, if we take sodium as the 1st element, then the 8th element from it is potassium, and according to Newlands' law of octaves, the properties of 8th element potassium should be similar to those of the 1st element sodium. This means that according to Newlands' law of octaves, the elements lithium, sodium and potassium should have similar chemical properties. We also know that lithium, sodium and potassium form a Dobereiner's triad having similar

chemical properties. From this we conclude that Dobereiner's triads also exist in the columns of Newlands' octaves.

Q.2. What were the limitations of Dobereiner's classification of elements ?

Ans. The main limitation of Dobereiner's classification of elements was that it failed to arrange all the then known elements in the form of triads of elements having similar chemical properties. Dobereiner could identify only three triads from the elements known at that time. So, his classification of elements was not much successful. Another limitation was that Dobereiner failed to explain the relation between atomic masses of elements and their chemical properties.

Q.3. What were the limitations of Newlands' law of octaves ?

Ans. Newlands' law of octaves for the classification of elements had the following limitations :

(*i*) Newlands' law of octaves was applicable to the classification of elements up to calcium only. After calcium, every eighth element did not possess the properties similar to that of the first element. Thus, Newlands' law of octaves worked well with lighter elements only.

(*ii*) Newlands assumed that only 56 elements existed in nature and no more elements would be discovered in the future. But later on, several new elements were discovered whose properties did not fit into Newlands' law of octaves.

(*iii*) In order to fit elements into his table, Newlands put even two elements together in one slot and that too in the column of unlike elements having very different properties. For example, the two elements cobalt (Co) and nickel (Ni) were put together in just one slot, and that too in the column of elements like fluorine, chlorine and bromine which have very different properties from these elements.

NCERT Book, Page 85

Q.1. Use Mendeleev's periodic table to predict the formulae for the oxides of the following elements :

K, C, Al, Si, Ba

Ans. See Sample Problem on page 275 of this book.

Q.2. Besides gallium, which other elements have since been discovered for which gaps were left by Mendeleev in his periodic table ? (any two)

Ans. Scandium (Sc) and Germanium (Ge).

Q.3. What were the criteria used by Mendeleev in creating his periodic table ?

Ans. Mendeleev used two criteria in creating his periodic table :

(*i*) increasing atomic masses, and

(*ii*) grouping together of elements having similar chemical properties.

Mendeleev took the formulae of the oxides and hydrides formed by the elements as the basic chemical properties of elements for their classification in the form of a periodic table.

Q.4. Why do you think the noble gases are placed in a separate group ?

Ans. The noble gases are placed in a separate group because they are chemically very inert or unreactive (having completely filled outermost electron shells).

NCERT Book, Page 90

Q.1. How could the Modern periodic table remove various anomalies of Mendeleev's periodic table ?

Ans. When the elements are arranged according to their atomic numbers on the basis of modern periodic law, then all the anomalies (or defects) of Mendeleev's classification disappear. This is discussed below.

(i) **Explanation for the Position of Isotopes.** All the isotopes of an element have the same number of protons, so their atomic number is also the same. Since all the isotopes of an element have the same atomic number, they can be put at one place in the same group of the periodic table. For example, both the isotopes of chlorine, Cl-35 and Cl-37, have the same atomic number of 17, so both of them can be put at one place in the same group of the periodic table.

(ii) **Explanation for the Position of Cobalt and Nickel.** The atomic number of cobalt is 27 and that of nickel is 28. Now, according to modern periodic law, the elements are arranged in the order of increasing atomic numbers. So, cobalt with lower atomic number (27) should come first and nickel with higher atomic number (28) should come later, even if their atomic masses are in the wrong order.

(*iii*) **Explanation for the Position of Hydrogen.** Hydrogen element has been placed at the top of group 1, above the alkali metals because the electronic configuration of hydrogen is similar to those of alkali metals. Both, hydrogen as well as alkali metals have 1 valence electron each.

Q.2. Name two elements you would expect to show chemical reactions similar to magnesium. What is the basis for your choice ?

Ans. See Sample Problem 5 on page 297 of this book.

Q.3. Name :

(*a*) three elements that have a single electron in their outermost shells.

(*b*) two elements that have two electrons in their outermost shells.

(*c*) three elements with filled outermost shells.

Ans. (*a*) Three elements that have a single electron in their outermost shells are : Lithium, Sodium and Potassium.

(*b*) Two elements that have two electrons in their outermost shells are : Magnesium and Calcium.

(*c*) Three elements with completely filled outermost shells are : Helium, Neon and Argon.

Q.4. (*a*) Lithium, sodium, potassium are all metals that react with water to liberate hydrogen gas. Is there any similarity in the atoms of these elements ?

(*b*) Helium is an unreactive gas and neon is a gas of extremely low reactivity. What, if anything, do their atoms have in common ?

Ans. (*a*) Yes, there is a similarity in the atoms of lithium, sodium and potassium elements. All these elements have similar electronic configurations having 1 electron each in their valence shells. The electronic configurations of lithium, sodium and potassium are given below :

Lithium : 2, 1
Sodium : 2, 8, 1
Potassium : 2, 8, 8, 1

(*b*) Helium and neon are noble gases. The common thing between helium and neon is that both of them have the valence shells (outermost shells) completely filled with electrons. Helium has 2 electrons in its K valence shell (K shell can accommodate only a maximum of 2 electrons), whereas neon has 8 electrons in its valence shell.

Q.5. In the modern periodic table, which are the metals among the first ten elements ?

Ans. In the modern periodic table, the first ten elements (having atomic numbers from 1 to 10) are :

H, He, Li, Be, B, C, N, O, F, Ne

Out of these 10 elements only 2 elements, Lithium (Li) and Beryllium (Be) are metals.

Q.6. By considering their position in the periodic table, which one of the following elements would you expect to have maximum metallic character ?

Ga, Ge, As, Se, Be

Ans. See Sample Problem 2 on page 290 of this book.

NCERT Book, Pages 91 and 92

Q.1. Which of the following statements is not a correct statement about the trends when going from left to right across the periods of periodic table ?

(*a*) The elements become less metallic in nature

(*b*) The number of valence electrons increases

(*c*) The atoms lose their electrons more easily

(*d*) The oxides become more acidic

Ans. (*c*) The atoms lose their electrons more easily.

Q.2. Element X forms a chloride with the formula XCl_2 which is a solid with a high melting point. X would most likely be in the same group of the periodic table as :

(*a*) Na (*b*) Mg (*c*) Al (*d*) Si

Ans. (*b*) Mg (For details, see Sample Problem 3 on page 296 of this book).

Q.3. Which element has :

(*a*) two shells, both of which are completely filled with electrons ?

(*b*) the electron configuration 2, 8, 2 ?

(*c*) a total of three shells, with four electrons in its valence shell ?

(*d*) a total of two shells, with three electrons in its valence shell ?

(*e*) twice as many electrons in its second shell as in its first shell ?

Ans. (*a*) Neon (2, 8) (*b*) Magnesium (2, 8, 2) (*c*) Silicon (2, 8, 4)

(*d*) Boron (2, 3) (*e*) Carbon (2, 4)

Q.4. (*a*) What property do all elements in the same column of the periodic table as boron have in common ?

(*b*) What property do all elements in the same column of the periodic table as fluorine have in common ?

Ans. (*a*) The element boron is in column (or group) 13 of the periodic table and has a valency of 3. So, all the elements in the same column of periodic table as boron will have valency of 3.

(*b*) The element fluorine is in column (or group) 17 of the periodic table and has a valency of 1. So, all the elements in the same column of periodic table as fluorine will have a valency of 1.

Q.5. An atom has electronic configuration 2, 8, 7.

(*a*) What is the atomic number of this element ?

(*b*) To which of the following elements would it be chemically similar ? (Atomic numbers are given in parentheses)

N (7) F (9) P (15) Ar (18)

Ans. (*a*) 17 (*b*) F(9)

(For details, see Sample Problem 1 on page 281 of this book)

Q.6. The positions of three elements A, B and C in the periodic table are shown below :

Group 16	Group 17
–	–
–	A
–	–
B	C

(*a*) State whether A is a metal or non-metal.

(*b*) State whether C is more reactive or less reactive than A.

(*c*) Will C be larger or smaller in size than B ?

(*d*) Which type of ion, cation or anion, will be formed by element A ?

Ans. See Sample Problem 1 on page 295 of this book.

Q.7. Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to group 15 of the periodic table. Write the electronic configurations of these two elements. Which of these will be more electronegative ? Why ?

Ans. The atomic number of nitrogen is 7 so its electronic configuration is 2, 5. The atomic number of phosphorus is 15 so its electronic configuration is 2, 8, 5. We can see that nitrogen atom has two electron shells whereas phosphorus atom has three electron shells. Due to the presence of only two electron shells in it, a nitrogen atom is smaller than a phosphorus atom. Nitrogen will be more electronegative because its atom has a small size due to which the attraction of its nucleus for the incoming electron is more.

Q.8. How does the electronic configuration of an element relate to its position in the modern periodic table ?

Ans. The electronic configuration of an element tells us two things : 'the number of electron shells' and 'the number of valence electrons' in one atom of the element.

(*i*) The 'number of electron shells' in an atom of the element gives us the 'period number' of the element in the periodic table. If an element has 2 electron shells in its atom, it belongs to 2nd period, if an element has 3 electron shells, it belongs to 3rd period, and so on. For example, the electronic configuration of carbon element is $\underset{2,\,4}{\text{K L}}$. Since the carbon atom has two electron shells (K and L), therefore, it belongs to 2nd period of the periodic table.

(*ii*) **The 'group number' of an element in the periodic table having up to two valence electrons is 'equal to the number of valence electrons'**. If an element has 1 valence electron, it belongs to group 1 and if the element has 2 valence electrons, then it will be in group 2 of the periodic table. For example, the electronic configuration of sodium element is $\underset{2,\,8,\,1}{K\ L\ M}$. Since sodium has 1 valence electron (in M shell), so it belongs to group 1 of the periodic table.

(*iii*) **The 'group number' of an element having more than 2 valence electrons is equal to the 'number of valence electrons plus 10'.** If an element has 3 valence electrons, its group number will be 3 + 10 = 13, if the element has 4 valence electrons, then its group number will be 4 + 10 = 14, and so on. For example, the electronic configuration of aluminium is $\underset{2,\,8,\,3}{K\ L\ M}$. Since aluminium has 3 valence electrons (in M shell), therefore, it belongs to group number 3 + 10 = 13 of the periodic table.

Q.9. In the modern periodic table, calcium (atomic number 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38. Which of these have physical and chemical properties resembling calcium ?

Ans. See Sample Problem 2 on page 281 of this book.

Q.10. Compare and contrast the arrangement of elements in Mendeleev's periodic table and the Modern periodic table.

Ans.

Mendeleev's periodic table	*Modern periodic table*
1. Mendeleev's periodic table is based on atomic masses of elements.	1. Modern periodic table is based on atomic numbers of elements.
2. Mendeleev's periodic table does not tell us why elements in a group have similar chemical properties but the elements in a period have different properties.	2. Modern periodic table tells us that the elements in a group have similar chemical properties because they have similar electronic configurations (having the same number of valence electrons) but elements in a period have different chemical properties because they have different electronic configurations (having different number of valence electrons).
3. Mendeleev's periodic table does not explain the reason for the periodicity (repetition) in the properties of elements.	3. Modern periodic table says that since the electronic configurations of elements (with same number of valence electrons) are repeated at regular intervals, therefore, the properties of elements are also repeated at regular intervals.
4. Mendeleev's periodic table does not tell us why the properties of elements are repeated after 2, 8, 18 and 32 elements.	4. Modern periodic table tells us that since the electronic configurations of elements are repeated after 2, 8, 18 and 32 elements, therefore, the properties of elements are also repeated after 2, 8, 18 and 32 elements (2, 8, 18 and 32 are the maximum number of electrons which can be accommodated in K, L, M and N shells of atoms).
5. Mendeleev's periodic table had a number of anomalies (or defects).	5. There are no anomalies in the modern periodic table.

Value Based Questions
(with Answers)
FIRST TERM

Q.1. Rahul is a ten year old boy. He had purchased a packet of potato chips more than a month ago. Rahul opened the packet at that time but could eat only some of the potato chips from it. He then kept the open packet containing remaining potato chips on his book rack. He wanted to eat the remaining potato chips today. Just when Rahul was about to put these potato chips into his mouth, his elder sister Pavni, who is a student of class X, entered the room. She found that these potato chips were giving unpleasant smell. When she put one potato chip in her mouth, it had also unpleasant taste. Pavni took away the packet from Rahul and did not allow him to eat these potato chips. She threw away the potato chips into a dustbin.

(*a*) What name is given to the condition in which potato chips kept open for a considerable time give out unpleasant smell and taste ?

(*b*) Which chemical reaction is responsible for the spoilage of potato chips kept exposed by Rahul for a considerable time ?

(*c*) What produces the unpleasant smell as well as unpleasant taste in potato chips ? Explain.

(*d*) With which gas the plastic bags containing potato chips are filled and then sealed by manufacturers ? How does it help ?

(*e*) What values are displayed by Pavni in this episode ?

Ans. (*a*) Rancidity.

(*b*) Oxidation reaction.

(*c*) Potato chips contain oil. When the oil present in potato chips (which have been kept exposed for a considerable time) gets oxidised by the oxygen of air, its oxidation products have unpleasant smell and taste. The potato chips are then said to have turned rancid. They become unfit to eat.

(*d*) The plastic bags containing potato chips are filled with nitrogen gas and then sealed. When the potato chips are surrounded by an unreactive gas nitrogen, there is no oxygen (of air) in the plastic bag to cause oxidation of oil present in potato chips and make them rancid.

(*e*) The values displayed by Pavni are (*i*) Awareness (or knowledge) that oil and fat containing foods get spoiled on keeping exposed for a long time and become unfit to eat, and (*ii*) Concern for the health of her brother (because she tasted the potato chips herself first and finding them rancid, did not allow her brother to eat them).

Q.2. Mr. Kumar runs a small garment making factory in a premises having a roof made of asbestos sheets. These asbestos sheets are supported on long wooden planks and fixed to planks with J-shaped hooks. For the last many days, the workers of factory are complaining to Mr. Kumar that the new clothes made by them and kept on hangers are getting spoiled with a red-brown powdery substance. Mr. Kumar tried his best but could not locate the source of this substance which was spoiling their newly fabricated clothes. One day Mr. Kumar's son Rajesh, who is a student of class X, came to the factory. Mr. Kumar told him the problem which he was facing for the last so many days. Rajesh went near the clothes which had been spoiled, looked up at the roof carefully from that place and understood the problem. He explained everything to his father. He also suggested the measure to be taken to solve this problem. Mr. Kumar was very happy.

(*a*) What is the red-brown powdery substance known as ?

(*b*) From where do you think this substance was coming on the newly made garments in the factory ?

(*c*) What type of chemical reaction is involved in the formation of red-brown substance ?

(*d*) What is the general name of the process in which metals are eaten up by air or moisture, etc. ?

(*e*) What is the special name of the above process if the metal involved is iron ?

(*f*) What suggestion do you think was given by Rajesh to solve this problem ?

(*g*) What values are displayed by Rajesh in this episode ?

Ans. (*a*) The red-brown powdery substance is called 'rust'.

(*b*) The red-brown substance (or rust) was falling down from the rusted iron hooks used in fixing asbestos sheets of roof to the wooden planks.

(*c*) Oxidation reaction is involved in the formation of red-brown substance [in which the iron metal of hook is oxidised by the oxygen of air in the presence of moisture to form hydrated iron (III) oxide called rust].

(*d*) Corrosion of metals.

(*e*) Rusting of iron.

(*f*) Rajesh must have suggested painting the iron hooks (after cleaning them thoroughly).

(*g*) The values displayed by Rajesh in this episode are (*i*) Careful observation (*ii*) Knowledge of rusting of iron and its prevention, and (*iii*) Problem solving skills.

Q.3. Piyush is a student of class 10. His teacher was teaching the type of chemical reactions in the class. Piyush was asked to carry out the reaction of electrolysis of water in the laboratory. Piyush set up the complete apparatus for the electrolysis of water. He took pure water (distilled water) to carry out this reaction. When Piyush passed electric current through this water for a considerable time, even then no chemical reaction took place. Piyush told this problem to his classmate Arjun. Arjun thought over the problem and asked Piyush to add a little of a certain substance into pure water before passing electric current through it. When electric current was passed through water after adding a little of this substance, then a chemical reaction took place to form two gases X and Y. The volume of gas X collected over one of the electrodes was 8 mL whereas the volume of gas Y collected over the other electrode was 16 mL.

(*a*) Why no chemical reaction took place when electric current was passed through pure water ?

(*b*) What substance was added in a little quantity to pure water before passing electric current again ?

(*c*) How did the addition of little of this substance help in the electrolysis of water ?

(*d*) What is gas X ? Over which electrode is it collected ?

(*e*) What is gas Y ? Over which electrode is it collected ?

(*f*) What type of chemical reaction is demonstrated by this experiment ? Why ?

(*g*) What values are displayed by Arjun in this episode ?

Ans. (*a*) Because pure water (or distilled water) is a non-conductor of electricity.

(*b*) Sulphuric acid.

(*c*) Sulphuric acid is an electrolyte. The addition of a little of sulphuric acid made pure water a good conductor of electricity. (The water containing a little of sulphuric acid is called acidified water).

(*d*) The gas X is oxygen. It is collected over the positive electrode (called anode).

(*e*) The gas Y is hydrogen. It is collected over the negative electrode (called cathode).

(*f*) This experiment shows a decomposition reaction. In this decomposition reaction water decomposes into two constituents : oxygen and hydrogen.

(*g*) The values displayed by Arjun in this episode are : (*i*) Awareness (or knowledge) that pure water is a non-conductor of electricity which can be made a good conductor by adding a little of dilute sulphuric acid, and (*ii*) Helping nature.

Q.4. Raghav is a student of class X who was trying to convert the groundnut oil into solid fat (*vanaspati ghee*). He took the oil in an appropriate flask having an arrangement for passing hydrogen gas into it. Raghav passed the hydrogen gas into oil and heated them together for a considerable time. On cooling the apparatus, Raghav found that even after heating together oil and hydrogen for a considerable time, no solid fat was formed. Raghav shared this problem with his sister Divya who is studying in class XI. She advised him to add a certain finely divided substance while heating oil with hydrogen gas. When Raghav repeated the experiment by adding this substance to oil and hydrogen mixture, then the liquid oil was converted into a solid fat. Divya advised Raghav not to consume the fat prepared by him in the laboratory.

(*a*) What was the finely divided substance which Raghav was asked to add for converting oil into fat ? What is its function ?

(*b*) What type of substance is (*i*) an oil, and (*ii*) a fat ?

(*c*) What is the special name of conversion of oils into fats used in Industry ?

(*d*) What are the two types of chemical reactions exemplified by the conversion of oils into fats ?

(*e*) Why did Divya ask Raghav not to consume the fat prepared by him in the laboratory ?

(*f*) What values are exhibited by Divya in this episode ?

Ans. (*a*) Raghav was asked to add finely divided nickel for converting oil into fat. Finely divided nickel acts as a catalyst in the reaction between oil and hydrogen.

(*b*) (*i*) An oil is an unsaturated organic compound. It is usually in liquid form at the room temperature.
(*ii*) A fat is a saturated organic compound. It is usually a solid (or semi-solid) at the room temperature.

(*c*) Hydrogenation of oils.

(*d*) (*i*) The conversion of oil into fat exemplifies a combination reaction (because in this reaction two substances, oil and hydrogen, combine to form a single substance called fat).
(*ii*) The conversion of oil into fat also exemplifies a reduction reaction (because addition of hydrogen to a substance is called reduction).

(*e*) Divya asked Raghav not to consume the fat prepared by him in the laboratory because it contained finely divided nickel metal particles which were added as catalyst but could not be removed by Raghav. These nickel metal particles could damage his health.

(*f*) The values exhibited by Divya in this episode are (*i*) Awareness (or knowledge) that hydrogenation of oils takes place in the presence of finely divided nickel as catalyst (*ii*) Helping nature, and (*iii*) Concern for the health of her brother.

Q.5. Reshma is the student of class X in a city school. One day she was sitting in the school garden with her friends during the recess. There was a tall tree at the edge of the garden having a large honeycomb attached to it. Some students were playing cricket in the school playground. Suddenly the cricket ball hit the honeycomb due to which a large number of honey-bees started flying here and there. Reshma was stung on her face by a honey-bee. The sting was so painful that Reshma started crying. She was immediately rushed to the science laboratory. One of her classmates Shanta gave her vinegar solution to rub on the stung area to get relief from pain. Another classmate Amarjit, however, asked Reshma to rub baking soda solution on the stung area of face. On rubbing baking soda solution, Reshma felt a lot of relief from pain.

(*a*) What kind of liquid is injected into the skin when a honey-bee stings a person ?

(*b*) Why did rubbing baking soda solution on the stung area of skin give relief from pain ?

(*c*) What type of chemical reaction takes place when baking soda solution is rubbed on the honey-bee sting area ?

(*d*) Why do you think rubbing the honey-bee sting area with vinegar could not give relief from pain ?

(*e*) Name one plant whose stinging hair on leaves inject a similar liquid to that injected by honey-bee sting and can be treated by rubbing baking soda solution ?

(*f*) What values are displayed by Amarjit in this episode ?

Ans. (*a*) Honey-bee sting injects an acidic liquid into the skin of a person.

(*b*) Baking soda is a mild base. Being a base, baking soda solution neutralises the acidic liquid injected by honey-bee sting and cancels its effect. This gives relief from pain.

(*c*) Neutralisation reaction (between an acid and a base).

(*d*) The honey-bee sting injects an acidic liquid into the skin of a person which means that the honey-bee sting contains an acid. Now, vinegar also contains an acid. So, vinegar itself being acidic, cannot neutralise the effect of acidic liquid injected by honey-bee sting and hence could not provide any relief from pain.

(*e*) Nettle plant.

(*f*) The values displayed by Amarjit in this episode are (*i*) Awareness (of the acidic nature of honey-bee sting and basic nature of baking soda) (*ii*) Knowledge (that acids and bases are chemically opposite substances which can neutralise or cancel the effect of each other), and (*iii*) Desire to remove the suffering of others.

Q.6. Shailesh lives in a big industrial city having a large number of chemical industries on its outskirts. This city has also a very heavy traffic density. There is a big lake in the middle of this city which has much less water left in it but the lake has still a large number of fish in it. During the last one and a half months, there has been too much rain in the city with the pH of rain water being about 5.5. One day people found that many fish in the lake had died. No one knew the reason for the death of fish in the lake or how the death of remaining fish in the lake could be prevented. Shailesh, who is a student of class X, could understand the reason for the death of fish in lake. He also suggested an immediate solution for the prevention of death of more fish in the lake water.

(*a*) What conclusion do you draw from the fact that the rain water has a pH of about 5.5 ? What name is given to such a rain ?

(*b*) What makes the pH of rain water to be about 5.5 ?

(*c*) What happens to lake water when too much rain water having pH of 5.5 collects in it ?

(*d*) Why have the fish died after the heavy rains ?

(*e*) What suggestion do you think has been made by Shailesh to prevent the death of more fish in the lake ? Why ?

(*f*) What values are displayed by Shailesh in this episode ?

Ans. (*a*) The rain water having a pH of about 5.5 is acidic in nature. Such a rain is called acid rain.

(*b*) The chemical industries and heavy traffic (vehicles) in this city emit many harmful gases into the air and pollute it. The acidic gases (such as sulphur dioxide and nitrogen oxides) present in polluted air dissolve in rain water to produce acids. The presence of these acids lowers the pH of rain water to about 5.5 (making it quite acidic in nature).

(*c*) Too much acid rain can lower the pH of lake water appreciably and make it highly acidic.

(*d*) The high acidity of lake water caused by too much acid rain has caused the death of fish in the lake.

(*e*) Shailesh might have suggested adding calcium carbonate to the lake water. This is because calcium carbonate neutralises the excess acid present in lake water (which comes from acid rain), reducing the acidity of lake water. This reduction in the acidity of lake water can prevent the death of more fish in the lake.

(*f*) The various values displayed by Shailesh in this episode are (*i*) Awareness (or knowledge) of the occurrence of acid rain and its harmful effects on aquatic animals such as fish (*ii*) Understanding of neutralisation reaction involving acidic and basic substances, and (*iii*) Concern to save the life of remaining fish in the lake.

Q.7. Shivani is a student of class X. She lives in a big house on the outskirts of Delhi. Her family has a kitchen garden at the back of the house in which various types of seasonal vegetables are grown. Shivani's parents have been getting good crops of vegetables for many years. But from last year, the yield of vegetables from the kitchen garden has reduced a lot. Shivani asked the gardener if he was putting any chemical fertiliser into the soil or not. The gardener told Shivani that he was putting a lot of ammonium sulphate fertiliser into the soil every time before sowing the fresh crop of vegetables and he has been doing this for many years to increase the yield of vegetables more and more. Shivani could now understand the problem. She then asked the gardener to mix a certain substance with the soil uniformly before growing the next crop of vegetables. The gardener did the same. Every one was happy to see that there was bumper crop of vegetables this time.

(*a*) What had happened to the soil in the kitchen garden over the years ? Why ?

(*b*) Shivani took a little of soil from the kitchen garden, stirred it with some water in a test-tube, filtered it and tested the filtrate with universal indicator. The universal indicator turned orange. What does this tell us about the nature of soil ?

(*c*) Why did the yield of vegetables in the kitchen garden reduce a lot ?

(*d*) What substance/substances do you think Shivani asked the gardener to put in the soil of kitchen garden ?

(*e*) How did the addition of above substance/substances help the soil ?

(*f*) What values are displayed by Shivani in this episode ?

Ans. (*a*) The soil had turned too acidic over the years. This happened due to the continued use of ammonium sulphate fertiliser. Ammonium sulphate is an acidic salt. When ammonium sulphate is added to soil, then ammonium ions (containing nitrogen) are absorbed by the roots of growing vegetable plants but sulphate ions go on accumulating in the soil. These sulphate ions form sulphuric acid which increases the acidity of soil.

(*b*) The fact that universal indicator turned orange, tells us that the soil of the kitchen garden is too acidic.

(*c*) The continued use of ammonium sulphate fertiliser made the soil in the kitchen garden too acidic. The vegetable plants could not grow well in this highly acidic soil and hence the yield was reduced.

(*d*) Shivani may have asked the gardener to put quicklime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate) in the soil of kitchen garden.

(*e*) All these substances are bases which neutralise the excess acid present in the kitchen garden soil and reduce its acidity. This makes the soil fertile again and leads to a bumper crop of vegetables.

(*f*) The values displayed by Shivani are (*i*) Awareness (or knowledge) of how the chemical fertilisers change the nature of soil (*ii*) Understanding of neutralisation reactions of acids and bases, and (*iii*) Desire to improve the yield of vegetables in the kitchen garden.

Q.8. Veena and Seema were coming home after attending the birthday party of their classmate Beena. Beena's mother had prepared a large number of delicious dishes for this occasion. A lot of soft drinks like Coca-Cola, and Pepsi, etc., were also served. The home-made cake and ice-cream were also there in plenty for everyone. Veena and Seema ate a lot of food, cake and ice-cream. They also had many soft drinks each. Actually, Seema liked the food too much so she ate too much. On reaching home, Seema started feeling uncomfortable. She also got pain in the stomach. Seema is a student of class X and her mother Mrs. Sarla is a teacher in the same school who teaches science to class X. Mrs. Sarla told her daughter Seema that she had three substances A, B and C in the kitchen which can be consumed safely. The substances A, B and C give blue colour, orange colour and green colour respectively with the universal indicator. Mrs. Sarla asked Seema which substance would she like to take in order to obtain relief from pain and why ? Seema made the right choice and explained the reason to her mother.

(*a*) What is the general name of the condition which is faced by Seema ?

(*b*) Which substance is produced in excess in the stomach that causes the above condition ?

(*c*) What is the general name of substances which are usually taken to obtain relief from the above condition ?

(*d*) What is the nature of (*i*) substance A (*ii*) substance B, and (*iii*) substance C ?

(*e*) Which substance A, B or C do you think was chosen by Seema to get relief from stomach pain ? Why ?

(*f*) What values are displayed by Seema in this incident ?

Ans. (*a*) Indigestion.

(*b*) The excess of hydrochloric acid is produced in the stomach (due to over-eating).

(*c*) Antacids (which are mild bases having no toxic effects on the body).

(*d*) (*i*) Substance A which gives blue colour with universal indicator is a base (or basic in nature).

(*ii*) Substance B which gives orange colour with universal indicator is an acid (or acidic in nature).

(*iii*) Substance C which gives green colour with universal indicator is neither a base nor an acid, it is neutral in nature.

(*e*) Seema chose substance A which is a base. This is because being basic, the substance A will neutralise excess acid in stomach and give relief from pain and discomfort.

(*f*) The values displayed by Seema are (*i*) Awareness (or knowledge) that indigestion caused by over-eating is due to the formation of excess hydrochloric acid in the stomach and can be cured by taking antacids (*ii*) Understanding of the effect of acids and bases on universal indicator, and (*iii*) Greedy nature (which led to over-eating).

Q.9. Bunty is a ten year old boy who was playing in the park with other friends. Suddenly a wasp came flying and stung him on the face. Bunty felt a lot of pain and came running home. Just then, Bunty's younger sister Arti, who is just five years old, was stung by an ant on the arm causing a lot of burning pain. She also came running home. Bunty's elder sister Reema, who is a student of class X, was at home at that time. Reema immediately took vinegar bottle from the kitchen shelf and rubbed some vinegar on the stung area of skin on Bunty's face. This gave Bunty some relief. Reema then took baking soda container from the kitchen, made a solution of baking soda in water, and rubbed this baking soda solution on the stung area of Arti's arm. She also got relief from pain.

(*a*) What type of liquid was injected by wasp's sting into Bunty's skin ?

(*b*) Why did rubbing vinegar on the stung area of skin reduce Bunty's pain ?

(*c*) Which chemical is injected by an ant's sting into Arti's skin ?

(*d*) Why did rubbing baking soda solution on stung area of skin reduce Arti's pain ?

(*e*) Name a plant whose stinging leaf hair inject the same chemical into the skin of a person (who touches it) as the ant's sting.

(*f*) What type of chemical reaction takes place :

(*i*) When vinegar is rubbed on Bunty's skin having wasp sting ?

(*ii*) When baking soda solution is rubbed on Arti's arm having ant's sting ?

(*g*) What values are displayed by Reema in this whole episode ?

Ans. (*a*) Alkaline liquid (or basic liquid).

(*b*) Vinegar is an acidic substance. Being an acidic substance, vinegar neutralises the alkaline liquid (or basic liquid) injected by wasp sting and cancels its effect.

(*c*) Methanoic acid.

(*d*) Baking soda is a base (or basic substance). Being a basic substance, baking soda neutralises the methanoic acid injected by an ant's sting and cancels its effect.

(*e*) Nettle plant.

(*f*) (*i*) Neutralisation reaction.

(*ii*) Neutralisation reaction.

(*g*) The values displayed by Reema in this episode are (*i*) Awareness (or knowledge) that a wasp sting injects an alkaline liquid whereas an ant's sting injects an acidic liquid into skin (*ii*) Understanding of neutralisation reactions of acids and bases, and (*iii*) Desire to mitigate the suffering of others.

Q.10. Rohan and Vikram are very good friends. Rohan studies in class 9 whereas Vikram studies in class 10. During a dental check up in the school, Rohan was told that tooth decay had just started on the top of his large back teeth and where one tooth touches another. He also heard the dentist telling his assistant that pH change is the cause of tooth decay. Rohan could not understand anything. He told everything to Vikram. Vikram could understand what had happened. He explained everything to Rohan and also gave him advice to prevent further tooth decay.

(*a*) What is meant by tooth decay ?

(*b*) What type of micro-organisms are responsible for causing tooth decay ?

(*c*) How does tooth decay start ?

(*d*) What is meant by saying that pH change is the cause of tooth decay ?

(*e*) What advice do you think Vikram gave to Rohan to prevent further tooth decay ?

(*f*) What values are displayed by Vikram in this episode ?

Ans. (*a*) Tooth decay is the gradual destruction of the hard, outer tissues of the tooth (such as enamel and dentine) leading to the formation of cavities or caries in the tooth. In most simple terms, tooth decay means rotting of tooth. Progressive tooth decay can lead to the death of tooth.

(*b*) Bacteria (which are present in the mouth).

(*c*) When we eat food (including sugary food), some of the food particles stick to our teeth and accumulate on the surface of our teeth. The bacteria present in our mouth break down the sugar present in these food particles to form acid. This acid first attacks the enamel (and then dentine) of our tooth and corrodes it. This starts the tooth decay.

(*d*) The acid formed by the action of bacteria on the sugary food present on our teeth lowers the pH in mouth (making it more acidic). Tooth decay starts when the pH of acid formed in the mouth falls below 5.5. This is because then the acid becomes strong enough to attack the hard enamel of our teeth and corrode it gradually. This is why it is said that pH change in the mouth is the cause of tooth decay.

(*e*) Vikram gave the following advice to Rohan to prevent further tooth decay :

(*i*) Clean the mouth thoroughly after eating food by rinsing with lots of clean water so as to remove the food particles sticking on the surface of teeth.

(*ii*) Clean the teeth by brushing by using a toothpaste (at least twice a day). The toothpaste is basic in nature. The basic toothpaste neutralises the excess acid in the mouth and prevents tooth decay.

(*iii*) Eat less of sugary foods like sweets, toffees, chocolates, ice-cream and candy, etc.

(*f*) The values displayed by Vikram are (*i*) Awareness of the cause of tooth decay (*ii*) Knowledge that toothpaste is basic in nature which can prevent tooth decay, and (*iii*) Concern for the dental health of his friend.

Q.11. Radha is a student of class X in a city school. One day Radha was doing practicals in the science laboratory of her school. Just then her science teacher, Mrs. Chopra, came to the laboratory with a beaker of a colourless solution. She told Radha that the colourless solution contains the nitrate of a metal which is usually alloyed with 24 carat gold to make 22 carat gold for ornaments. Mrs. Chopra asked Radha to device a method to obtain the dissolved metal from the solution in the solid form. Radha started thinking about it. After some time, Radha took a certain 'wire' from the laboratory, cleaned it and placed it in the colourless solution in the beaker. She allowed this wire to remain immersed in the solution for a considerable time. Radha noticed a gradual change in the colour of solution in the beaker and saw a thick deposit of a substance on the wire kept in the solution. Radha was happy that she had done her job well.

(*a*) Name the metal whose nitrate solution you think is given in the beaker ? Why do you think so ?

(*b*) What was the nature of 'wire' placed by Radha in the given solution ? Why was this particular wire used ?

(*c*) What change in the colour of solution was observed by Radha in the beaker and why ?

(*d*) Which substance was deposited on the wire placed in the solution ?

(*e*) Which chemical reaction is utilised by Radha in this process ? Why does this reaction occur ?

(*f*) What values are displayed by Radha in this episode ?

Ans. (*a*) The metal whose nitrate solution is given in the beaker is silver. That is, the beaker contains silver nitrate solution (which is a colourless solution). Now, two metals silver and copper are usually alloyed with 24 carat pure gold to obtain 22 carat gold for making ornaments. Here the metal has to be silver because silver nitrate solution is colourless. On the other hand, copper nitrate solution would have been blue in colour.

(*b*) The wire placed by Radha in silver nitrate solution was of copper metal. This is because copper is more reactive than silver and hence can displace silver from silver nitrate solution.

(*c*) Radha observed that the colourless silver nitrate solution in the beaker gradually turned blue due to the formation of copper nitrate solution (which is blue in colour).

(*d*) Silver metal present in dissolved form in the silver nitrate solution was deposited on the copper wire (in solid form).

(*e*) Radha utilised the displacement reaction of a metal with a salt solution. This displacement reaction occurs because copper is more reactive than silver due to which copper can displace silver from silver nitrate solution to form solid silver metal (which then deposits on copper wire). Some of the copper of copper wire passes into solution forming blue copper sulphate solution.

(*f*) The various values displayed by Radha in this episode are (*i*) Awareness of alloys of gold (*ii*) Knowledge of reactivity series of metals (*iii*) Understanding of displacement reactions, and (*iv*) Desire to complete the task given by her teacher.

Q.12. Mukesh is a student of class X. He lives in a big house. There is a big iron gate in the boundary wall of his house which was installed about one year back. For the last few days, Mukesh has been observing that red-brown patches have appeared at some of the places on the iron gate. When Mukesh brought this development to the notice of his family, his sister, who is a student of class VI, said that the iron gate should be cleaned properly with sand paper to remove the red-brown patches and then smeared with oil or grease to protect it from further damage. Mukesh did not agree with her and suggested a different treatment for the iron gate. Mukesh's father also agreed with his plan of action.

(*a*) What are the red-brown patches on the surface of iron gate ? Name the process which leads to the formation of these patches.

(*b*) What conditions are necessary for the formation of red-brown patches on the iron gate ?

(*c*) What harm can be done if this iron gate having red-brown patches is allowed to remain as such for a long time (without any treatment) ?

(*d*) Explain why, this iron gate cannot be smeared with oil or grease to protect it from further damage ?

(*e*) What treatment do you think was suggested by Mukesh to protect the iron gate from further damage ? How does this treatment work to protect the iron gate ?

(*f*) What values are displayed by Mukesh in this episode ?

Ans. (*a*) The red-brown patches on the surface of iron gate are of 'rust'. The red-brown patches are formed due to the 'rusting of iron' (of the iron gate).

(*b*) The conditions necessary for the rusting of iron to take place are (*i*) presence of air, and (*ii*) presence of water (or moisture). In this case of rusting of iron gate, damp air (or moist air) present around the iron gate provides both the conditions, air and water (or moisture) required for the rusting of iron.

(*c*) If this rusted iron gate is allowed to remain in this way, then the soft and porous rust will keep on falling from the surface of iron gate and then the fresh iron below will start rusting. The rusting of iron is a continuous process which will ultimately eat up the whole iron gate and make it useless.

(*d*) The iron gate cannot be smeared with oil or grease because this oil and grease will spoil the hands and clothes of a person when the gate is opened or closed. Moreover, oil and grease can be washed away by rains.

(*e*) Mukesh suggested the painting of iron gate. When a coat of paint is applied to the surface of this iron gate, then air and moisture (present in moist air) cannot come in contact with the iron of iron gate and hence no rusting will take place.

(*f*) The values displayed by Mukesh in this episode are (*i*) Keen observation (*ii*) Awareness of rusting and conditions necessary for rusting (*iii*) Understanding of correct method of prevention of rusting to be applied, and (*iv*) Desire to protect the iron gate of his house from further damage.

Q.13. Arun's elder sister Rama is getting married next month. His father and mother were taking Rama to a jeweller's shop to select and buy gold jewellery for this occasion. Arun insisted on going with them to the jeweller's shop. The family saw a number of jewellery pieces. Rama liked one of the gold necklaces very much and wanted to buy it immediately. The jeweller said that this necklace was made of 22 carat gold. Just when Arun's father was about to make payment for this necklace, Arun stepped in. He asked the jeweller to show the hallmark on this gold necklace. The jeweller told him that this necklace is yet to be sent to the hallmarking laboratory for testing and stamping. Arun asked his father not to buy this necklace until the jeweller gets it hallmarked. The jeweller then asked for one week's time to get the necklace hallmarked. Meanwhile Arun explained the need for hallmarking of gold jewellery to his family. When Arun and his family returned after one week, the necklace carried hallmark. They also obtained hallmark certificate and a proper receipt from the jeweller before paying money and taking delivery of necklace. Rama was very happy to get this necklace.

(*a*) How many carats is pure gold ? Why are ornaments not made of pure gold ?

(*b*) What is meant by 22 carat gold ? What can a dishonest jeweller do to earn more profit from gold jewellery ?

(*c*) What is 'hallmark' ? Which Government Organisation controls the hallmark scheme for jewellery in India ?

(*d*) Why should we buy only hallmarked gold jewellery ?

(*e*) What values are displayed by Arun in this episode ?

Ans. (*a*) The pure gold is 24 carats. Ornaments are not made of pure gold because pure gold is very soft (and hence it becomes difficult to work with it).

(*b*) 22 carat gold means that 22 parts of pure gold has been alloyed by mixing 2 parts of either silver or copper. The addition of little of silver or copper makes the gold hard. This hardened gold is more suitable for making ornaments (because it becomes easier to work with it). In India, gold ornaments are usually made of 22 carat gold. The dishonest jeweller can mix a large amount of cheaper metals such as silver or copper to the pure gold and still sell the ornaments made from it as of 22 carat gold to earn more profit.

(*c*) Hallmark is a mark (or logo) stamped on the article of gold jewellery which certifies the purity of gold used for making that jewellery. The hallmark scheme is controlled by a Government Organisation called Bureau of Indian Standards (BIS). There are many authorised hallmarking laboratories in every city of India which test the purity of gold in every piece of jewellery before hallmarking it (The term 'Hallmark' has come from the Goldsmith's 'Hall' in London where gold jewellery articles were tested and stamped).

(*d*) We should buy only hallmarked gold jewellery because it contains the gold and its alloyed metal (silver or copper) in the correct ratio. It does not contain more of the cheaper metals (like silver or copper). Hallmark is a quality assurance certification of the purity of gold used in every piece of jewellery.

(*e*) The values displayed by Arun in this episode are (*i*) Awareness (or knowledge) of the existence of 'hallmark certification' for the purity of gold jewellery (*ii*) Correct decision making skills (in not buying unmarked jewellery), and (*iii*) Desire to protect his family from being cheated by jeweller.

SECOND TERM

Q.14. One day Anita was standing in the kitchen and talking to her mother who was cooking vegetables in a stainless steel utensil. Anita observed that the bottom of cooking utensil was getting blackened from outside. She showed this to her mother. The mother told Anita that the bottoms of all the cooking utensils kept on the gas stove were getting blackened for the last few days and she had tough time cleaning these utensils. Being a science student of class X, Anita checked the gas stove thoroughly and could understand the reason for this problem. She explained everything to her mother. As Anita was getting late for school, she asked her mother to take a particular step to stop the blackening of cooking utensils. Anita's mother did the same. The mother was glad that the bottoms of cooking utensils kept on gas burner were no longer being blackened.

(*a*) Why is the bottom of cooking utensil kept on burning gas stove getting blackened ? Explain.

(*b*) Apart from blackening the bottoms of cooking utensils, state two other disadvantages of using gas stove in this condition.

(*c*) What did Anita find on checking the gas stove thoroughly which was causing this problem ?

(*d*) What step Anita might have asked her mother to take to get rid of this problem ?

(*e*) What type of flame was produced by the gas stove burner after the required step was taken by Anita's mother ? Why ?

(*f*) What values are displayed by Anita in this episode ?

Ans. (*a*) The fuel (LPG) is not burning completely in the gas stove producing a yellow, sooty flame. The soot (unburnt carbon particles) present in sooty flame sticks to the bottom of the cooking utensil and blackens it. The incomplete burning of fuel (or LPG) giving sooty flame is due to the fact that sufficient air is not being made available for the complete burning of fuel.

(*b*) (*i*) Since the fuel is not burning completely, there is wastage of fuel in this case. Due to this less heat is being produced.

(*ii*) The sooty flame puts unburnt carbon particles into the air and pollutes the environment.

(*c*) Anita must have found that the air holes of the gas stove were partially blocked.

(*d*) Anita must have asked her mother to clean the holes of the gas burner properly to bring in free flow of air sufficient for the complete combustion of fuel.

(*e*) After the air holes of the gas stove were opened fully by proper cleaning, then sufficient air became available for the complete burning of fuel to produce a smokeless, blue flame.

(*f*) The values displayed by Anita are (*i*) Good observation skills (*ii*) Understanding of combustion of fuels under different conditions (*iii*) Application of knowledge in everyday situations, and (*iv*) Concern for the environment (to keep it clean).

Q.15. Abhinav studies in tenth standard in a city school. One day his science teacher was discussing oils and fats in the class. During this discussion, Abhinav came to know many facts about oils and fats which he did not know earlier. When Abhinav came back home from school, he asked his mother what type of cooking medium she used to prepare food for the family. The mother replied that she was using vegetable *ghee* (or *vanaspati ghee*) for cooking food. Abhinav requested his mother not to use vegetable *ghee* because it is said to be harmful for health. He asked her to purchase vegetable oil always and use it for cooking food because vegetable oils are said to be good for health. Abhinav's mother agreed to do the same.

(*a*) What is the difference in the physical states of vegetable oils and fats such as vegetable *ghee* (or *vanaspati ghee*) ?

(*b*) How are vegetable oils and fats different chemically ?

(*c*) Name the process by which a vegetable oil is converted into a fat called vegetable *ghee* (or *vanaspati ghee*) in industry.

(*d*) Why is fat such as vegetable *ghee* (or *vanaspati ghee*) not considered good for health ?

(*e*) Name the most common animal fat consumed by people ?

(*f*) Why is vegetable oil considered to be good for health ?

(*g*) What values are displayed by Abhinav in this episode ?

Ans. (*a*) Vegetable oils are in liquid state at the room temperature whereas fats are solids (or semi-solids) at room temperature.

(*b*) Vegetable oils are unsaturated organic compounds (containing unsaturated fatty acids) whereas fats are saturated organic compounds (containing saturated fatty acids).

(*c*) Vegetable oils (like groundnut oil) can be converted into a fat (like vegetable *ghee* or *vanaspati ghee*) by the process of 'hydrogenation' of oils.

(*d*) Fats are not considered good for health because due to the presence of saturated fatty acids, they tend to raise the level of cholesterol in blood in the long run and increase the risk of heart disease (especially if too much fat is consumed).

(*e*) The most common animal fat consumed by people is butter.

(*f*) Vegetable oils are considered good for health because due to the presence of unsaturated fatty acids, they tend to lower the level of cholesterol in blood and decrease the risk of heart disease.

(*g*) The values displayed by Abhinav are (*i*) Awareness (or knowledge) that vegetable oils are better for health than fats (*ii*) Application of knowledge in real-life situations, and (*iii*) Concern for the heatlh of his family.

Q.16. Mohan went to his ancestral village during the summer holidays to meet his uncle (*chacha ji*) and his family. Mohan's uncle has a very big house in the village but they have no piped water supply. They draw water from a well near their house. One day Mohan took a bucket of water from the well and started washing his dirty clothes with soap given by his aunt. Mohan observed that the soap did not give lather with well water easily, only a curdy precipitate was formed, making it difficult to wash the clothes properly. Mohan had brought a packet of some powder with him from the city. So, Mohan used this powder to wash his clothes with well water without facing any difficulty. Mohan explained everything to his uncle's family and advised them to stop using soap for washing clothes by using well water and asked them to use the powder which he had used for washing clothes with the same well water easily.

(*a*) What type of water is the 'well water' ? Why ?

(*b*) Why is soap not suitable for washing clothes with well water ?

(*c*) What was the powder used by Mohan for washing clothes easily even with well water ?

(*d*) Why is this powder for washing clothes suitable even with well water ?

(*e*) What values are displayed by Mohan in this episode ?

Ans. (*a*) The well water is 'hard water'. The hardness of well water is due to the presence of calcium and magnesium ions in it.

(*b*) Soap is not suitable for washing clothes with hard well water because of the following reasons :

(*i*) A lot of soap is wasted in reacting with the calcium and magnesium ions present in hard water to form an insoluble curdy precipitate (called scum) before it can be used for the real purpose of washing clothes.

(*ii*) The scum (or curdy precipitate) formed by the action of soap on hard water sticks to the clothes being washed and interferes with the cleansing ability of additional soap.

(*iii*) A lot of water is also wasted in using soap to wash clothes with hard water because the clothes being washed have to be rinsed many more times with water to remove the scum sticking to them.

(*c*) Detergent powder.

(*d*) Detergents are suitable for washing clothes even with hard water because they do not form insoluble calcium and magnesium salts with hard water. Unlike soap, a detergent can lather well even with hard well water.

(*e*) The values displayed by Mohan are (*i*) Awareness (that the well water is hard water) (*ii*) Knowledge of the working of soaps and detergents with hard water (*iii*) Application of knowledge to solve day-to-day problems, and (*iv*) Helping nature.

Q.17. One day Amit went to a bicycle repair shop to get broken iron part of his younger brother's bicycle welded. This shop has a gas welding set. At that time, the main welder Mr. Ahmad was not present in the shop. Mr. Ahmad's assistant Chhotu offered to do the welding of broken bicycle part. When Chhotu started doing welding, Amit observed that a yellow sooty flame was being produced by the welding torch. By using this flame, Chhotu was unable to weld the two pieces of broken iron part together. Being a science student of class X, Amit could understand the mistake being made by Chhotu. He pointed the mistake to Chhotu. Chhotu then followed the instructions of Amit and succeeded in welding the broken iron part. By that time, Mr. Ahmad had also arrived. He thanked Amit for correcting the mistake of Chhotu. He also advised Chhotu to be careful in future.

(*a*) Which organic compound is used in gas welding ?

(*b*) What was the reason for the yellow sooty flame being produced by the welding torch ?

(*c*) Why the yellow sooty flame could not weld the broken iron pieces ?

(*d*) What was the mistake being made by Chhotu which was corrected by Amit ?

(*e*) What was the colour of the flame produced by welding torch now and why could it weld broken iron pieces together ?

(*f*) What values are displayed by Amit in this episode ?

Ans. (*a*) The organic compound used in gas welding is acetylene (or ethyne). It is a gas.

(*b*) The reason for the production of yellow sooty flame by the welding torch was the incomplete combustion of acetylene in air. This is because air does not contain sufficient oxygen to bring about the complete combution of acetylene (which has high percentage of carbon in it).

(*c*) The temperature of yellow sooty flame obtained by burning acetylene in air is not very high. This temperature of welding torch flame is insufficient to melt iron and weld the iron pieces together.

(*d*) Chhotu was using the combustion of acetylene in air for welding . He should have used the combustion of acetylene in pure oxygen for welding. Actually, Chhotu forgot to open the knob of oxygen cylinder before welding to mix oxygen with acetylene before lighting the welding torch. Amit asked Chhotu to use oxygen-acetylene flame for welding.

(*e*) The colour of oxygen-acetylene flame produced by burning a mixture of oxygen and acetylene in the welding torch was blue. The blue oxygen-acetylene flame is extremely hot and produces a very high temperature which is sufficient to melt iron and weld the two broken iron pieces together.

(*f*) The values displayed by Amit in this episode are (*i*) Awareness (or knowledge) that in gas welding a mixture of acetylene and pure oxygen is burned in the welding torch so as to produce a very high temperature, and (*ii*) Desire to help others.

Q.18. Rahul is studying in class X whereas his younger brother Mohan is a student of class VI. Mohan has been asked by his teacher to make a working model to show that some non-metal can also be a good conductor of electricity. Mohan has already made an electric circuit by using a dry cell whose both the terminals are connected to two long copper wires having crocodile clips attached to their ends, and one of the copper wires has a torch bulb connected in it through a bulb holder. Mohan, however, failed to get a non-metal which could conduct electricity. Mohan asked his brother for help. Rahul told Mohan to take a pencil, sharpen this pencil at both ends, and then connect it in the circuit made by him by attaching the two crocodile clips at its two ends. Mohan did the same. As soon as the pencil sharpened at both ends was connected in the circuit, the torch bulb started glowing.

(*a*) Of what substance is the black core of pencil made ? What does the glowing of bulb in this activity indicate ?

(*b*) Name the element of which the above substance is an allotrope ?

(*c*) Which allotrope of this element :

(*i*) is used in glass cutters ?

(*ii*) is used in lubricating oils ?

(*iii*) has a spherical molecule made up of 60 atoms ?

(*d*) Name two properties of this element due to which it forms a large number of compounds.

(*e*) Name one compound each of this element which is used :

(*i*) as a solvent.

(*ii*) to ripen raw fruits.

(*iii*) to preserve biological specimens.

(*f*) What values are displayed by Rahul in this episode ?

Ans. (*a*) The black core of pencil is made of graphite (which is a form of 'carbon' non-metal). The glowing of bulb indicates that graphite conducts electricity. In other words, non-metal 'carbon' in the form of graphite is a good conductor of electricity.

(*b*) Carbon element.

(*c*) (*i*) Diamond (*ii*) Graphite (*iii*) Buckminsterfullerene

(*d*) (*i*) Catenation (self-linking), and (*ii*) Tetravalency (4 valency).

(*e*) (*i*) Ethyl alcohol (or Ethanol) (*ii*) Ethene (*iii*) Formaldelyde (in the form of its water solution called formalin).

(*f*) The values displayed by Rahul in this episode are (*i*) Awareness (that pencil lead is made of graphite which is a good conductor of electricity) (*ii*) Desire to help his younger brother (*iii*) Knowledge of the allotropes of carbon, and (*iv*) Understanding of properties and uses of carbon compounds.

Q.19. Vinod and Pramod are the best friends. Both study in class X in different schools. Vinod has been running around in various Government offices for the last one month to get sanction for PNG connection for his home. Due to his efforts, Vinod's family has just got a PNG connection in which cooking gas is supplied through pipes. On the other hand, Pramod's family has an LPG connection in which cooking gas is supplied in cylinders. One day Vinod and Pramod were discussing PNG and LPG. Pramod said that PNG is a cooking gas and LPG is also a cooking gas, therefore, their chemical composition is exactly the same. Vinod, however, did not agree with Pramod. Vinod then explained the difference between PNG and LPG to Pramod, and also told him the advantage of having a PNG connection.

(*a*) What is the full form of PNG ? Name the major component of PNG.

(*b*) What is the main advantage of having a PNG connection in the home over the LPG connection ?

(*c*) What is the difference between PNG and CNG ?

(*d*) Write the full form of LPG. Name the major component of LPG.

(*e*) The major component of LPG exists in two forms. Name these two forms. What special name is given to these two forms in organic chemistry ?

(*f*) What values are displayed by Vinod in this episode ?

Ans. (*a*) The full form of PNG is Piped Natural Gas. The major component of PNG is methane (CH_4).

(*b*) PNG connection provides an uninterrupted and continuous supply of cooking gas to the home through pipes (just like water supply). In LPG connection, however, cooking gas is supplied to home in cylinders which are to be booked periodically. And late supply of LPG cylinder may create problem for the household.

(*c*) PNG is piped natural gas whereas CNG is compressed natural gas. Chemically PNG and CNG are just the same. The difference lies in the way they are supplied and used. PNG is the natural gas which is supplied to the homes through a network of pipes to be used as cooking gas. On the other hand, CNG is natural gas which is compressed and filled in cylinders to be used as fuel in motor vehicles (such as cars autos, buses, and trucks, etc.).

(*d*) The full form of LPG is Liquefied Petroleum Gas. The major component of LPG is butane (C_4H_{10}).

(*e*) Butane (C_4H_{10}) is present in LPG cylinders in two forms called normal-butane (*n*-butane) and *iso*-butane. These two forms of butane are called isomers of butane. They have the same molecular formula but different structures.

(*f*) The various values displayed by Vinod in this episode are (*i*) Awareness (that PNG is available as cooking gas in their area) (*ii*) Intiative and drive (to get a PNG connection) (*iii*) Desire to make the life of his family more comfortable (by removing the tension of getting LPG cylinders), and (*iv*) Knowledge of the composition of PNG and LPG.

Q.20. Rohit's family got a wedding invitation from a relative who lives in a village. Rohit was very excited. He had never attended a village wedding so he wanted to attend this marriage alongwith his parents. Rohit's family was invited by the Bride's side. When the marriage party (*baraat*) reached the village at around 9 PM, Rohit noticed that a large number of persons in the marriage party were drunk and some were still drinking in the cars parked along the roadside. One of the drunk persons (who was a sharpshooter of police in the city) fired two celebratory shots from his licenced gun one of which hit a child sitting on the rooftop and injured him. After a while some argument started between two drunk men of the marriage party over a petty matter and they came to blows in full public view. Everyone noticed that bridegroom's uncle was so drunk that he slept throughout the marriage ceremonies without eating food at all. While all this drama was unfolding at marriage venue in the village, a person brought the news that the bridegroom's cousin brother, who was heavily drunk, had met with a car accident and taken to hospital in a serious condition. Being a student of class X, Rohit had studied the harmful effects of drinking alcohol but today he had seen all this with his own eyes. Rohit's father told him that such things also happen in many city marriages. Next day, when the intoxication due to alcohol had worn off, Rohit gathered all the people in marriage *pandal* and gave them a lecture on the harmful effects of drinking alcohol citing horrible incidents of the previous night. Most of the people appreciated Rohit's effort and vowed not to drink alcohol again.

(*a*) Why did a famous sharpshooter fire a gun shot in the wrong direction which hit a child sitting on the rooftop and injured him ?

(*b*) Why did a simple argument on a petty matter between two drunk men lead to a serious quarrel ?

(*c*) Why did bridegroom's drunk uncle sleep throughout the marriage ceremonies without eating anything ?

(*d*) Why did bridegroom's drunk cousin brother cause a serious car accident ?

(*e*) What values are displayed by Rohit in this episode ?

Ans. (*a*) Alcohol drinking slows down the activity of the nervous system and the brain due to which the judgement of a person gets impaired. Because of this impaired judgement, brought about by drinking alcohol, even a famous sharpshooter fired a gun shot in the wrong direction injuring a child.

(*b*) Alcohol drinking lowers inhibitions (mental restrain) due to which drunk men become quarrelsome and come to blows even during simple arguments on petty matters.

(*c*) Excessive alcohol drinking causes unconsciousness. So the bridegroom's uncle who slept throughtout the marriage ceremonies had actually become unconscious. He did not know where he was.

(*d*) Alcohol drinking increases the 'reaction time' of the driver. A drunk driver cannot press the brake pedal quickly to stop a fast moving car or turn the stearing wheel quickly in an emergency situation to avoid the accident with another running vehicle on the road. This is why bridegroom's drunk cousin brother caused a serious road accident.

(*e*) The values displayed by Rohit are (*i*) Awareness (or knowledge) of the harmful effects of drinking alcohol, and (*ii*) Social responsibility (to make village people understand the harmful effects of alcohol so as to avoid alcohol).

Q.21. Vineet's father has got two more rooms constructed in their existing house. The rooms are almost complete but only the wood polish remains to be done on the doors and windows of the new rooms. Vineet's father had brought two litres of alcohol containing some additive which is specifically used for doing wood polish. The bottle containing this alcohol was handed over to the painters and kept in the new room. Since Vineet's father wanted the work to be finished as soon as possible, therefore, two painters were working till late at night. Before going to sleep, Vineet wanted to check how much wood polishing work the painters had done. As soon as Vineet entered one of the two new rooms, he was shocked to see that one of the painters had put some alcohol into a glass and was about to drink it. Vineet snatched the glass containing this alcohol from painter's hand before he could drink it. He then told the painter that it was not pure alcohol. Actually, it was the alcohol to which some additive had been added to make it unfit for drinking. It was to be used only for wood polish. Vineet also told the painters about the extremely harmful effects of drinking such an impure alcohol. The painter said 'sorry' to Vineet and promised not to drink it in future.

(*a*) What substance is most commonly added to ethyl alcohol to make it unfit for drinking ?

(*b*) Why does the addition of above substance make ethyl alcohol unfit for drinking ?

(*c*) What is alcohol called after the addition of above substance ?

(*d*) Why should alcohol be made unfit for drinking by mixing additive such as above ?

(*e*) What could have happened if the painter had consumed this particular alcohol at Vineet's house ?

(*f*) What values are displayed by Vineet in this episode ?

Ans. (*a*) Methyl alcohol (or methanol).

(*b*) Methyl alcohol is a poisonous substance. So, the addition of some methyl alcohol to ethyl alcohol makes ethyl alcohol unfit for drinking.

(*c*) Denatured alcohol.

(*d*) A lot of alcohol is used in industry for various purposes. So, for industrial uses, alcohol is supplied 'duty free' (without charging production tax) by the Government. This makes the industrial alcohol much cheaper than its market rate. So, to prevent the misuse of industrial alcohol for drinking purposes (or black-marketing), it is made unfit for drinking by mixing about 10 per cent of a poisonous substance like methyl alcohol.

(*e*) If the painter had consumed denatured alcohol, then the methyl alcohol present in it could have caused severe poisoning leading to blindness and even death.

(*f*) The values displayed by Vineet in this episode are (*i*) Sense of responsibility (in keeping an eye on painters working in the house) (*ii*) Awareness (that denatured alcohol is poisonous and unfit for drinking) (*iii*) Quick decision making (in snatching glass of denatured alcohol from the painter), and (*iv*) Saving his family from possible trouble (resulting from any harm to the painter).

Q.22. Rohan was told that six elements A, B, C, D, E and F have atomic numbers of 2, 12, 20, 18, 4 and 10 respectively (where A, B, C, D, E and F are not the chemical symbols of these elements). Based on this information, Rohan was asked to answer the following questions :

(*a*) Which of these elements belong to the same groups of the periodic table ? Why ?

(*b*) Which of these elements belong to the same periods of the periodic table ? Why ?

(*c*) Which of these elements are (*i*) metals, and (*ii*) non-metals ?

(*d*) Which of these elements are chemically (*i*) reactive, and (*ii*) unreactive ?

(*e*) What values are displayed by Rohan in answering the above questions ?

Ans. First of all Rohan wrote down the electronic configurations of all the given six elements as follows :

Element	*Atomic number*	*Electronic configuration* K L M N
A	2	2
B	12	2, 8, 2
C	20	2, 8, 8, 2
D	18	2, 8, 8
E	4	2, 2
F	10	2, 8

(*a*) (*i*) Elements B (2, 8, 2), C (2, 8, 8, 2) and E (2, 2) belong to the same group (group 2) of the periodic table because all of them have an equal number of 2 valence electrons. (Element A has also 2 valence electrons but these 2 electrons are in its only electron shell, K shell, so it does not belong to group 2).

(*ii*) Elements A (2), D (2, 8, 8) and F (2, 8) also belong to the same group (group 18) because they are all inert gases having completely filled outermost electron shells with 8 valence electrons (except element A which has 2 valence electrons in its only shell, K shell).

(*b*) (*i*) Element B (2, 8, 2) and element D (2, 8, 8) belong to the same period (3rd period) because they both have 3 electron shells (K, L and M shells) each.

(*ii*) Element E (2, 2) and element F (2, 8) belong to the same period (2nd period) because they both have 2 electron shells (K and L shells) each.

(*c*) (*i*) Elements B, C and E belonging to group 2 are metals.

(*ii*) Elements A, D and F belonging to group 18 are non-metals.

(*d*) (*i*) Elements B, C and E of group 2 are chemically reactive because they have 2 valence electrons each which they can lose to react with other elements.

(*ii*) Elements A, D and F of group 18 are chemically unreactive because their atoms have completely filled valence shells. They can neither lose electrons nor gain electrons or share electrons to react with other elements.

(*e*) The various values displayed by Rohan in answering these questions are (*i*) Awareness (that in modern periodic classification the elements are arranged according to their electronic configurations) (*ii*) Knowledge (to correlate the properties of elements to their electronic configurations), and (*iii*) Ability to apply knowledge in solving problems.

Q.23. In his periodic table, Mendeleev arranged all the then known 63 elements in the order of increasing atomic masses in horizontal rows but in such a way that elements having similar properties came directly under one another in the same vertical column. In the classification of the then known elements, Mendeleev was guided mainly by two factors. In order to make sure that the elements having similar properties fell in the same vertical column, Mendeleev left some gaps in his periodic table. Though the leaving of gaps in the periodic table was considered to be a big drawback of his classification of elements at that time but Mendeleev stuck to his decision.

(*a*) What are the horizontal rows of Mendeleev's periodic table known as ? How many horizontal rows of elements were there in Mendeleev's original periodic table ?

(*b*) What are the vertical columns of Mendeleev's periodic table known as ? How many vertical columns were there in Mendeleev's original periodic table ?

(*c*) What were the similar properties used by Mendeleev to classify the then known elements into vertical columns ?

(*d*) What were the two main guiding factors for Mendeleev in the classification of the then known elements ?

(*e*) For what purpose were some gaps left by Mendeleev in his periodic table ? Does the modern periodic table also have the gaps left by Mendeleev ? Explain your answer.

(*f*) What values were displayed by Mendeleev in presenting his classification of elements ?

Ans. (*a*) The horizontal rows of elements in the periodic table are called periods. There were seven periods in Mendeleev's original periodic table.

(*b*) The vertical columns of Mendeleev's periodic table are called groups. There were eight groups in Mendeleev's original periodic table.

(*c*) The similar properties used by Mendeleev to classify the elements into vertical columns (or groups) were the similar formulae of their oxides and hydrides.

(*d*) The two main guiding factors for Mendeleev in the classification of the then known elements were :

(*i*) increasing atomic masses, and

(*ii*) grouping together of elements having similar properties.

(*e*) These gaps were left for the elements which had not been discovered at that time. Mendeleev thought that these elements would be discovered later on in future. The modern periodic table does not have any gaps because new elements were discovered later on which were placed correctly in the gaps left by Mendeleev.

(*f*) The various values displayed by Mendeleev were (*i*) Self confidence (because he had full faith in his work on the classification of elements) (*ii*) Courage (to leave gaps in his periodic table for the then unknown elements) (*iii*) Foresight (to tell in advance that more elements would be discovered later on which will fill the gaps), and (*iv*) Prophecy (to predict the properties of the then unknown elements).

Q.24. There are three elements X, Y and Z having atomic numbers of 6, 16 and 19 respectively. Based on this information, Rakshit has been asked to answer the following questions :

(*a*) In which group of the periodic table would you expect to find (*i*) element X (*ii*) element Y, and (*iii*) element Z ?

(*b*) Which two elements will form ionic bonds ? Why ?

(*c*) What will be the formula of ionic compound formed ?

(*d*) Which two elements will form covalent bonds ? Why ?

(*e*) What will be the formula of covalent compound formed ?

(*f*) What values are displayed by Rakshit in answering the above questions ?

Ans. In order to answer the questions, Rakshit first wrote down the electronic configuraitons of the elements X, Y and Z by using their atomic numbers, as follows :

Element	*Atomic number*	*Electronic configuration*
		K L M N
X	6	2, 4
Y	16	2, 8, 6
Z	19	2, 8, 8, 1

(*a*) (*i*) Element X has 4 valence electrons in its atom, so it will occur in group 4 + 10 = 14 of the modern periodic table.

(*ii*) Element Y has 6 valence electrons in its atom, so it will be found in group 6 + 10 = 16 of the modern periodic table.

(*iii*) Element Z has just 1 valence electron in its atom, so it will be in group 1 of the modern periodic table.

(*b*) An ionic bond is formed between a metal element and a non-metal element. Now, element Z of group 1 is a metal and element Y of group 16 is a non-metal, therefore, the elements Z and Y will combine to form ionic bonds (Please note that element X of group 14 is also a non-metal 'carbon' but it does not combine with metals to form ionic bonds).

(*c*) The element Z has 1 valence electron, so its valency is 1 (or 1+). Element Y has 6 valence electron, so its valency will be 2 (or 2–). Here two Z^+ ions will combine with one Y^{2-} ion so that the formula of ionic compound formed will be Z_2Y.

(*d*) A covalent bond is formed between two non-metal elements. Here, element X of group 14 is a non-metal and element Y of group 16 is also a non-metal, therefore, the elements X and Y will combine together to form covalent bonds.

(*e*) The element X has 4 valence electrons, so its valency is 4. The element Y has 6 valence electrons, so its valency is 2. This means that one atom of element X will combine with two atoms of element Y to form a covalent compound having the formula XY_2.

(*f*) The values displayed by Rakshit in answering these questions are (*i*) Knowledge of modern classification of elements (*ii*) Understanding of periodic table and chemical bonding, and (*iii*) Problem solving skills.

Q.25. Devendra was told that the elements P, Q and R belong to group 2, group 14 and group 17, respectively, of the long form of periodic table. Based on this information, he was asked to answer the following questions :

(*a*) What is the valency of (*i*) element P (*ii*) element Q, and (*iii*) element R ? Give reasons for your answer.

(*b*) What is the nature of oxide of (*i*) element P (*ii*) element Q, and (*iii*) element R ? Give reasons for your answer.

(*c*) Give one example each of (*i*) element P (*ii*) element Q, and (*iii*) element R.

(*d*) Name three elements which occur in the same group as element R but exist in three different physical states at room temperature.

(*e*) What values are displayed by Devendra in answering these questions ?

Ans. (*a*) (*i*) The valency of element P is 2. This can be explained as follows : The elements of group 2 of periodic table have 2 valence electrons each in their atoms. So, the atom of this element can lose 2 valence electrons (to some other atom), to attain the nearest inert gas electron configuration and hence shows a valency of 2.

(*ii*) The valency of element Q is 4. This can be explained as follows : The elements of group 14 of periodic table have 14 – 10 = 4 valence electrons each in their atoms. An atom of this element can share its 4 valence electrons with 4 more electrons to achieve the nearest inert gas electron configuration and hence shows a valency of 4.

(*iii*) The valency of element R is 1. This can be explained as follows : The elements of group 17 of periodic table have 17 – 10 = 7 valence electrons each in their atoms. An atom of this element having 7 valence electrons can accept 1 more electron to complete the stable, inert gas electron configuration and hence shows a valency of 1.

(*b*) (*i*) The elements of group 2 of periodic table are metals. Now, metals form basic oxides. So, the nature of oxide of element P is basic.

(*ii*) The elements of group 14 of periodic table are non-metals. Now, non-metals form acidic oxides. So, the nature of oxide of element Q is acidic.

(*iii*) The elements of group 17 of periodic table are also non-metals. Now, non-metals form acidic oxides. So, the nature of oxide of element R is acidic.

(*c*) (*i*) An example of element P of group 2 is magnesium (Mg).

(*ii*) An example of element Q of group 14 is carbon (C).

(*iii*) An example of element R of group 17 is chlorine (Cl).

(*d*) Element R occurs in group 17 of periodic table which comprises halogen elements. So, in group 17 of periodic table :

(*i*) iodine is a solid element.

(*ii*) bromine is a liquid element, and

(*iii*) chlorine is a gaseous element.

(*e*) The various values displayed by Devendra in answering these questions are (*i*) Knowledge of the characteristics of groups of the periodic table, and (*ii*) Application of knowledge in solving problems.