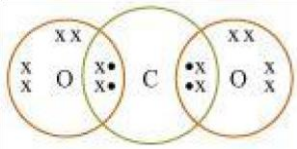
Carbon and its Compounds

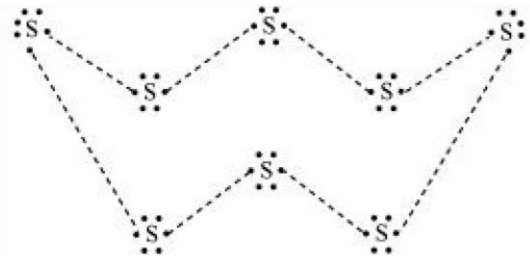
Question 1: What would be the electron dot structure of carbon dioxide which has the formula CO2 ?

Answer: Electron dot structure of CO2 is



Question 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.)

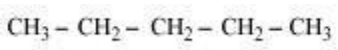
Answer: Electron dot structure of a sulphur molecule



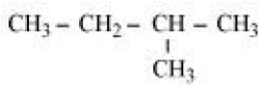
Question 3: How many structural isomers can you draw for pentane?

Answer: Three structural isomers are possible for pentane.

(i)



(ii)



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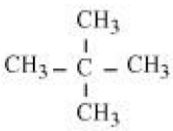


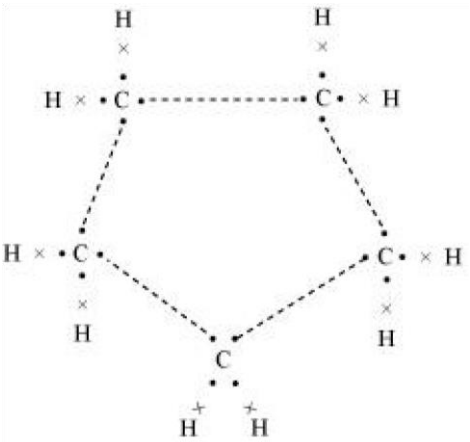
Question 4: What are the two properties of carbon which lead to the huge number of carbon compounds we see around us?

Answer: The two features of carbon that give rise to a large number of compounds are as follows:
(i) Catenation − It is the ability to form bonds with other atoms of carbon.

(ii) Tetravalency − With the valency of four, carbon is capable of bonding with four other atoms.

Question 5: What will be the formula and electron dot structure of cyclopentane?

Answer: The formula for cyclopentane is C5H10. Its electron dot structure is given below.



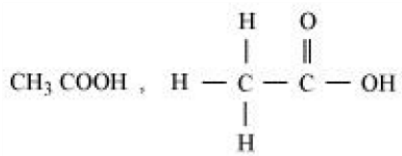
Question 6: Draw the structures for the following compounds.

(i) Ethanoic acid (ii) Bromopentane*

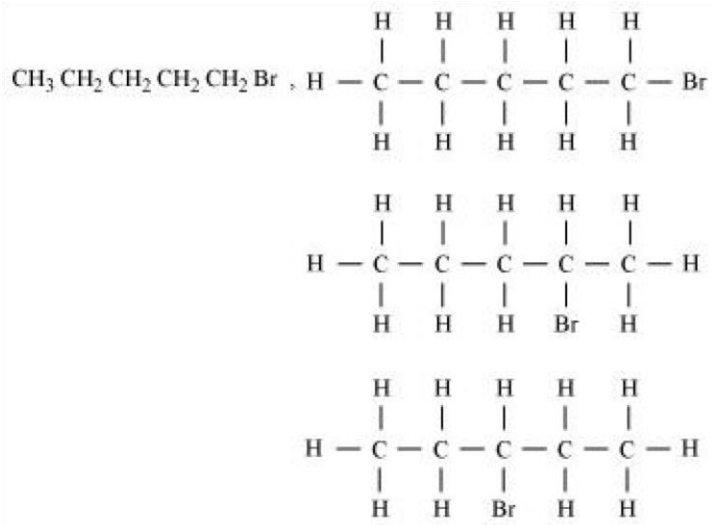
(iii) Butanone (iv) Hexanal

Answer: *Are structural isomers possible for bromopentane?

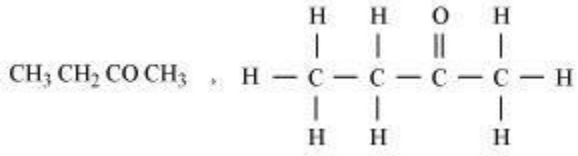
(i)



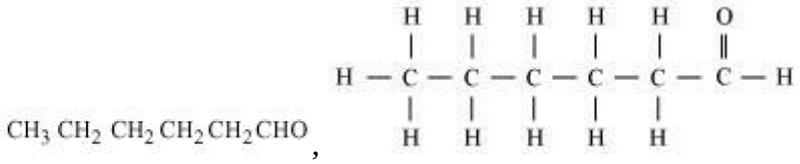
(ii) There are many structural isomers possible for bromopentane. Among them, the structures of three isomers are given.



(iii)



(iv)

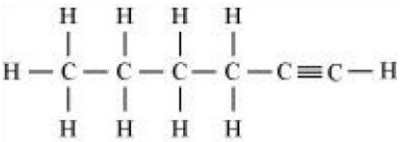


Question 7: How would you name the following compounds?

(i)

(ii)

(iii)

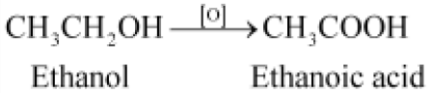


Answer: (i) Bromoethane

(ii) Methanal (formaldehyde)

(iii) Hexyne

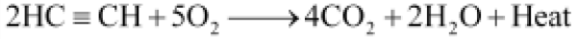
Question 8: Why is the conversion of ethanol to ethanoic acid an oxidation reaction?



Ethanol Ethanoic acid

Answer: Since the conversion of ethanol to ethanoic acid involves the addition of oxygen to ethanol, it is an oxidation reaction.

Question 9: A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used?



Answer: When ethyne is burnt in air, it gives a sooty flame. This is due to incomplete combustion caused by limited supply of air. However, if ethyne is burnt with oxygen, it gives a clean flame with temperature 3000°C because of complete combustion. This oxy-acetylene flame is used for welding. It is not possible to attain such a high temperature without mixing oxygen. This is the reason why a mixture of ethyne and air is not used.

Question 10: How would you distinguish experimentally between an alcohol and a carboxylic acid?

Answer: We can distinguish between an alcohol and a carboxylic acid on the basis of their reaction with carbonates and hydrogen carbonates. Acid reacts with carbonate and hydrogen carbonate to evolve CO_2 gas that turns lime water milky.

Metal Carbonate/ Metal Hydrogencarbonate + Carboxylic acid

↓

Salt + Water + Carbon dioxide

Alcohols, on the other hand, do not react with carbonates and hydrogen carbonates.

Question 11: Would you be able to check if water is hard by using a detergent?

Answer: Detergents are ammonium or sulphonate salts of long chain carboxylic acids. Unlike soap, they do not react with calcium and magnesium ions present in hard water to form scum. They give a good amount of lather irrespective of whether the water is hard or soft. This means that detergents can be used in both soft and hard water. Therefore, it cannot be used to check whether the water is hard or not.

Question 12: 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?

Answer: A soap molecule has two parts namely hydrophobic and hydrophilic. With the help of these, it attaches to the grease or dirt particle and forms a cluster called micelle. These micelles remain suspended as a colloid. To remove these micelles (entrapping the dirt), it is necessary to agitate clothes.

Question 13: 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.

Answer: (b) Ethane has 7 covalent bonds.

Question 14: Butanone is a four-carbon compound with the functional group

(a) carboxylic acid.

(b) aldehyde.

(c) ketone.

(d) alcohol.

Answer: (c) The functional group of butanone is ketone.

Question 15: 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.

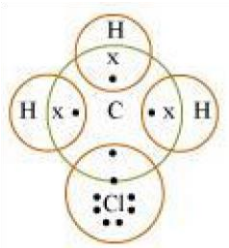
(c) the fuel is wet.

(d) the fuel is burning completely.

Answer: (b) While cooking, if the bottom of the vessel is getting blackened on the outside, then it means that the fuel is not burning completely.

Question 16: Explain the nature of the covalent bond using the bond formation in CH3Cl.

Answer: Carbon can neither lose four of its electrons nor gain four electrons as both the processes require extra amount of energy and would make the system unstable. Therefore, it completes its octet by sharing its four electrons with other carbon atoms or with atoms of other elements. The bonds that are formed by sharing electrons are known as covalent bonds. In covalent bonding, both the atoms share the valence electrons, i.e., the shared electrons belong to the valence shells of both the atoms.



Here, carbon requires 4 electrons to complete its octet, while each hydrogen atom requires one electron to complete its duplet. Also, chlorine requires an electron to complete the octet. Therefore, all of these share the electrons and as a result, carbon forms 3 bonds with hydrogen and one with chlorine.

Question 17: Draw the electron dot structures for

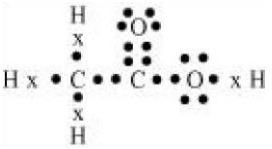
(a) ethanoic acid.

(b) H2S.

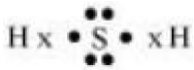
(c) propanone.

(d) F2.

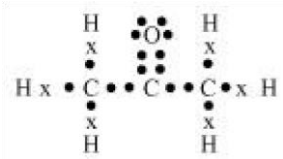
Answer: (a) Ethanoic acid



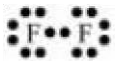
(b) H2 S



(c) Propanone



(d) F2



Question 18: What is a homologous series? Explain with an example.

Answer: A homologous series is a series of carbon compounds that have different numbers of carbon atoms but contain the same functional group.

For example, methane, ethane, propane, butane, etc. are all part of the alkane homologous series. The general formula of this series is CnH2n+2.

Methane CH4

Ethane CH3CH3

Propane CH3CH2CH3

Butane CH3CH2CH2CH3

It can be noticed that there is a difference of −CH2 unit between each successive compound.

Question 19: How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?

Answer:

- Ethanol is a liquid at room temperature with a pleasant odour while ethanoic acid has vinegar-like smell. The melting point of ethanoic acid is 17°C. This is below room temperature and hence, it freezes during winters.

• Ethanoic acid reacts with metal carbonates and metal hydrogencarbonates to form salt, water, and carbon dioxide gas while ethanol does not react with them.

Metal Carbonates/Metal Hydrogencarbonates + Carboxylic acid

↓

Salt + Water + Carbon dioxide

For example,

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$$

Metal Carbonates/Metal Hydrogencarbonates + Alcohols

↓

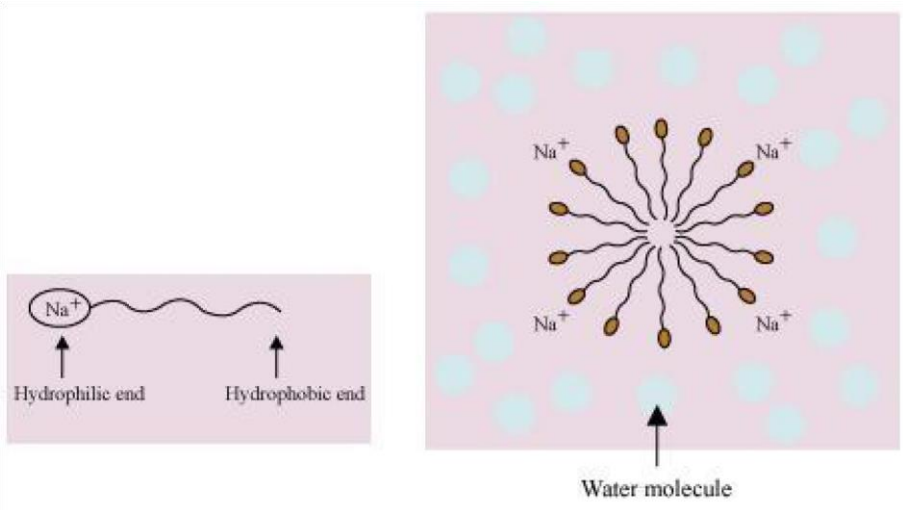
No reaction

For example,

$$CH_3CH_2OH + Na_2CO_3 \longrightarrow \text{No reaction}$$

Question 20: Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?

Answer: A soap is a sodium or potassium salt of long chain fatty acids. It has one polar end and one non-polar end. The polar end is hydrophilic in nature i.e., this end is attracted towards water. The non-polar end is hydrophobic but lipophilic, i.e., it is attracted towards hydrocarbons. When soap is added to water, soap molecules arrange themselves in a cluster to keep the non-polar portion out of water such that the non-polar ends are in the interior of the cluster and the polar ends are on the surface of the cluster. Since the dirt present on clothes is organic in nature and insoluble in water, the hydrophobic ends of the clusters attach themselves to the dirt. This cluster formation in which the dirt is entrapped is the micelle.



Micelle formation does not occur in alcohol because the alkyl chain of soap becomes soluble in alcohol.

Question 21: Why are carbon and its compounds used as fuels for most applications?

Answer: Most of the carbon compounds give a lot of heat and light when burnt in air. Saturated hydrocarbons burn with a clean flame and no smoke is produced. The carbon compounds, used as a fuel, have high calorific values. Therefore, carbon and its compounds are used as fuels for most applications.

Question 22: Explain the formation of scum when hard water is treated with soap.

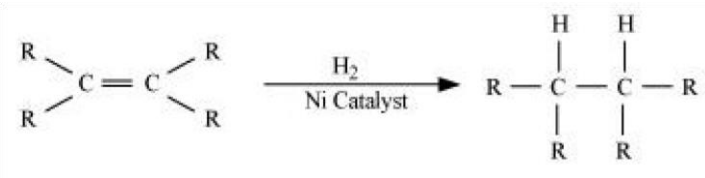
Answer: Soap does not work properly when the water is hard. A soap is a sodium or potassium salt of long chain fatty acids. Hard water contains salts of calcium and magnesium. When soap is added to hard water, calcium and magnesium ions present in water displace sodium or potassium ions from the soap molecules forming an insoluble substance called scum. A lot of soap is wasted in the process.

Question 23: What change will you observe if you test soap with litmus paper (red and blue) ?

Answer: Since soap is basic in nature, it will turn red litmus blue. However, the colour of blue litmus will remain blue.

Question 24: What is hydrogenation? What is its industrial application?

Answer: Hydrogenation is the process of addition of hydrogen. Unsaturated hydrocarbons are added with hydrogen in the presence of palladium and nickel catalysts to give saturated hydrocarbons.



This reaction is applied in the hydrogenation of vegetables oils, which contain long chains of unsaturated carbons.

Question 25: Which of the following hydrocarbons undergo addition reactions:

C2H6, C3H8, C3H6, C2H2 and CH4.

Answer: Unsaturated hydrocarbons undergo addition reactions. Being unsaturated hydrocarbons, C3H6 and C2H2undergo addition reactions.

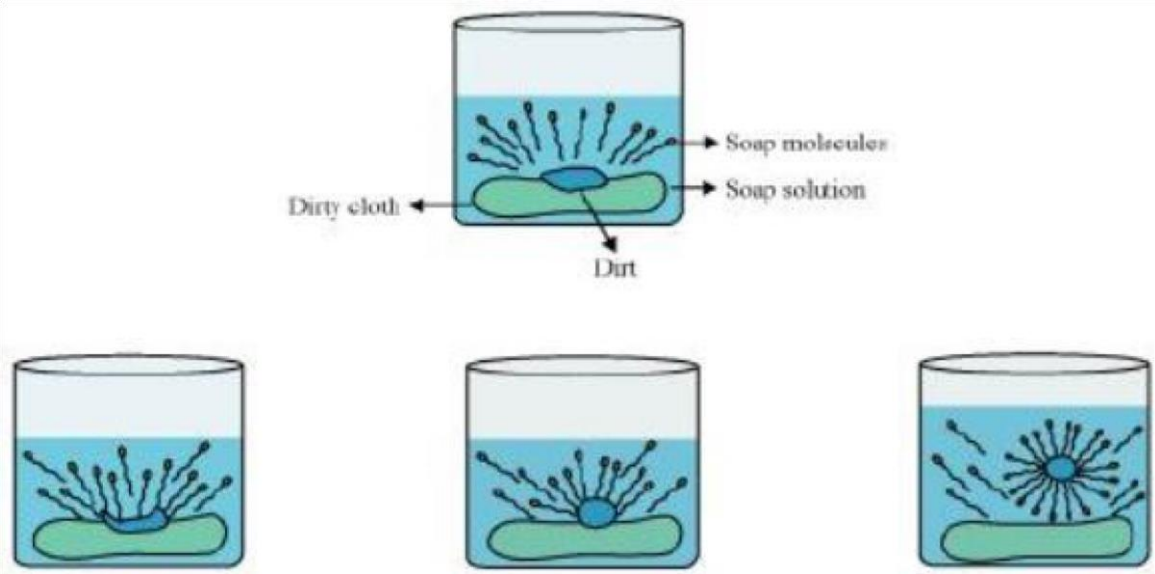
Question 26: Give a test that can be used to differentiate chemically between butter and cooking oil.

Answer: Butter contains saturated fats. Therefore, it cannot be hydrogenated. On the other hand, oil has unsaturated fats. That is why it can be hydrogenated to saturated fats (solids).

Question 27: Explain the mechanism of the cleaning action of soaps.

Answer: Cleansing action of soaps:

The dirt present on clothes is organic in nature and insoluble in water. Therefore, it cannot be removed by only washing with water. When soap is dissolved in water, its hydrophobic ends attach themselves to the dirt and remove it from the cloth. Then, the molecules of soap arrange themselves in micelle formation and trap the dirt at the centre of the cluster. These micelles remain suspended in the water. Hence, the dust particles are easily rinsed away by water.



Metals and Non-metals

Question 1: Explain the meanings of malleable and ductile.

Answer:

Malleable: Substances that can be beaten into thin sheets are called malleable. For example, most of the metals are malleable.

Ductile: Substances that can be drawn into thin wires are called ductile. For example, most of the metals are ductile.

Question 2: Why is sodium kept immersed in kerosene oil?

Answer: Sodium and potassium are very reactive metals and and combine explosively with air as well as water. Hence, they catch fire if kept in open. Therefore, to prevent accidental fires and accidents, sodium is stored immersed in kerosene oil.

Question 3: Write equations for the reactions of

(i) iron with steam

(ii) calcium and potassium with water

Answer:

(i) $3Fe_{(s)} + 4H_2O_{(g)} \longrightarrow Fe_3O_{4(aq)} + 4H_{2(g)}$

Iron Steam Iron (II,III) oxide Hydrogen

(ii) $Ca_{(s)} + 2H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)} + H_{2(g)} + Heat$

$2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_{2(g)} + Heat$

Calcium/ Potassium Water Calcium Hydroxide/ Potassium hydroxide Hydrogen

Question 4: Samples of four metals A, B, C and D were taken and added to the following solution one by one. The results obtained have been tabulated as follows.

Metal	Iron (II) sulphate	Cooper (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 Table above to answer the following questions about metals A, B, C and D.

(i) Which is the most reactive metal?

(ii) What would you observe if 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.

Answer: Explanation

$A + FeSO_4 \rightarrow$ No reaction, i.e., A is less reactive than iron

$A + CuSO_4 \rightarrow$ Displacement, i.e., A is more reactive than copper

$B + FeSO_4 \rightarrow$ Displacement, i.e., B is more reactive than iron

$B + ZnSO_4 \rightarrow$ No reaction, i.e., B is less reactive than zinc

$C + FeSO_4 \rightarrow$ No reaction, i.e., C is less reactive than iron

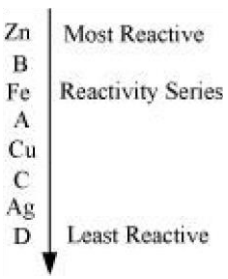
$C + CuSO_4 \rightarrow$ No reaction, i.e., C is less reactive than copper

$C + ZnSO_4 \rightarrow$ No reaction, i.e., C is less reactive than zinc

$C + AgNO_3 \rightarrow$ Displacement, i.e., C is more reactive than silver

$D + FeSO_4/CuSO_4/ZnSO_4/AgNO_3 \rightarrow$ No reaction, i.e., D is less reactive than iron, copper, zinc, and silver

From the above equations, we obtain:



(i) B is the most reactive metal.

(ii) If B is added to a solution of copper (II) sulphate, then it would displace copper.

$B + CuSO_4 \rightarrow$ Displacement

(iii) The arrangement of the metals in the order of decreasing reactivity is:
B > A > C > D

Question 5: Which gas is produced when dilute hydrochloric acid is added to a reactive metal? Write the chemical reaction when iron reacts with dilute H_2SO_4.

Answer: Hydrogen gas is evolved when dilute hydrochloric acid is added to a reactive metal.

When iron reacts with dilute H2SO4, iron (II) sulphate with the evolution of hydrogen gas is formed.

$$Fe_{(s)} + H_2SO_{4(aq)} \longrightarrow FeSO_{4(aq)} + H_{2(g)}$$

Question 6: What would you observe when zinc is added to a solution of iron (II) sulphate? Write the chemical reaction that takes place.

Answer: Zinc is more reactive than iron. Therefore, if zinc is added to a solution of iron (II) sulphate, then it would displace iron from the solution.

$$Zn_{(s)} + FeSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Fe_{(s)}$$

Question 7: (i) Write the electron-dot structures for sodium, oxygen and magnesium.

(ii) Show the formation of Na2O and MgO by the transfer of electrons.

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

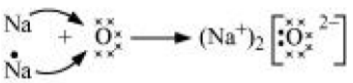
Answer: (i) The representation of elements with valence electrons as dots around the elements is referred to as electron-dot structure for elements.

(a) Sodium (2, 8, 1) = $\dot{Na}$

(b) Oxygen (2, 6) = $:\ddot{O}:$

(c) Magnesium (2, 8, 2) = $\dot{M}g$

(ii)



(iii) The ions present in Na2O are Na+ and O2− ions and in MgO are Mg2+ and O2− ions.

Question 8: Why do ionic compounds have high melting points?

Answer: Ionic compounds have strong electrostatic forces of attraction between the ions. Therefore, it requires a lot of energy to overcome these forces. That is why ionic compounds have high melting points.

Question 9: Define the following terms.

(i) Mineral (ii) Ore (iii) Gangue

Answer: (i) Mineral: Most of the elements occur in nature as in combined state as minerals. The chemical composition of minerals is fixed.

(ii) Ore: Minerals from which metals can be extracted profitably are known as ores.

(iii) Gangue: The impurities (sand, silt, soil, gravel, etc.) present in the ore are called gangue.

Question 10: Name two metals which are found in nature in the free state.

The metals at the bottom of the reactivity series are mostly found in free state. For example: gold, silver, and platinum.

Question 11: What chemical process is used for obtaining a metal from its oxide?

Answer: The chemical process used for obtaining a metal from its oxide is reduction. In this process, metal oxides are reduced by using suitable reducing agents such as carbon or by highly reactive metals to displace the metals from their oxides.

For example, zinc oxide is reduced to metallic zinc by heating with carbon.

$$ZnO_{(s)} + C_{(s)} \xrightarrow{\Delta} Zn_{(s)} + CO_{(g)}$$

Manganese dioxide is reduced to manganese by treating it with aluminium powder. In this case, aluminium displaces manganese from its oxide.

$$3MnO_{2(s)} + 4Al_{(s)} \longrightarrow 3Mn_{(l)} + 2Al_2O_{3(s)} + Heat$$

Oxides of more reactive metals are reduced by electrolysis.

Question 12:

Define the following terms.

(i) Mineral **(ii)** Ore **(iii)** Gangue

Answer:

(i)	Mineral	:	The naturally occurring elements or compounds in the earth's crust are known as minerals.
(ii)	Ore	:	Some minerals contain a large amount of a particular metal and metals can be extracted from them profitably. These minerals are known as ores.
(iii)	Gangue	:	The impurities (sand, silt, soil, gravel, etc.) present in the ore are called gangue.

Question 13: Metallic oxides of zinc, magnesium and copper were heated with the following metals.

Metal	Zinc	Magnesium	Copper
Zinc oxide	-	-	-
Magnesium oxide	-	-	-
Copper oxide	-	-	-

In which cases will you find displacement reactions taking place?

Answer:

Metal	Zinc	Magnesium	Copper
Zinc oxide	No reaction	Displacement	No reaction
Magnesium oxide	No reaction	No reaction	No reaction
Copper oxide	Displacement	Displacement	No reaction

Question 14: Which metals do not corrode easily?

Answer: More reactive a metal is, more likely it is to be corroded. Therefore, less reactive metals are less likely to get corroded. This is why gold plating provides high resistance to corrosion.

Question 15: What are alloys?

Answer: Alloys are homogeneous mixtures of two or more elements. The elements could be two metals, or a metal and a non-metal. An alloy is formed by first melting the metal and then dissolving the other elements in it. For example, steel is an alloy of iron and carbon.

Question 16: 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.

(d) $AgNO_3$ solution and copper metal

Question 17: Which of the following methods is suitable for preventing an iron frying pan from rusting?

(a) Applying grease

(b) Applying paint

(c) Applying a coating of zinc

(d) all of the above.

Answer: (c) Applying a coating of zinc

(We can also apply grease and paint to prevent iron from rusting. However, in case of iron frying pan, grease and paint cannot be applied because when the pan will be heated and washed again and again, the coating of grease and paint would get destroyed.)

Question 18: 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

Answer: (a) The element is likely to be calcium

Question 19: 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.

Answer: (c) Food cans are coated with tin and not with zinc because zinc is more reactive than tin.

Question 20: 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 these tests in distinguishing between metals and non-metals.

Answer: (a) With the hammer, we can beat the sample and if it can be beaten into thin sheets (that is, it is malleable), then it is a metal otherwise a non-metal. Similarly, we can use the battery, bulb, wires, and a switch to set up a circuit with the sample. If the sample conducts electricity, then it is a metal otherwise a non-metal.

(b) The above tests are useful in distinguishing between metals and non-metals as these are based on the physical properties. No chemical reactions are involved in these tests.

Question 21: What are amphoteric oxides? Give two examples of amphoteric oxides.

Those oxides that behave as both acidic and basic oxides are called amphoteric oxides.

Examples: aluminium oxide (Al_2O_3), zinc oxide (ZnO)

Question 22: Name two metals which will displace hydrogen from dilute acids, and two metals which will not.

Answer: Metals that are more reactive than hydrogen displace it from dilute acids. For example: sodium and potassium. Metals that are less reactive than hydrogen do not displace it. For example: copper and silver.

Question 23: In the electrolytic refining of a metal M, what would you take as the anode, the cathode and the electrolyte?

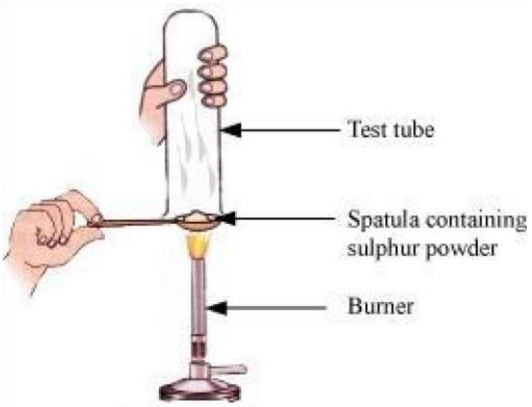
Answer: In the electrolytic refining of a metal M:

Anode → Impure metal M

Cathode → Thin strip of pure metal M

Electrolyte → Solution of salt of the metal M

Question 24: 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 figure below.



Collection of gas

(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.

Answer: (a) (i) There will be no action on dry litmus paper.

(ii) Since the gas is sulphur dioxide (SO2), it turns moist blue litmus paper to red because sulphur dioxide reacts with moisture to form sulphurous acid.

(b)

$$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$$

Sulphur dioxide

Question 24: State two ways to prevent the rusting of iron.

Answer: Two ways to prevent the rusting of iron are:

(i) Oiling, greasing, or painting: By applying oil, grease, or paint, the surface becomes water proof and the moisture and oxygen present in the air cannot come into direct contact with iron. Hence, rusting is prevented.

(ii) Galvanisation: An iron article is coated with a layer of zinc metal, which prevents the iron to come in contact with oxygen and moisture. Hence, rusting is prevented.

Question 25: What type of oxides is formed when non-metals combine with oxygen?

Answer: Non-metals combine with oxygen to form acidic oxides.

For example:

$$S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$$

(Acidic in nature)

Question 26: 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.

Answer: (a) Platinum, gold, and silver are used to make jewellery because they are very lustrous. Also, they are very less reactive and do not corrode easily.

(b) Sodium, potassium, and lithium are very reactive metals and react very vigorously with air as well as water. Therefore, they are kept immersed in kerosene oil in order to prevent their contact with air and moisture.

(c) Though aluminium is a highly reactive metal, it is resistant to corrosion. This is because aluminium reacts with oxygen present in air to form a thin layer of aluminium oxide. This oxide layer is very stable and prevents further reaction of aluminium with oxygen. Also, it is light in weight and a good conductor of heat. Hence, it is used to make cooking utensils.

(d) Carbonate and sulphide ores are usually converted into oxides during the process of extraction because metals can be easily extracted from their oxides rather than from their carbonates and sulphides

Question 27: 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.

Answer: Copper reacts with moist carbon dioxide in air to form copper carbonate and as a result, copper vessel loses its shiny brown surface forming a green layer of copper carbonate. The citric acid present in the lemon or tamarind neutralises the basis copper carbonate and dissolves the layer. That is why, tarnished copper vessels are cleaned with lemon or tamarind juice to give the surface of the copper vessel its characteristic lustre.

Question 28: Differentiate between metal and non-metal on the basis of their chemical properties.
Answer:

Metal	**Non-metal**
Metals are electropositive.	Non-metals are electronegative.
They react with oxygen to form basic oxides. $4Na + O_2 \longrightarrow 2Na_2O$	They react with oxygen to form acidic or neutral oxides. $C + O_2 \longrightarrow CO_2$
These have ionic bonds.	These have covalent bonds.
They react with water to form oxides and hydroxides. Some metals react with cold water, some with hot water, and some with steam. $2Na + 2H_2O \longrightarrow 2NaOH + H_2 \uparrow$	They do not react with water.
They react with dilute acids to form a salt and evolve hydrogen gas. However, Cu, Ag, Au, Pt, Hg do not react. $2Na + 2HCl \longrightarrow 2NaCl + H_2 \uparrow$	They do not react with dilute acids. These are not capable of replacing hydrogen.
They react with the salt solution of metals. Depending on their reactivity, displacement reaction can occur. $CuSO_4 + Zn \longrightarrow ZnSO_4 + Cu$	These react with the salt solution of non-metals.
They act as reducing agents (as they can easily lose electrons). $Na \longrightarrow Na^+ + e^-$	These act as oxidising agents (as they can gain electrons). $Cl_2 + 2e^- \longrightarrow 2Cl^-$

Question 29: A man went 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?

Answer: He must have dipped the gold metal in the solution of aqua regia − a 3:1 mixture of conc. HCl and conc. HNO3. Aqua regia is a fuming, highly corrosive liquid. It dissolves gold in it. After dipping the gold ornaments in aqua regia, the outer layer of gold gets dissolved and the inner shiny layer appears. That is why the weight of gold ornament reduced.

Question 30: Give reasons why copper is used to make hot water tanks and not steel (an alloy of iron).

Answer: Copper does not react with cold water, hot water, or steam. However, iron reacts with steam. If the hot water tanks are made of steel (an alloy of iron), then iron would react vigorously with the steam formed from hot water.

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

That is why copper is used to make hot water tanks, and not steel.

Acids, Bases and Salts

Question 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?

Solution:- If the colour of red litmus paper gets changed to blue, then it is a base and if there is no colour change, then it is either acidic or neutral. Thus, basic solution can be easily identified.

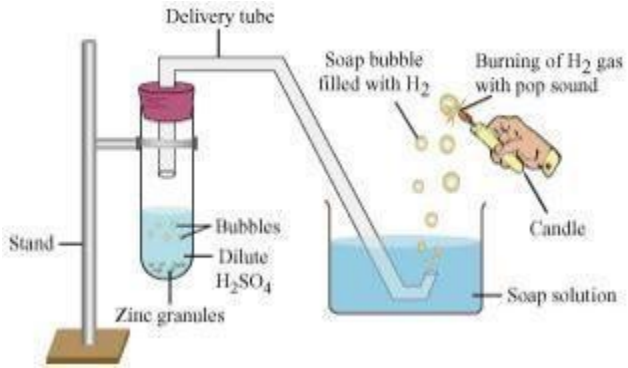
Let us mark the three test tubes as A, B, and C. A drop of the solution in A is put on the red litmus paper. Same is repeated with solution B and C. If either of them changes colour to blue, then it is basic. Therefore, out of three, one is eliminated. Out of the remaining two, any one can be acidic or neutral. Now a drop of basic solution is mixed with a drop of each of the remaining two solutions separately and then the nature of the drops of the mixtures is checked. If the colour of red litmus turns blue, then the second solution is neutral and if there is no change in colour, then the second solution is acidic. This is because acidic and basic solutions neutralize each other. Hence, we can distinguish between the three types of solutions.

Question 2: Why should curd and sour substances not be kept in brass and copper vessels?

Solutions:- Curd and other sour substances contain acids. Therefore, when they are kept in brass and copper vessels, the metal reacts with the acid to liberate hydrogen gas and harmful products, thereby spoiling the food.

Question 3: Which gas is usually liberated when an acid reacts with a metal? Illustrate with an example. How will you test for the presence of this gas?

Solution:- Hydrogen gas is usually liberated when an acid reacts with a metal.



Take few pieces of zinc granules and add 5 ml of dilute H2SO4. Shake it and pass the gas produced into a soap solution. The bubbles of the soap solution are formed. These soap bubbles contain hydrogen gas.

$$2H_2SO_4 + Zn \longrightarrow Zn(SO_4)_2 + 2H_2 \uparrow$$

We can test the evolved hydrogen gas by its burning with a pop sound when a candle is brought near the soap bubbles.

Question 4: 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.

Solutions:-

$$CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$

Calcium carbonate	Hydrochloric acid	Calcium chloride	Carbon dioxide	Water

Question 5: Why do HCl, HNO3, etc., show acidic characters in aqueous solutions while solutions of compounds like alcohol and glucose do not show acidic character?

Solutions:- The dissociation of HCl or HNO3 to form hydrogen ions always occurs in the presence of water. Hydrogen ions (H+) combine with H2O to form hydronium ions (H3O+).

The reaction is as follows:

$$HCl_{(aq)} \longrightarrow H^+ + Cl^-$$

$$H^+ + H_2O \longrightarrow H_3O^+$$

Although aqueous solutions of glucose and alcohol contain hydrogen, these cannot dissociate in water to form hydrogen ions. Hence, they do not show acidic character.

Question 6: Why does an aqueous solution of an acid conduct electricity?

Answer: Acids dissociate in aqueous solutions to form ions. These ions are responsible for conduction of electricity.

Question 7: Why does dry HCl gas not change the colour of the dry litmus paper?

Answer: Colour of the litmus paper is changed by the hydrogen ions. Dry HCl gas does not contain H+ ions. It is only in the aqueous solution that an acid dissociates to give ions. Since in this case, neither HCl is in the aqueous form nor the litmus paper is wet, therefore, the colour of the litmus paper does not change.

Since the process of dissolving an acid in water is exothermic, it is always recommended that acid should be added to water. If it is done the other way, then it is possible that because of the large amount of heat generated, the mixture splashes out and causes burns.

Question 8: How is the concentration of hydronium ions (H3O+) affected when a solution of an acid is diluted?

Answer: When an acid is diluted, the concentration of hydronium ions (H3O+) per unit volume decreases. This means that the strength of the acid decreases.

Question 9: How is the concentration of hydroxide ions (OH−) affected when excess base is dissolved in a solution of sodium hydroxide?

Answer: The concentration of hydroxide ions (OH−) would increase when excess base is dissolved in a solution of sodium hydroxide.

Question 10: 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 this is acidic and which one is basic?

Solutions:- A pH value of less than 7 indicates an acidic solution, while greater than 7 indicates a basic solution. Therefore, the solution with pH = 6 is acidic and has more hydrogen ion concentration than the solution of pH = 8 which is basic.

Question 11: What effect does the concentration of $H^+_{(aq)}$ ions have on the nature of the solution?

Answer: Concentration of $H^+_{(aq)}$ can have a varied effect on the nature of the solution. With an increase in H+ ion concentration, the solution becomes more acidic, while a decrease of H+ ion causes an increase in the basicity of the solution.

Question 12: Do basic solutions also have $H^+_{(aq)}$ ions? If yes, then why are these basic?

Answer: Yes, basic solution also has $H^+_{(aq)}$ ions. However, their concentration is less as compared to the concentration of OH− ions that makes the solution basic.

Question 13: Under what soil condition do you think a farmer would treat the soil of his fields with quick lime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate) ?

Answer: If the soil is acidic and improper for cultivation, then to increase the basicity of soil, the farmer would treat the soil with quick lime or slaked lime or chalk.

Question 14: What is the common name of the compound CaOCl2 ?

Solutions:- The common name of the compound CaOCl2 is bleaching powder.

Question 15: Name the substance which on treatment with chlorine yields bleaching powder?

Answer: Calcium hydroxide [Ca (OH)2], on treatment with chlorine, yields bleaching powder.

Question 16: Name the sodium compound which is used for softening hard water.

Answer: Washing soda (Na2CO3.10H2O) is used for softening hard water.

Question 17:- What will happen if a solution of sodium hydrocarbonate is heated? Give the equation of the reaction involved.

Answer: When a solution of sodium hydrocarbonate (sodium hydrogencarbonate) is heated, sodium carbonate and water are formed with the evolution of carbon dioxide gas.

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

Question 18: Write an equation to show the reaction between Plaster of Paris and water.

Answer: The chemical equation for the reaction of Plaster of Paris and water can be represented as

$$\underset{\text{Plaster of Paris}}{CaSO_4 \cdot \frac{1}{2}H_2O} + \underset{\text{Water}}{1\frac{1}{2}H_2O} \longrightarrow \underset{\text{Gypsum}}{CaSO_4.2H_2O}$$

Question 19: A solution turns red litmus blue, its pH is likely to be

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

Answer: (d) Bases turn red litmus blue and acids turn blue litmus red. Basic solution has a pH value more than 7. Since the solution turns red litmus blue, its pH is likely to be 10.

Question 20: 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

Answer: (b) The solution contains HCl.

Question 21: 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) 8mL (c) 12 mL (d) 16 mL

Answer: (d) 16 mL of HCl solution will be required.

Question 22: Which one of the following types of medicines is used for treating indigestion?

(a) Antibiotic

(b) Analgesic

(c) Antacid

(d) Antiseptic

Answer: (c) Antacid is used for treating indigestion.

Question 23: Write word equations and then balanced equations for the reaction 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.

Ansewr: (a) Sulphuric acid + Zinc → Zinc sulphate + Hydrogen

$$H_2SO_{4(aq)} + Zn_{(s)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$$

(b) Hydrochloric acid + Magnesium → Magnesium chloride + Hydrogen

$$2HCl_{(aq)} + Mg_{(s)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$$

(c) Sulphuric acid + Aluminium → Aluminium sulphate + Hydrogen

$$3H_2SO_{4(aq)} + 2Al_{(s)} \longrightarrow Al_2(SO_4)_{3(aq)} + 3H_{2(g)}$$

(d) Hydrochloric acid + Iron → Ferric chloride + Hydrogen

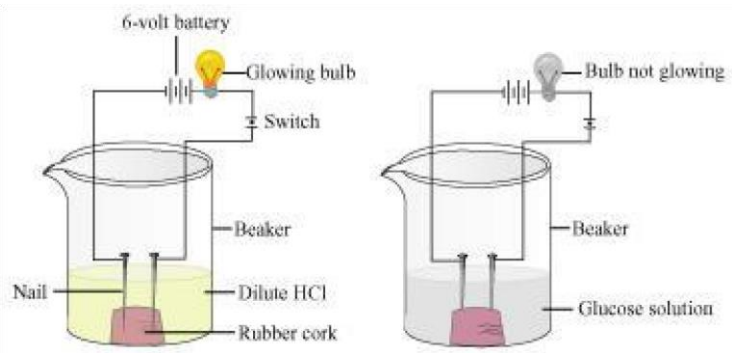
$$6HCl_{(aq)} + 2Fe_{(s)} \longrightarrow 2FeCl_{3(aq)} + 3H_{2(g)}$$

Question 24: Compounds such as alcohols and glucose also contain hydrogen but are not categorized as acids. Describe an activity to prove it.

Answer: Two nails are fitted on a cork and are kept it in a 100 mL beaker. The nails are then connected to the two terminals of a 6-volt battery through a bulb and a switch. Some dilute HCl is poured in the beaker and the current is switched on. The same experiment is then performed with glucose solution and alcohol solution.

Observations:

It will be observed that the bulb glows in the HCl solution and does not glow in the glucose solution.



Result:

HCl dissociates into H^+ and Cl^- ions. These ions conduct electricity in the solution resulting in the glowing of the bulb. On the other hand, the glucose solution does not dissociate into ions. Therefore, it does not conduct electricity.

Conclusion:

From this activity, it can be concluded that all acids contain hydrogen but not all compounds containing hydrogen are acids.

That is why, though alcohols and glucose contain hydrogen, they are not categorised as acids.

Question 25: Why does distilled water not conduct electricity, whereas rain water does?

Answer: Distilled water is a pure form of water and is devoid of any ionic species. Therefore, it does not conduct electricity. Rain water, being an impure form of water, contains many ionic species such as acids and therefore it conducts electricity.

Question 26: Why do acids not show acidic behaviour in the absence of water?

Acids do not show acidic behaviour in the absence of water because the dissociation of hydrogen ions from an acid occurs in the presence of water only. It is the hydrogen ions that are responsible for the acidic behaviour.

Question 27: Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9, respectively. Which solution is (a) neutral?

(b) strongly alkaline?

(c) strongly acidic?

(d) weakly acidic?

(e) weakly alkaline?

Answer: Arrange the pH in increasing order of hydrogen-ion concentration.

(a) Neutral → Solution D with pH 7

(b) Strongly alkaline → Solution C with pH 11

(c) Strongly acidic → Solution B with pH 1

(d) Weakly acidic → Solution A with pH 4

(e) Weakly alkaline → Solution E with pH 9

The pH can be arranged in the increasing order of the concentration of hydrogen ions as: $11 < 9 < 7 < 4 < 1$

Question 28: 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?

Answer: The fizzing will occur strongly in test tube A, in which hydrochloric acid (HCl) is added. This is because HCl is a stronger acid than CH3COOH and therefore produces hydrogen gas at a faster speed due to which fizzing occurs.

Question 29: Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd? Explain your answer.

Answer: The pH of milk is 6. As it changes to curd, the pH will reduce because curd is acidic in nature. The acids present in it decrease the pH.

Question 30: 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 long time to set as curd?

Answer: (a) The milkman shifts the pH of the fresh milk from 6 to slightly alkaline because in alkaline condition, milk does not set as curd easily.

(b) Since this milk is slightly basic than usual milk, acids produced to set the curd are neutralized by the base. Therefore, it takes a longer time for the curd to set.

Question 31: Plaster of Paris should be stored in a moisture-proof container. Explain why?

Answer: Plaster of Paris (POP) should be stored in a moisture-proof container because Plaster of Paris, a powdery mass, absorbs water (moisture) to form a hard solid known as gypsum.

$$\underset{(\text{POP})}{CaSO_4.\frac{1}{2}H_2O} + 1\frac{1}{2}H_2O \longrightarrow \underset{\text{Gypsum}(\text{Hard solid})}{CaSO_4.2H_2O}$$

Question 32: What is a neutralization reaction? Give two examples.

Answer: A reaction in which an acid and base react with each other to give a salt and water is termed as neutralization reaction. In this reaction, energy is evolved in the form of heat.

For example:

(i)

$$\underset{(\text{Base})}{NaOH} + \underset{(\text{Acid})}{HCl} \longrightarrow \underset{(\text{Salt})}{NaCl} + \underset{(\text{Water})}{H_2O}$$

(ii) During indigestion (caused due to the production of excess of hydrochloric acid in the stomach), we administer an antacid (generally milk of magnesia, $Mg(OH)_2$, which is basic in nature). The antacid neutralizes the excess of acids and thus gives relief from indigestion.

$$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$$

Question 33: Give two important uses of washing soda and baking soda.

Answer: Two important used of washing soda and baking soda are as follows:

(1) Washing soda:

(a) It is used in glass, soap, and paper industries.

(b) It is used to remove permanent hardness of water.

(2) Baking soda:

(a) It is used as baking powder. Baking powder is a mixture of baking soda and a mild acid known as tartaric acid. When it is heated or mixed in water, it releases CO_2 that makes bread or cake fluffy.

(b) It is used in soda-acid fire extinguishers.

Chemical Reactions and Equations

Question 1: Why should a magnesium ribbon be cleaned before burning in air?

Answer: Magnesium is very reactive metal. When stored it reacts with oxygen to form a layer magnesium oxide on its surface. This layer of magnesium oxide is quite stable and prevents further reaction of magnesium with oxygen. The magnesium ribbon is cleaned by sand paper to remove this layer so that the underlying metal can be exposed into air.

Question 2: Write the balanced equation 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

Answer:

(i) $H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$

(ii) $3BaCl_{2(s)} + Al_2(SO_4)_{3(s)} \longrightarrow 3BaSO_{4(s)} + 2AlCl_{3(s)}$

(iii) $2Na_{(s)} + 2H_2O_{(l)} \longrightarrow 2NaOH_{(aq)} + H_{2(g)}$

Question 3: Write a balanced chemical equation 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.

Answer:

$$BaCl_{2(aq)} + Na_2SO_{4(aq)} \longrightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$$

$$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

(i)

(ii)

Question 4: A solution of a 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.

Answer: The substance 'X' is calcium oxide. Its chemical formula is CaO.
Calcium oxide reacts vigorously with water to form calcium hydroxide (slaked lime).

$$CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)}$$

Calcium oxide (Quick lime)	Water	Calcium hydroxide (Slaked lime)

Question 5: Why is the amount of gas collected in one of the test tubes in Activity 1.7 double of the amount collected in the other? Name this gas.

Answer: Water (H2O) contains two parts hydrogen and one part oxygen. Therefore, the amount of hydrogen and oxygen produced during electrolysis of water is in a 2:1 ratio. During electrolysis, since hydrogen goes to one test tube and oxygen goes to another, the amount of gas collected in one of the test tubes is double of the amount collected in the other.

Question 6: Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Answer: When an iron nail is placed in a copper sulphate solution, iron displaces copper from copper sulphate solution forming iron sulphate, which is green in colour.

$$Fe_{(s)} + CuSO_{4(aq)} \longrightarrow FeSO_{4(aq)} + Cu_{(s)}$$

Iron	Copper sulphate (Blue colour)	Iron sulphate (Green colour)	Copper

Therefore, the blue colour of copper sulphate solution fades and green colour appears.

Question 7: Give an example of a double displacement reaction other than the one given in Activity 1.10. Sodium carbonate reacts with calcium chloride to form calcium carbonate and sodium chloride.

Answer:

$$Na_2CO_{3(aq)} + CaCl_{2(aq)} \longrightarrow CaCO_{3(s)} + 2NaCl_{(aq)}$$

Sodium carbonate	Calcium chloride	Calcium carbonate	Sodium chloride

In this reaction, sodium carbonate and calcium chloride exchange ions to form two new compounds. Hence, it is a double displacement reaction.

Question 8: Identify the substances that are oxidised and the substances that are reduced in the following reactions.

$$4Na_{(s)} + O_{2(g)} \longrightarrow 2Na_2O_{(s)}$$

$$CuO_{(s)} + H_{2(g)} \longrightarrow Cu_{(s)} + H_2O_{(l)}$$

(i)

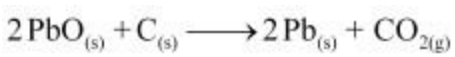
(ii)

Answer:

(i) Sodium (Na) is oxidised as it gains oxygen and oxygen gets reduced.

(ii) Copper oxide (CuO) is reduced to copper (Cu) while hydrogen (H2) gets oxidised to water (H2O).

Question 9: Which of the statements about the reaction below are incorrect?



(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

Solutions:-

(i) (a) and (b)

Question 10:

The above reaction is an example of a

(a) combination reaction.

(b) double displacement reaction.

(c) decomposition reaction.

(d) displacement reaction

Solution:-

(d) The given reaction is an example of a displacement reaction.

Question 11: 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.

Solution:-
(a) Hydrogen gas and iron chloride are produced. The reaction is as follows:

$$Fe_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)} + H_2 \uparrow$$

Question 12: What is a balanced chemical equation? Why should chemical equations be balanced?

Answer: A reaction which has an equal number of atoms of all the elements on both sides of the chemical equation is called a balanced chemical equation. The law of conservation of mass states that mass can neither be created nor destroyed. Hence, in a chemical reaction, the total mass of reactants should be equal to the total mass of the products. It means that the total number of atoms of each element should be equal on both sides of a chemical equation. Hence, it is for this reason that chemical equations should be balanced.

Question 13: 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.

Answer:

(a) $3H_{2(g)} + N_{2(g)} \longrightarrow 2NH_{3(g)}$

(b) $2H_2S_{(g)} + 3O_{2(g)} \longrightarrow 2H_2O_{(l)} + 2SO_{2(g)}$

(c) $3BaCl_{2(aq)} + Al_2(SO_4)_{3(aq)} \longrightarrow 2AlCl_{3(aq)} + 3BaSO_{4(s)}$

(d) $2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_{2(g)}$

Question 14: 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) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$

Solutions:-

(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) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

Question 15: 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

Answer:

(a) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

(b) $Zn + 2\,AgNO_3 \longrightarrow Zn(NO_3)_2 + 2\,Ag$

(c) $2\,Al + 3\,CuCl_2 \longrightarrow 2\,AlCl_3 + 3\,Cu$

(d) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 + 2\,KCl$

Question 16: Write the balanced chemical equation 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)

Answer:

(a) $2KBr_{(aq)} + BaI_{2(aq)} \longrightarrow 2KI_{(aq)} + BaBr_{2(s)}$; Double displacement reaction

(b) $ZnCO_{3(s)} \longrightarrow ZnO_{(s)} + CO_{2(g)}$; Decomposition reaction

(c) $H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$; Combination reaction

(d) $Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$; Displacement reaction

Question 17: What does one mean by exothermic and endothermic reactions? Give examples.

Answer: Chemical reactions that release energy in the form of heat, light, or sound are called exothermic reactions.

Example: Mixture of sodium and chlorine to yield table salt

$$Na_{(s)} + \frac{1}{2} Cl_{2(s)} \longrightarrow NaCl_{(s)} + 411 \text{ kJ of energy}$$

In other words, combination reactions are exothermic.

Reactions that absorb energy or require energy in order to proceed are called endothermic reactions.

For example: In the process of photosynthesis, plants use the energy from the sun to convert carbon dioxide and water to glucose and oxygen.

$$6CO_{2(g)} + 6H_2O_{(l)} \xrightarrow{\text{Sunlight}} \underset{\text{Glucose}}{C_6H_{12}O_{6(aq)}} + 6O_{2(g)}$$

Question 18: Why is respiration considered an exothermic reaction? Explain.

Answer: Energy is required to support life. Energy in our body is obtained from the food we eat. During digestion, large molecules of food are broken down into simpler substances such as glucose. Glucose combines with oxygen in the cells and provides energy. The special name of this combustion reaction is respiration. Since energy is released in the whole process, it is an exothermic process.

$$\underset{\text{Glucose}}{C_6H_{12}O_{6(aq)}} + \underset{\text{Oxygen}}{6O_{2(g)}} \longrightarrow \underset{\text{Carbon dioxide}}{6CO_{2(g)}} + \underset{\text{Water}}{6H_2O_{(l)}} + \text{Energy}$$

Question 19: Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

Answer: Decomposition reactions are those in which a compound breaks down to form two or more substances. These reactions require a source of energy to proceed. Thus, they are the exact opposite of combination reactions in which two or more substances combine to give a new substance with the release of energy.

Decomposition reaction: $AB + Energy \longrightarrow A + B$

$$2H_2O_{(l)} \xrightarrow{\text{Electrolysis}} 2H_{2(g)} + O_{2(g)}$$

Combination reaction: $A + B \longrightarrow AB + Energy$

$$2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)} + Energy$$

Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

(a) Thermal decomposition:

$$\underset{\text{Ferrous sulphate}}{2FeSO_{4(s)}} \xrightarrow{\Delta} \underset{\text{Ferric oxide}}{Fe_2O_{3(s)}} + \underset{\text{Sulphur dioxide}}{SO_{2(g)}} + \underset{\text{Sulphur trioxide}}{SO_{3(g)}}$$

(b) Decomposition by light:

$$\underset{\text{Silver chloride}}{2AgCl_{(s)}} \xrightarrow{\text{Light}} \underset{\text{Silver}}{2Ag_{(s)}} + \underset{\text{Chlorine}}{Cl_{2(g)}}$$

(c) Decomposition by electricity:

$$\underset{\text{Aluminium oxide}}{2Al_2O_{3(aq)}} \xrightarrow{\text{Electricity}} \underset{\text{Aluminium}}{4Al_{(s)}} + \underset{\text{Oxygen}}{3O_{2(g)}}$$

Question 20: What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Answer: In a displacement reaction, a more reactive element replaces a less reactive element from a compound.

$A + BX \longrightarrow AX + B;$ where A is more reactive than B

In a double displacement reaction, two atoms or a group of atoms switch places to form new compounds.

$$AB + CD \longrightarrow AD + CB$$

For example:

Displacement reaction:

$$CuSO_{4(aq)} + Zn_{(s)} \longrightarrow ZnSO_{4(aq)} + Cu_{(s)}$$

Double displacement reaction:

$$Na_2SO_{4(aq)} + BaCl_{2(aq)} \longrightarrow BaSO_{4(s)} + 2\,NaCl_{(aq)}$$

Question 21: In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Answer:

$$\underset{\text{Silver nitrate}}{2\,AgNO_{3(aq)}} + \underset{\text{Copper}}{Cu_{(s)}} \longrightarrow \underset{\text{Copper nitrate}}{Cu(NO_3)_{2(aq)}} + \underset{\text{Silver}}{2\,Ag_{(s)}}$$

Question 22: What do you mean by a precipitation reaction? Explain by giving examples.

Answer: A reaction in which an insoluble solid (called precipitate) is formed is called a precipitation reaction.

For example:

$$\underset{\text{Sodium carbonate}}{Na_2CO_{3(aq)}} + \underset{\text{Calcium chloride}}{CaCl_{2(aq)}} \longrightarrow \underset{\text{Calcium carbonate}}{CaCO_{3(s)}} + \underset{\text{Sodium chloride}}{2\,NaCl_{(aq)}}$$

In this reaction, calcium carbonate is obtained as a precipitate. Hence, it is a precipitation reaction.

Another example of precipitation reaction is:

$$\underset{\text{Sodium sulphate}}{Na_2SO_{4(aq)}} + \underset{\text{Barium chloride}}{BaCl_{2(aq)}} \longrightarrow \underset{\text{Barium sulphate}}{BaSO_{4(s)}} + \underset{\text{Sodium chloride}}{2\,NaCl_{(aq)}}$$

In this reaction, barium sulphate is obtained as a precipitate.

Question 23: Explain the following in terms of gain or loss of oxygen with two examples each.

(a) Oxidation

(b) Reduction

(a) Oxidation is the gain of oxygen.

Answer:

For example:

(i) $CO_2 + \underbrace{H_2}_{\text{Addition of oxgyen – oxidation}} \longrightarrow CO + H_2O$

(ii) $\underbrace{2Cu + O_2}_{\text{Gain of oxgyen – oxidation}} \longrightarrow 2CuO$

In equation (i), H2 is oxidized to H2O and in equation (ii), Cu is oxidised to CuO.

(b) Reduction is the loss of oxygen.

For example:

(i) $\underbrace{CO_2 + H_2}_{\text{Removal of oxgyen – reduction}} \longrightarrow CO + H_2O$

(ii) $\underbrace{CuO + H_2 \xrightarrow{\Delta}}_{\text{Loss of oxgyen – reduction}} Cu + H_2O$

In equation (i), CO2 is reduced to CO and in equation (ii), CuO is reduced to Cu.

Question 24: A shiny brown-coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Answer: 'X' is copper (Cu) and the black-coloured compound formed is copper oxide (CuO). The equation of the reaction involved on heating copper is given below.

$$\underset{\text{(Shiny brown in colour)}}{2Cu} + O_2 \xrightarrow{\text{Heat}} \underset{\text{(Black in colour)}}{2CuO}$$

Question 25: Why do we apply paint on iron articles?

Answer: Iron articles are painted because it prevents them from rusting. When painted, the contact of iron articles from moisture and air is cut off. Hence, rusting is prevented their presence is essential for rusting to take place.

Question 26: Oil and fat containing food items are flushed with nitrogen. Why?

Answer: Nitrogen is an inert gas and does not easily react with these substances. On the other hand, oxygen reacts with food substances and makes them rancid. Thus, bags used in packing food items are flushed with nitrogen gas to remove oxygen inside the pack. When oxygen is not present inside the pack, rancidity of oil and fat containing food items is avoided.

Question 27: Explain the following terms with one example each.

(a) Corrosion

(b) Rancidity

(a) Corrosion:

Answer: Corrosion is defined as a process where materials, usually metals, deteriorate as a result of a chemical reaction with air, moisture, chemicals, etc.

For example, iron, in the presence of moisture, reacts with oxygen to form hydrated iron oxide.

$$4Fe + 3O_2 + nH_2O \longrightarrow \underset{\text{Hydrated iron oxide}}{2Fe_2O_3.nH_2O}$$

This hydrated iron oxide is rust.

(b) Rancidity:

The process of oxidation of fats and oils that can be easily noticed by the change in taste and smell is known as rancidity.

For example, the taste and smell of butter changes when kept for long.

Rancidity can be avoided by:

1. Storing food in air tight containers

2. Storing food in refrigerators

3. Adding antioxidants

4. Storing food in an environment of nitrogen