3. Chemical reaction and equations

1. Choose the correct option from the bracket and explain the statement giving reason.

(1) To prevent rusting, a layer of <u>zinc</u> metal is applied on iron sheets.

Ans. The rusting of iron is an oxidation process. Due to corrosion of an iron a deposit of reddish substance ($Fe_2O_3.H_2O$)

is formed on it.This substance is called rust.To prevent corrosion,a layer of zinc metal (galvanisation) is applied on iron sheets.

(2) The conversion of ferrous sulphate to ferric sulphate is <u>an oxidation</u> reaction.

Ans. When ferric ion is formed from ferrous ion, the positive charge is increased by one unit. While this happens the ferrous ion loses one electron. A process in which a metal or its ion loses one or more electrons is called an oxidation

$2FeSO_4 \rightarrow Fe(SO_4)_3$

$Fe^{2+} + SO_4^{2-} \rightarrow 2Fe^{3+} + 3SO_4^{2-}$

Net reaction:

$Fe^{2+} \rightarrow Fe^{2+} + e^-$

Ferrous ferric

(3) When electric current is passed through acidulated water <u>decomposition</u> of water takes place.

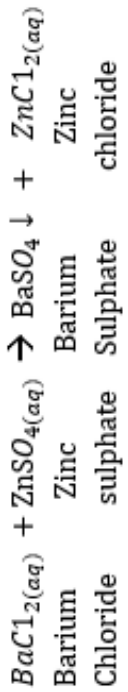
Ans. This decomposition takes place with the help of an electric current, it is also called electrolytic decomposition

$$2H_2O_{(1)} \xrightarrow{electric\ current} 2H_2 \uparrow + O_2 \uparrow$$

(4) Addition of an aqueous solution of ZnSO, to an aqueous solution of BaCl, is an example of <u>double displacement</u> reaction.

Ans.

(Rotate your phone)



Barium chloride reacts with zinc sulphate to form a white precipitate of barium sulphate. White precipitate is formed by exchange of ions Ba ++ and SO, between the reactants.

2. Write answers to the following.

a. What is the reaction called when oxidation and reduction take place simultaneously? Explain with one example.

Ans. The reaction which involes simultaneous oxidation and reduction is called an oxidation reduction or redox reaction.

In a redox reaction, one reactant gets oxidised while the other gets reduced during a reaction. Redox reaction = Reduction + Oxidation In redox reaction, the reductant is oxidized by the oxidant and the oxidant is reduced by the reductant.

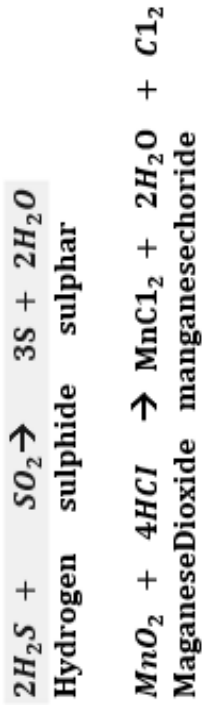
Example:

$CuO_{(8)} + H_{2(g)} \rightarrow Cu_{(8)} + H_20$

In this reaction, oxygen is removed from copper oxide therefore it is a reduction of CuO. While hydrogen accepts oxygen to form water that means oxidation of hydrogen takes place. Thus oxidation and reduction reactions occur simultaneously.

Other examples of redox reactions:

(Rotate your phone)



b. How can the rate of the chemical reaction, namely, decomposition of hydrogen peroxide be increased?

Ans. At room temperature, the decomposition of hydrogen peroxide into water and oxygen takes place slowly. However, the same reaction occurs at a faster rate on adding manganese dioxide (MnO_2), powder in it.

c. Explain the term reactant and product giving examples.

Ans. (1) The substance which undergoes bond breaking while taking port in a chemical reaction is called reactant.

(2) The substance formed as a result of a chemical reaction by formation of new bonds is called product.

(3) Example: In a chemical reaction, the formation of carbon dioxide gas takes place by combustion of coal in air. In this reaction, coal (carbon) and oxygen (from air) are the reactants while carbon dioxide is the product.

d. Explain the types of reaction with reference to oxygen and hydrogen. Illustrate with examples.

Ans. With reference to oxygen and hydrogen there are two types of reaction

(1) Oxidation reaction

(2) Reduction reaction.

e. Explain the similarity and difference in two events, namely adding NaOH to water and adding CaO to water.

Ans. Similarity: Both NaOH and CaO, when dissolved separately in water, solid NaOH dissolves releasing heat, resulting in rise in temperature. This reaction is exothermic reaction. When solid Cao dissolves in $\text{water}, Ca(OH)_2, \text{is formed},$

large amount of heat is evolved.This reaction is also exothermic reaction.
Both reactions are combination reactions and single product is obtained.
(Rotate your phone)

$$NaOH_{(s)} + H_2O \rightarrow NaOH_{(aq)} + \text{Heat}$$
$$CaO_{(s)} + H_2O \rightarrow Ca(OH)_{2(aq)} + \text{Heat}$$

Difference: (1) Aqueous solution of NaOH is considered as a strong alkali.
(2) Aqueous solution of $Ca(OH)_2$
is considered as a weak alkali.

3. Explain the following terms with examples.
a. Endothermic reaction
b. Combination reaction
c. Balanced equation
d. Displacement reaction
Ans. Remaining

4. Give scientific reasons.
a. When the gas formed on heating limestone is passed through freshly prepared lime water, the lime water turns milky.
Ans. When lime stone is heated, calcium oxide and carbon dioxide are formed. This carbon dioxide gas is passed through freshly prepared lime water, insoluble calcium carbonate and water are formed. In this reaction, lime water turns milky.
(Rotate your phone)

$$Ca(OH)_2 + CO_2 \rightarrow \underset{\text{Calcium Carbonate}}{CaCO_3} + H_2O$$

b. It takes time for pieces of Shahabad tile to disappear in HCl, but its powder disappears rapidly.

Ans. (1) The rate of a reaction depends upon the size of the particles of the reactants taking part in the reaction. The smaller the size of the reactants particles, the more is their total surface area and the faster is the rate of reaction.

(2)In the reaction of dil. HCl with pieces of Shahabad tile,

CO_2 effervescence

is formed and the tile disappears slowly.On the other hand,

CO_2 effervescence forms at

faster rate with Shahabad tile powder and it disappears rapidly.

c. While preparing dilute sulphuric acid from concentrated sulphuric acid in the laboratory, the concentrated sulphuric acid is added slowly to water with constant stirring.

Ans. (Equations)

(1) The preparation of dilute sulphuric acid falls in the category of extreme exothermic process.

(2) During the preparation of dilute sulphuric acid, large amount of water is taken in a glass container

which is surrounded by ice.Cool it for twenty minutes. Now small quantity of conc.

H_2SO_4 is added

slowly with stirring. Therefore, only a small amount of heat is liberated at a time. In this way dilute sulphuric acid is prepared.

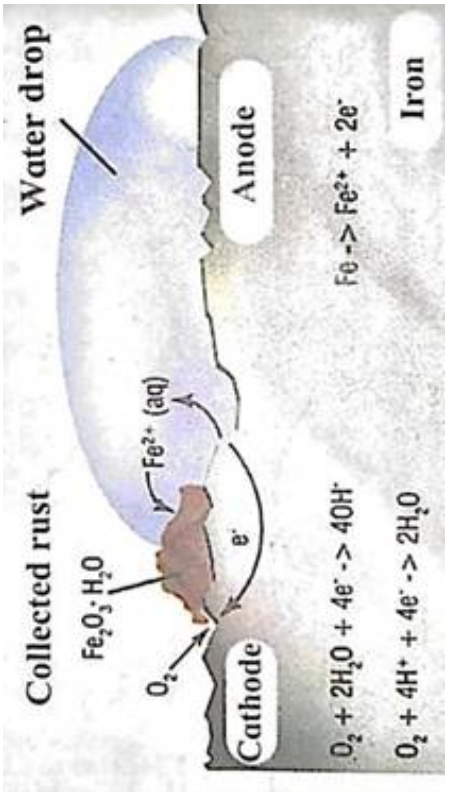
(3) On the other hand, in the process of dilution of conc. sulphuric acid with water, very large amount of heat is liberated. As a result, water gets evaporated instantaneously, if it is poured in to conc. H_2SO_4 which may cause an accident.

d. It is recommended to use air tight container for storing oil for long time.

Ans. (1) If edible oil is allowed to stand for a long time, it undergoes air oxidation, it becomes rancid and its smell and taste changes.

(2) Rancidity in the food stuff cooked in oil or ghee is prevented by using antioxidants. The process of oxidation reaction of food stuff can also be slowed down by storing it in air tight container.

5. Observe the following picture a write down the chemical reaction with explanation. (Rotate your phone)



Ans. oxygen and iron surface, The rust is formed by an electrochemical reaction. Fe oxidises to $Fe_2O_3.\ H_2O$ on one part of iron surface while oxygen gets reduced to H_2O on another part of surface. Different regions on the surface of iron become anode and cathode.

(1) Fe is oxidised to Fe^{2+} in the anode region

$$Fe_{(S)} \rightarrow Fe^{2+}{}_{(aq)} + 2e^-$$

(2) O_2 is reduced to form water in the cathode region

$$O_{2(g)} + 4H^+{}_{(aq)} + 4e^-\ 2H_2O_{(1)}$$

When Fe^{2+} ions migrate

from the anode region they react with water and futher get oxidised to form Fe^{2+}.

A reddish coloured hydrated oxide is formed from Fe^{3+}.

It is called rust. It collects on the surface.

$$Fe^{3+}{}_{(aq)} + 4H_2O_{(1)}\ Fe_2O_3.\ H_2O_{(S)} + 6H^+$$

Because of various components in the atmosphere, oxidation of metals takes place, consequently resulting in their damage. This is called 'corrosion'. Iron rusts and a reddish coloured layer is formed on it. This is corrosion of iron.

6. Identify the following reactions the reactants that undergo oxidation and reduction.

a. $\mathbf{Fe + S \rightarrow FeS}$

Ans. $Fe + S \rightarrow FeS$

In this reaction, iron (Fe) undergoes oxidation and sulphur (S) undergoes reduction.

b. $\mathbf{2Ag_2O \rightarrow 4Ag + O_2 \uparrow}$

Ans. $2Ag_2O \rightarrow 4Ag + O_2 \uparrow$

In this reaction,reduction of
$2Ag_2O$ takes place.

c. $\mathbf{2Mg + O_2 \rightarrow 2MgO}$

Ans. $2Mg + O_2 \rightarrow 2MgO$
In this reaction, oxidation of Mg takes place.

c. $\mathbf{NiO + H_2 \rightarrow Ni + H_2O}$

Ans. $NiO + H_2 \rightarrow Ni + H_2O$
In this reaction, reduction of NiO takes place and oxidation of
H_2takes place.

7. Balance the following equation stepwise.

1) $\mathbf{H_2S_2O_{7(i)} + H_2O_{(1)} \rightarrow H_2SO_{4(1)}}$

Ans. Step 1: Rewrite the given equation as it is
$H_2S_2O_{7(i)} + H_2O_{(1)} \rightarrow H_2SO_{4(1)}$

Step 2: Write the number of atoms of each element in the unbalanced equation on both sides of equations.

Element	Numbers of atoms in reactants (left side)	Number of atoms in products (right side)
H	4	2
S	2	1
O	8	4

Step 3: To equalise the number of hydrogen atoms, sulphur atoms and oxygen atoms we use 2 as the coefficient or factor in the product.

Element	Numbers of atoms in reactants (left side)	Number of atoms in products (right side)
S	4	2 × 2
O	2	1 × 2
H	8	4 × 2
Total	14	14

Now the equation becomes $H_2S_2O_7 + H_2O \quad H_2SO_4$
Now, count the atoms of each element on both sides of the equation. The number of atoms on both sides are equal. Hence, the balanced equation is
$H_2S_2O_7 + H_2O \quad H_2SO_4$
Now indicate the physical states of the reactants and products.
$H_2S_2O_{7(1)} + H_2O_{(1)} \quad H_2SO_{4(1)}$

2)

$$SO_{2(g)} + H_2S_{(aq)} \rightarrow S_{(S)} + H_2O_{(1)}$$

Ans. Step 1: Rewrite the given equation as it is

$SO_{2(g)} + H_2S_{(aq)} \rightarrow S_{(S)} + H_2O_{(1)}$

Step 2: Write the number of atoms of each element in the unbalanced equation on both sides of equations.

Element	Numbers of atoms in reactants (left side)	Number of atoms in products (right side)
S	2	1
O	2	1
H	2	2

The number of hydrogen atoms on both sides of the equation are same, therefore, equalise the number of sulphur atoms and oxygen atoms,

Step 3: To balance the number of sulphur atoms:

-	In reactants		In Products
Number of atoms of sulphur	(SO_2)	(H_2S)	(s)
Initially	1	1	1
To Balance	1	1	1 × 2

To equalise the number of sulphur atoms, we use 2 as the factor in the product, now the equation becomes $SO_2 + H_2S \rightarrow 2S + H_2O$

Step 4: To equalise the number of oxygen atoms in the unbalance equation.

Number of atoms of oxygen	In reactants (SO_2)	In Products (H_2O)
Initially	2	1
To balance	2	1 × 2

To equalise the number of hydrogen atoms we use 2 as the factor in the reactant i.e, H_2O now the unbalanced equation become

$SO_2 + H_2S \rightarrow 2S + H_2O$

Step 5: To equalize the number to hydrogen atom in unbalanced equation:

Number of atoms of hydrogen	In reactants (H_2S)	In Products (H_2O)
Initially	2	4
To balance	2 × 2	4

Now, count the atoms of each element on both sides of the equation, there are less number of sulphur atoms in the product. Now equalise the sulphur atoms, the balanced equation becomes, SO, +

$$SO_2 + 2\,H_2S \rightarrow 2S + H_2O$$

To equalize the number of hydrogen atoms we use 2 as the factor in the reactant i.e, H_2S, now the unbalanced equation become

$$SO_2 + 2H_2S \rightarrow 3S + 2\,H_2O$$

Now indicate the physical states of reactants and products.

$$SO_{2(g)} + H_2S_{(aq)} \rightarrow 3S_{(S)} + 2H_2O_{(1)}$$

3) $\boldsymbol{Ag_{(S)} + HCI_{(1)} \rightarrow Agc1 \downarrow + H_2 \uparrow}$

Ans. Step 1: Rewrite the given equation as it is Ag + HCl » AGCL + H2

$$Ag_{(S)} + HCI_{(1)} \rightarrow \text{Agc1} \downarrow + H_2$$

Step 2: Write the number of atoms of each element in the unbalanced equation on both sides of equations.

Element	Numbers of atoms in reactants (left side)	Number of atoms in products (right side)
Ag	1	1
H	1	2
CI	1	1

The number of silver and chlorine atoms on both sides of the equation are same, therefore, equalise the number of hydrogen atoms.

Step 3: To balance the number of hydrogen atoms.

Number of atoms of hydrogen	In reactants HCI	In products H_2
Initially	1	2
To balance	1 × 2	2

Equalise the number of hydrogen atoms, we use 2 as the factor in the product HCL, now the unbalanced equation become

$$Ag + 2HCI \rightarrow AgCl + H_2$$

Step 4: To balance the number of chlorine atoms:

Number of atoms of chlorine	In reactants (2HCl)	In products (AgCl)
Initially	2	1
To balance	2	2 × 1

To equalise the number of chlorine atoms, we use 2 as the factor in the product AgCl, now the unbalanced equation becomes

$$Ag + 2HCl \rightarrow 2AgCl + H_2$$

Now count the atoms of each element on both sides of the equation, there are less number of silver atoms in the reactant. Now equalise the silver atoms, the balanced equation becomes

$$2Ag + 2HCl \rightarrow 2AgCl + H_2$$

Now indicate the physical states of the reactants and products

$$2Ag_{(s)} + 2HCl_{(i)} \rightarrow 2AgCl \downarrow + H_2 \uparrow$$

4) $\boldsymbol{H_2SO_{4(aq)} + NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + H_2O_{(1)}}$

Ans. Step 1: Rewrite the given equation as it is

$$H_2SO_{4(aq)} + NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + H_2O_{(1)}$$

Step 2: Write the number of atoms of each element in the unbalanced equation on both sides of the equation.

Element	Number of atoms in reactants	Number of atoms in products
Na	1	2
S	1	1
O	5	5
H	3	2

The number of oxygen atoms involved in different compounds on both sides (reactants and products) are equal. Therefore, balance the number of atoms of the second element, sodium.

Step 3: To balance the number of sodium atoms:

Number of atoms in Sodium	In reactants	In Products
To begin with	1 (in NaOH)	$2(in\ Na_2SO_4)$
To balance	1 × 2	2

To equalise the number of sodium atoms, we use 2 as the factor of NaOH in the reactants. Now, the partly balanced equation becomes as follows:

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + H_2O$$

Step 4: Now, balance the number of hydrogen atoms:

Number of atoms of hydrogen	In reactants	In products
To begin with	$(in\ H_2SO_4)$ 2 (in NaOH)	$2(in\ H_2O)$
To balance	4	2 × 2

To equalise the number of hydrogen atoms, we use 2 as the factor of H,0 in the products. The equation then becomes

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

Now, count the atoms of each element on both sides of the equation. The number of atoms on both sides are equal. Hence, the balanced equation is

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

Now indicate the physical states of the reactants and the products.

$H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(1)}$

8. Identify the endothermic and exothermic reaction.

a. $\mathbf{HCl + NaOH \rightarrow NaCl + H_2O + Heat}$

Ans. The exothermic and the reaction

b. $\mathbf{2KCO_3(S) \xrightarrow{\Delta} 2KCl(S) + 3O_2 \uparrow}$

Ans. The exothermic and the reaction

c. $\mathbf{Cao + H_2O \rightarrow Ca(OH)_2 + Heat}$

Ans. The exothermic and the reaction

d. $\mathbf{CaCO_3(S) \xrightarrow{\Delta} CaO(S) + CO_2}$

Ans. The exothermic and the reaction

9. Match the column in the following table:

Ans.

Reactants	products
$BaCl_{2(aq)} + ZnSO_{4(aq)}$	$BaSO_2 \downarrow + ZnCl_{2(aq)}$
$2AgCl_{(S)}$	$2Ag_{(S)} + C0_{2(g)}$
$CuSO_{4(aq)} + Fe$	$FeSO_{4(aq)} + Cu_{(S)}$
$H_2O_{(i)} + C0_{2(g)}$	$H_2CO_{3(aq)}$

(table continued)

Types of chemical rection
Double displacement
Decomposition
Displacement
Combination