

Chemical Reactions

EXERCISE

Question 1.

State what is a chemical reaction. A chemical reaction is often accompanied by external indications or characteristics which include – **(a)** Colour change **(b)** Effervescence or gas evolved **(c)** Evolution or absorption of heat **(d)** Formation of a precipitate. With reference to each of the above indications, state the external indication seen during – **(i)** Addition of dilute acid to an active metal **(ii)** Addition of dilute hydrochloric acid to silver nitrate **(iii)** Addition of water to quicklime **(iv)** Thermal decomposition of mercury [II] oxide.

Answer:

Chemical reaction : "Is a chemical change in which matter changes into a new substance or substances."

1. **Addition of dil. acid to an active metal :** Gas is evolved, test tube or flask becomes hot (heat is produced).
2. **Addition of dil. hydrochloric acid to silver nitrate :** A white coloured precipitate of AgCl is seen.
3. **Addition of water to quick lime :** Hissing sound accompanied by a lot of heat (boiling).
4. **Thermal decomposition of mercury [II] oxides :** Red colour of Hg[II]O changes to silvery (Hg metal).

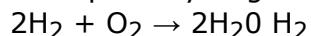
Question 2.

State why a direct combination reaction is called a – 'synthesis reaction'.

Answer:

When two or more substances [element with element or element with compound or compound with another compound] combine to form a new compound with new properties. Hence direct combination is called 'synthesis reaction'.

Example : Hydrogen (a gas) + Oxygen (a gas) combines to form water (liquid).



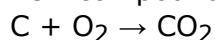
Question 3.

Differentiate between –

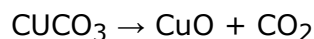
- (a)** Direct combination reaction & a decomposition reaction
- (b)** Displacement reaction & a neutralization reaction.

Answer:

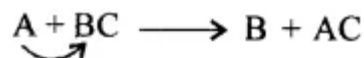
(a) Direct combination : "Is a reaction in which two elements or compound combine to give one new compound."



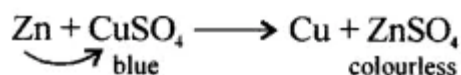
- **Decomposition reaction :** "A chemical compound (breaks up) decomposes into two or more simpler substances." Copper carbonate \rightarrow Copper oxide + carbon dioxide



(b) Displacement reaction : "A chemical reaction in which an element displaces the element from a solution of its compound."



In a activity series of metals, an element placed higher displaces the element placed below it.



Here Zn is placed above Cu in activity series of metal and is more reactive than copper has displaced Cu from copper sulphate.

- **Neutralization reaction :** "A reaction between an acid and a base to form salt and water is called neutralization reaction."

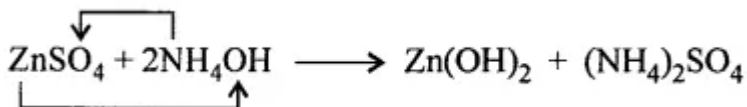


Question 4.

Classify the following reactions into – **(a)** Direct combination **(b)** Decomposition **(c)** Displacement **(d)** Double decomposition – The reactions are – **(i)** Zinc hydroxide on heating gives zinc oxide & water **(ii)** Zinc reacts with copper [II] sulphate to give zinc sulphate & copper **(iii)** Zinc sulphate reacts with ammonium hydroxide to give ammonium sulphate & zinc hydroxide **(iv)** Molten zinc at high temperatures, burns in air to give zinc oxide.

Answer:

1. Zinc hydroxide a single compound decomposes into two simpler components zinc oxide and water, hence it is decomposition reaction.
2. Zinc reacts with copper [II] sulphate to give zinc sulphate and copper is displacement reaction. Zinc being more reactive than copper displaced copper from copper sulphate.
3. Is double decomposition as exchange of ions takes place.



Question 5.

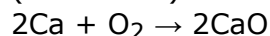
Give balanced equations for –

1. A direct combination reaction involving two elements, one of which is a non-metal
2. A thermal decomposition reaction involving heat on limestone [calcium carbonate]
3. An electrolytic decomposition reaction involving a neutral liquid
4. A displacement reaction involving a metal above hydrogen in the activity series with copper [II] sulphate solution
5. A double decomposition neutralization reaction involving an acid & a base

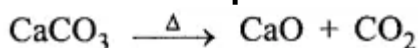
6. A white precipitate obtained during a double decomposition reaction involving a silver salt with a sodium salt.

Answer:

1. **Balanced chemical equation of :** A combination reaction between calcium and oxygen (non-metal) to form calcium oxide.

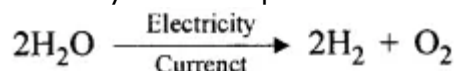


2. **Thermal decomposition of limestone :**

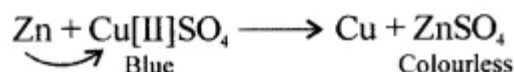


Limestone

3. Electrolytic decomposition of neutral liquid [water]



4. Displacement reaction



[more reactive displaces less reactive Cu]

5. Neutralization of acid with base to form salt and water.

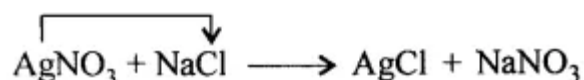


Base Hydrochloric acid Salt Water



Base Acid Salt Water

6. Double decomposition reaction



Silver nitrate
Sodium chloride
White ppt.

Question 6.

State what is meant by 'reactivity series of metals'. With reference to – **(a)** Water **(b)** Acids explain with suitable examples how the reactivity of the metals could be differentiated.

Answer:

Activity series of metals : "Is a series of arrangement of metals in decreasing order of their reactivity."

i.e. metals at top are most reactive and least reactive metals are at the bottom of the series. Metal above is more reactive than the lower metal. In other words K is more reactive than all the metals below it and Na is more reactive than all the metals below it.

(a) Action of metals with water : K, Na, Ca react with cold water.

K : Darts on water surface and react violently.

Na : Revolves on the water surface and bums.

Ca : Sinks in water, react less violently.

Hence, $K > Na > Ca$ calcium is less reactive than K and Na.

Mg and Al react with boiling water/steam.

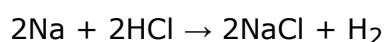
Hence, Mg and Al are less reactive than K, Na and Ca. Zn, Fe, Pb also react with steam and reaction stops soon. Fe when hot reacts with steam

This shows that $Mg > Al > Zn > Fe > Pb$.

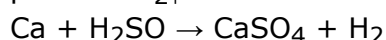
Cu, Hg, Ag, Pt, Au do not react with steam or even when hot are less reactive.

(b) Action of metals with acids : As reactivity decreases from top to bottom in metal activity series.

K and Na react with dil. HCl and dil. H_2SO_4 explosively to produce $H_2\uparrow$



Ca, Mg, Al, Zn and iron react less vigorously with decreasing vigour with dil. H_2SO_4 or dil. HCl to produce $H_2\uparrow$



Metals below hydrogen do not react with dil. acid and do not displace H_2 from it.

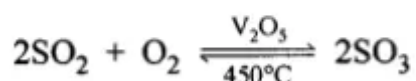
Question 7.

A chemical reaction may be 'reversible' in nature. State the meaning of the term in italics. Give a reason why a catalyst is used in certain chemical reactions. Give a r balanced equation for the following – (a) A reversible catalytic reaction involving –

1. nitrogen as one of the reactants
2. sulphur dioxide as one of the reactants.

Answer:

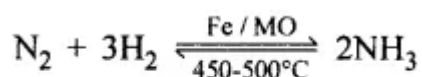
Reversible reaction : "A chemical reaction is said to be reversible in nature if "products formed react together – to form actual reactants depending on the condition of the reaction."



A catalyst is used to make the reaction fast or slow down it. When $KClO_3$ is heated, oxygen is produced but reaction is very slow. If we add MnO_2 to $KClO_3$ and heat the rate of production of oxygen becomes faster.

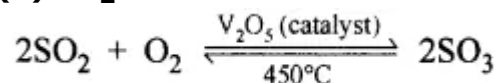
Balanced chemical equations for reversible reactions involving,

(a) Nitrogen as one of the reactants



Here iron is used as catalyst

(b) SO₂ as one of the reactants.



Question 8.

State which type of chemical reactions proceed with – **(a)** Evolution of heat energy **(b)** Absorption of heat energy. State in each of the following reactions whether heat is evolved or absorbed –
(i) water is added to quicklime **(ii)** two neutral gases on passage through an electric arc give nitric oxide **(iii)** two neutral gases combine to give – a basic gas.

Answer:

(a) Exothermic reactions.

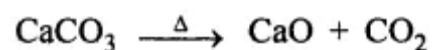
(b) Endothermic reactions.

1. When water is added to quicklime heat is evolved.
2. Nitrogen and oxygen.
3. Nitrogen gas and hydrogen gas give NH₃ (ammonia a basic gas).

Question 9.

Certain thermal decomposition reactions, result in formation of oxides. Give balanced equations for the thermal decomposition of the following, which result in formation of a metallic oxide

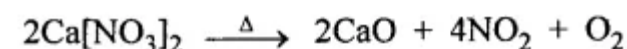
(a) Limestone



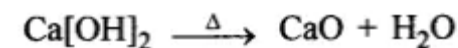
(b) Lead carbonate



(c) Calcium nitrate



(d) Calcium hydroxide.



Answer:

(a) Limestone CaCO₃ decomposes to CaO and CO₂

(b) Lead carbonate PbCO₃

(c) Calcium nitrate Ca[NO₃]₂

(d) Calcium hydroxide

Question 10.

State the meaning of the term 'oxide'. Give a balanced equation for formation of the following oxides –

- (a) Sulphur dioxide from a non-metal
- (b) Zinc oxide from a metal
- (c) Lead oxide from a mixed Oxide.

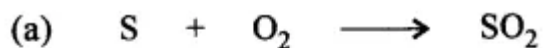
Answer:

Oxide is product obtained on combining with oxygen.

i. e. combination with oxygen.

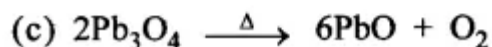
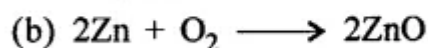
OR

Binary compounds of a metallic or non-metallic element with oxygen.



Non-metal

Sulphur



Question 11.

Give two examples each of the following oxides – (a) Acidic oxides (b) Basic oxides (c) Amphoteric oxides (d) Neutral oxides. State which of the following oxides i.e. (a) to (d) (i) React with water to give a base (ii) React with a base to give salt & water (iii) React with acids & bases to give salt & water.

Answer:

(a) Acidic oxides : Non-metallic oxides are acidic oxides.

1. SO_2
2. CO_2
3. NO_2 are acidic oxides.

(b) Basic oxides : Metallic oxides are basic oxides.

1. Na_2O
2. K_2O
3. CaO are basic oxides.

(c) Amphoteric oxides : Oxides of metals like Zn, Pb, Al are amphoteric oxides.

1. ZnO
2. PbO
3. Al_2O_3 are amphoteric oxides.

(d) Neutral oxides : Oxides like NO , CO , N_2O are neutral oxides.

1. Basic oxides react with water to give bases.
2. Acidic oxide reacts with base to give salt and water.
3. Amphoteric oxide reacts with acids and bases to give salt and water.

Question 12.

Give one example each of –

- (a) A peroxide
- (b) A mixed oxide
- (c) A dioxide.

Answer:

Examples of :

- (a) A peroxide — Na_2O_2 (Sodium peroxide)
- (b) A mixed oxide — Pb_3O_4
- (c) A dioxide – PbO_2

OBJECTIVE TYPE QUESTIONS

Q.1. Select the correct answer from A, B, C, D and E for each statement given below :

A: Iron

B: Carbonic acid

C: Hydrogen

D: Oxygen

E: Carbon monoxide

Question 1.

The product formed during direct combination reaction of carbon dioxide & water.

Answer:

B: Carbonic acid

Question 2.

The neutral gas obtained on thermal decomposition of potassium nitrate.

Answer:

D: Oxygen

Question 3.

The displaced product of the displacement reaction of sodium with cold water.

Answer:

C: Hydrogen

Question 4.

The catalyst used in the catalytic reaction involving the reactants nitrogen & hydrogen.

Answer:

A: Iron

Question 5.

A neutral oxide which does not react with an acid or a base to give salt & water.

Answer:

E: Carbon monoxide

Q.2. Complete the statements by filling in the blank with the correct word/s :

Question 1.

Direct combination reaction of phosphorus pentoxide with water gives ____ [$\text{H}_3\text{PO}_3/\text{H}_3\text{PO}_4$].

Answer:

Direct combination reaction of phosphorus pentoxide with water gives **H_3PO_4** .

Question 2.

Decomposition of silver salts in the presence of sunlight is an example of ____ [double decomposition/photochemical decomposition].

Answer:

Decomposition of silver salts in the presence of sunlight is an example of **photochemical decomposition**.

Question 3.

The element molybdenum used in the reaction of nitrogen with hydrogen at elevated temperatures is an example of a ____ [promoter/catalyst].

Answer:

The element molybdenum used in the reaction of nitrogen with hydrogen at elevated temperatures is an example of a **promoter**.

Question 4.

The reaction of coke with steam to give water gas is an example of an ____ [exothermic/endothermic] reaction.

Answer:

The reaction of coke with steam to give water gas is an example of an **endothermic** reaction.

Question 5.

The metal which reacts with steam and the reaction is reversible is ____ [calcium/iron].

Answer:

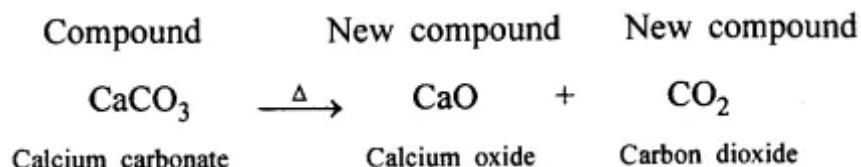
The metal which reacts with steam and the reaction is reversible is **iron**.

Q.3. Give a balanced equation for each of the following types of reactions :

Question 1.

A thermal decomposition reaction in which a compound decomposes to give two new compounds.

Answer:

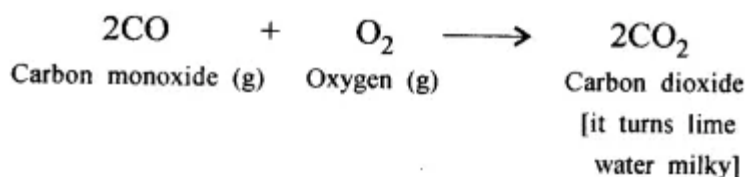


Question 2.

A reaction of direct combination i.e. synthesis in which two gases combine to give another gas – which turns lime water milky.

Answer:

Synthesis when two gases combine to give a gas which turns lime water milky.

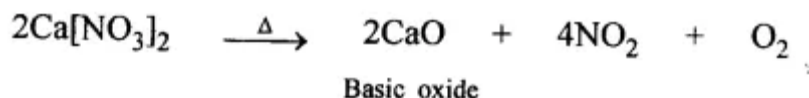


Question 3.

A thermal decomposition reaction in which a metallic nitrate decomposes to give – a basic oxide.

Answer:

Metallic nitrate is calcium nitrate on thermal decomposition gives CaO which is a basic oxide.

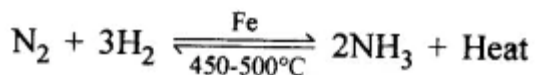
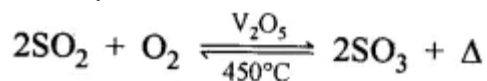


Question 4.

A catalytic, reversible, exothermic reaction.

Answer:

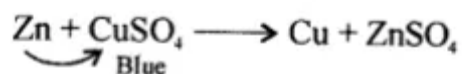
A catalytic, reversible, exothermic reaction.



Question 5.

A displacement reaction in which a metal above hydrogen in the reactivity series, displaces another metal from the solution of its compound.

Answer:



Q.4. Differentiate between the following :

Question 1.

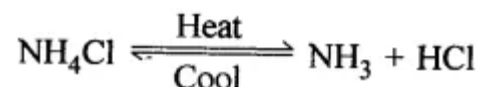
Thermal decomposition & thermal dissociation.

Answer:

Thermal decomposition and thermal dissociation.

Decomposition of a compound on heating into two elements or element and compound or into two new compounds. It is irreversible reaction.

Thermal dissociation is the decomposition of a substance into two or more simpler substances on heating but reaction is reversible.



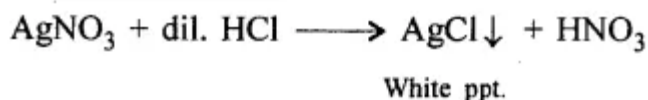
Question 2.

Neutralization reaction & a precipitation reaction.

Answer:

Formation of salt and water when an acid reacts with a base is called neutralisation.

- **Precipitation** : Formation of semi solid (insoluble) product is called precipitation.

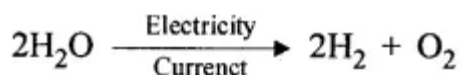


Question 3.

Electrolytic decomposition & photochemical decomposition.

Answer:

- **Electrolytic decomposition** : "A decomposition reaction which is brought about by – passage of electric current."



- **Photochemical decomposition** : "A decomposition reaction which takes place in presence of light."
e.g. decomposition of silver salts in presence of sun light.

Question 4.

A catalyst & a promoter.

Answer:

- **Catalyst** : "A substance which alters the rate of chemical reaction."
e.g. MnO_2 , V_2O_5 , Fe, Pt. etc.
- **The positive catalyst** : A catalyst which speeds up the reaction.

- **Negative catalyst** : A catalyst which reduces the rate of reaction, e.g. alcohol. Enzymes are biological catalysts present in human body and accelerate the biochemical reactions in the body.
- **Promoters** is a catalyst to catalyst, i.e. a substance which increases the activity of a catalyst.
Molybdenum [MO] is added to the catalyst iron [Fe] to increase its efficiency.

Question 5.

An acidic oxide & a basic oxide.

Answer:

- **Acidic oxide** : Non-metal oxide is called acidic oxide i.e. SO_2 , NO_2 when acidic oxide dissolves in water forms acid.
- **Basic oxide** : Metallic oxide is called basic oxide, e.g. CaO , Na_2O basic oxide dissolved in water is called alkali.

Q.5. Match the chemical reactions in List I with the appropriate answer in List II.

List I	List II
1. $\text{XY} \xrightleftharpoons{\text{heat}} \text{X} + \text{Y}$	A: Displacement reaction
2. $\text{XY} \rightarrow \text{X} + \text{Y}$	B: Double decomposition
3. $\text{X}^+\text{Y}^- + \text{A}^+\text{B}^- \rightarrow \text{X}^+\text{B}^- + \text{A}^+\text{Y}^-$	C: Endothermic reaction
4. $\text{X} + \text{YZ} \rightarrow \text{XZ} + \text{Y}$	D: Thermal dissociation
5. $\text{X} + \text{Y} \xrightarrow{\text{heat}} \text{XY} - \Delta$	E: Decomposition reaction

Answer:

List I	List II
1. $\text{XY} \xrightleftharpoons{\text{heat}} \text{X} + \text{Y}$	D: Thermal dissociation
2. $\text{XY} \rightarrow \text{X} + \text{Y}$	E: Decomposition reaction
3. $\text{X}^+\text{Y}^- + \text{A}^+\text{B}^- \rightarrow \text{X}^+\text{B}^- + \text{A}^+\text{Y}^-$	B: Double decomposition
4. $\text{X} + \text{YZ} \rightarrow \text{XZ} + \text{Y}$	A: Displacement reaction
5. $\text{X} + \text{Y} \xrightarrow{\text{heat}} \text{XY} - \Delta$	C: Endothermic reaction