

Chapter 1: Chemical Reactions and Equations

Q1) Why should a Magnesium ribbon be cleaned before burning in air?

Soln: When left unused, the outer layer of Magnesium metal reacts with the atmospheric oxygen and forms Magnesium Oxide (MgO) layer which is a very stable compound thus preventing further reactions with Oxygen. It is therefore necessary to clean the ribbon by brushing it to remove the layer of MgO so that the reaction becomes feasible with the atmospheric oxygen.

Q2) Write a balanced equations for the following chemical reactions.

i) Hydrogen + Chloride \rightarrow Hydrogen chloride

ii) Barium chloride + Aluminium Sulphate \rightarrow Barium sulphate + Aluminum chloride

iii) Sodium + Water \rightarrow Sodium hydroxide + Hydrogen

Soln:



Q3) Write a balanced chemical equation with state symbols for the following reactions

i) Solutions of Barium chloride and Sodium sulfate in water react to give insoluble Barium sulfate and solution of Sodium chloride.

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

Soln:



Q4) A solution of a substance 'X' is used for whitewashing.

i) Name the substance 'X' and write its formula.

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

Soln:

i) The substance 'X' which is used in whitewashing is quick lime or **Calcium Oxide** and its formula is **CaO**.

ii) $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$

Q5) Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Soln:

When an iron nail is dipped in the copper sulphate solution, the iron displaces copper from the copper sulphate because iron is more reactive than copper. Therefore the colour of the copper sulphate solution changes. The reaction is :

$\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$

Q6) Identify the substances that are oxidized and that are reduced in the following equation.

i) $4\text{Na}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{Na}_2\text{O}(\text{s})$

ii) $\text{CuO}(\text{s}) + \text{H}_2(\text{g}) \rightarrow \text{Cu}(\text{s}) + \text{H}_2\text{O}(\text{l})$

Soln:

The Sodium (Na) in the first equation is getting oxidized with the addition of Oxygen (O_2) and the Copper (Cu) in the second equation is reduced since the addition of Hydrogen (H_2).

Exercise:

Q1) Which of the statements about the reaction below are incorrect?

$2\text{PbO}(\text{s}) + \text{C}(\text{s}) \rightarrow 2\text{Pb}(\text{s}) + \text{CO}_2(\text{g})$

(a) Lead is getting reduced

(b) Carbon Dioxide is getting oxidised

(c) Carbon is getting oxidised

(d) Lead oxide is getting reduced

(i) (a) and (b)

(ii) (a) and (c)

(iii) (a), (b) and (c)

(iv) all

Soln:

(i) (a) and (b)

Explanation: (a) because Oxygen is being removed and (b) because the removed oxygen from Lead is added to the elemental Carbon.

Q2) $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$

The above reaction is an example of a

1. **Combination reaction.**
2. **Double displacement reaction.**
3. **Decomposition reaction.**
4. **Displacement reaction.**

Soln:

4. Displacement reaction.

Explanation: The Oxygen from the Ferrous oxide is getting displaced to the Aluminium metal to form Aluminium Oxide.

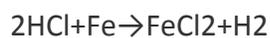
Q3) What happens when dilute hydrochloric acid is added to iron fillings? Tick the correct answer.

1. **Hydrogen gas and Iron chloride are produced.**
2. **Chlorine gas and Iron hydroxide are produced.**
3. **No reaction takes place.**
4. **Iron salt and water are produced.**

Soln:

1. Hydrogen gas and Iron chloride are produced.

Explanation: The Chlorine from the Hydrogen chloride is displaced to the Iron fillings undergoing the following reaction.



Q4) What is a balanced chemical equation? Why should a chemical equation be balanced?

Soln:

A balanced chemical equation is the one in which the number of different atoms on both the sides of the chemical equation that is on the reactant side and the product side of a reaction are equal. The chemical equation needs to be balanced so that it obeys the Law Of Conservation of Mass. Balancing of chemical equation has no defined method and is purely a trial and error attempt.

Q5) Translate the following statements into chemical equations and 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.

Soln:

(a) Unbalanced: $\text{H}_2 + \text{N}_2 \rightarrow \text{NH}_3$

Balanced: $3\text{H}_2 + \text{N}_2 \rightarrow 2\text{NH}_3$

(b) Unbalanced: $\text{H}_2\text{S} + \text{O}_2 \rightarrow \text{H}_2\text{O} + \text{SO}_2$

Balanced: $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{H}_2\text{O} + 2\text{SO}_2$

(c) Unbalanced: $\text{BaCl}_2 + \text{Al}_2(\text{SO}_4)_3 \rightarrow \text{AlCl}_3 + \text{BaSO}_4$

Balanced: $3\text{BaCl}_2 + \text{Al}_2(\text{SO}_4)_3 \rightarrow 2\text{AlCl}_3 + 3\text{BaSO}_4$

(d) Unbalanced: $\text{K} + \text{H}_2\text{O} \rightarrow \text{KOH} + \text{H}_2$

Balanced: $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$

Q6) Balance the following chemical equations.

1. $\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$

2. $\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$

3. $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$

4. $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{HCl}$

Soln:

1. $2\text{HNO}_3 + 2\text{Ca}(\text{OH})_2 \rightarrow 2\text{Ca}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$

2. $6\text{NaOH} + 3\text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{SO}_4 + 6\text{H}_2\text{O}$

3. $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$
4. $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl}$

Q7) Write the balanced chemical equation for the following reactions.

1. **Calcium hydroxide + Carbon dioxide \rightarrow Calcium carbonate + Water**
2. **Zinc + Silver nitrate \rightarrow Zinc nitrate + Silver**
3. **Aluminium + Copper chloride \rightarrow Aluminium chloride + Copper**
4. **Barium chloride + Potassium sulphate \rightarrow Barium sulphate + Potassium chloride**

Soln:

1. $2\text{Ca}(\text{OH})_2 + 2\text{CO}_2 \rightarrow 2\text{CaCO}_3 + 2\text{H}_2\text{O}$
2. $\text{Zn} + 2\text{AgNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + 2\text{Ag}$
3. $2\text{Al} + 3\text{CuCl}_2 \rightarrow 2\text{AlCl}_3 + 3\text{Cu}$
4. $\text{BaCl}_2 + \text{K}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{KCl}$

Q8) Write a balanced chemical equation for the following and identify the type of reaction of each case

1. $\text{KBr} + \text{BaI}_2 \rightarrow \text{KI} + \text{BaBr}_2$
2. $\text{ZnCO}_3 \rightarrow \text{ZnO} + \text{CO}_2$
3. $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$
4. $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$

Soln:

1. $2\text{KBr} + \text{BaI}_2 \rightarrow 2\text{KI} + \text{BaBr}_2$ (Double Displacement Reaction)
2. $\text{ZnCO}_3 \rightarrow \text{ZnO} + \text{CO}_2$ (Decomposition Reaction)
3. $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ (Combination Reaction)
4. $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ (Displacement Reaction)

Q9) What is meant by exothermic and endothermic reactions? Give examples.

Soln:

An **endothermic** reaction occurs when energy is absorbed from the surroundings in the form of heat. (Example: Photosynthesis, melting of ice, evaporation). Conversely, an **exothermic** reaction is one in which energy is released from the system into the surroundings. (Example: Explosions, concrete setting, nuclear fission and fusion).

Q10) Why is respiration considered to be an exothermic reaction?

Soln:

For the survival of life we require energy. We obtain this energy from the food we eat. The food molecules, through the process of digestion is broken down into simpler molecule like glucose. These substances come in contact with the Oxygen present in our body cells to form Carbon dioxide and water along with a certain amount of energy (Respiration process). Since the energy is in the form of heat (that maintains our body temperature) the respiration is considered to be an exothermic reaction. The reaction taking place is:



Q11) Why are decomposition reactions called the opposite of Combination reactions? Write equations for decomposition reactions.

Soln:

Combination reaction is said to be the reaction between two or more molecules to form a larger molecule whereas the decomposition reaction is defined as the splitting of a larger molecules into two or more smaller molecules. That essentially explains that the decomposition reaction is the opposite of the combination reaction.

In most of the cases the decomposition reaction is endothermic since heat from the surrounding or induced heat is used to break the bonds of the larger molecule. Few examples of decomposition reactions are:

- $ZnCO_3 \rightarrow ZnO + CO_2$
- $CaCO_3 + \text{Energy} \rightarrow CaO + CO_2$
- $2HgO \rightarrow 2Hg + O_2$

Q12) Write one equation each for decomposition reactions in which energy is supplied in the form of heat, light or electricity.

Soln:

(a) Thermal decomposition reaction (Thermolysis)

Decomposition of potassium chlorate: When heated strongly, potassium chlorate decomposes into potassium chloride and oxygen. This reaction is used for the preparation of oxygen.



(b) Electrolytic decomposition reaction (Electrolysis)

Decomposition of sodium chloride: On passing electricity through molten sodium chloride, it decomposes into sodium and chlorine.



(c) Photodecomposition reaction (Photolysis)

Decomposition of hydrogen peroxide: In the presence of light, hydrogen peroxide decomposes into water and oxygen



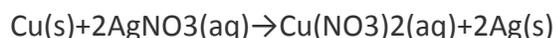
Q13) What is the difference between displacement and double displacement reactions? Write relevant equations for the above.

Soln:

- A displacement reaction is the one when a more reactive substance displaces a less reactive one from its salt solution whereas a double displacement reaction is the one where a mutual exchange of ions happens between two compounds.
- In a displacement reaction only a single displacement takes place whereas in the double displacement reaction, as the name suggests two displacement takes place between the molecules.
- Example:
- Displacement reaction
$$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$$
- Double displacement reaction
$$2\text{KBr} + \text{BaI}_2 \rightarrow 2\text{KI} + \text{BaBr}_2$$

Q14) In the refining of Silver, the recovery of silver from Silver nitrate solution involves displacement reaction by Copper metal. Write down the reaction involved.

Soln:



Q15) What do you mean by precipitation reaction? Explain by giving examples.

Soln:

When two solutions containing soluble salts are combined, a double displacement reaction takes place in which the ions are exchanged between the compounds. When one of such compound formed is in solid form (that is insoluble in aqua) then it settles down at the bottom of the container. This solid is known as the precipitate and the respective reaction is termed as the precipitation reaction. Few examples of precipitation reactions are:

- $\text{CdSO}_4(\text{aq}) + \text{K}_2\text{S}(\text{aq}) \rightarrow \text{CdS}(\text{s}) + \text{K}_2\text{SO}_4(\text{aq})$
- $2\text{NaOH}(\text{aq}) + \text{MgCl}_2(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{Mg}(\text{OH})_2(\text{s})$

Q16) Explain the following in terms of gain of oxygen with two examples each.

(a) Oxidation

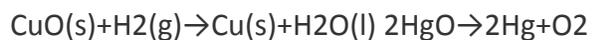
(b) Reduction

Soln:

(a) In a chemical reaction, when the oxygen is added to the element to form its respective oxide it is the element being oxidised. Example:



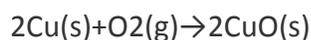
(b) In a chemical reaction, when the oxygen is being removed from the compound then it is said to be reduced. Example:



Q17) A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Soln:

The shiny brown coloured element is the Copper metal(Cu). When the metal is heated in air, it reacts with the atmospheric oxygen to form copper oxide. Hence the black coloured compound is the copper oxide.



Q18) Why do we apply paint on iron articles?

Soln:

Iron articles are painted to prevent them from rusting. When left unpainted, the metal surface comes in contact with the atmospheric oxygen and in the presence of moisture it forms Iron(III) oxide. But if painted the surface does not come in contact with moisture and air thus preventing rusting.

Q19) Oil and Fat containing food items are flushed with Nitrogen. Why?

Soln:

The main purpose of flushing Nitrogen into food packets that contain oil and fat items is to prevent Rancidity which occurs when the oil or fat reacts with the oxygen letting out an unpleasant smell and taste. Therefore by flushing Nitrogen, an unreactive surrounding is created thus preventing rancidity.

Q20) Explain the following terms with one example each.

(a) Corrosion

(b) Rancidity

Soln:

(a) Corrosion is a process where a refined metal is oxidised by the atmospheric oxygen to form a more stable compound such as oxides. The metal gradually degrades during the corrosion process. **Rusting** of iron is a good example of corrosion where the iron is converted to Iron oxide. Millions of dollars are spent annually to prevent rusting from bridges and other monuments.

(b) The condition produced by the aerial oxidation of the oil and fat present in the food material that produces an unpleasant taste and smell. The rancidity is retarded when the food is kept inside the refrigerator since the low temperature does not promote the oxidation reaction.