

# 1

## Chemical Reactions and Equations

### In the Chapter

- A complete chemical equation represents the reactants, products and their physical states symbolically.
- A chemical equation is balanced such that the numbers of atoms of each type involved in a chemical reaction are the same on the reactant and product sides of the equation. Equations must always be balanced.
- In a combination reaction two or more substances combine to produce a new single substance.
- Decomposition reactions are opposite to combination reactions. In a decomposition reaction, a single substance decomposes to form two or more substances.
- Reactions in which heat formed along with the products are known as exothermic reactions.
- Reactions in which energy is absorbed are called as endothermic reactions.
- When element displaces another element from its compound, a displacement reaction takes place.
- Two different atoms or groups of atoms (ions) are exchanged in double displacement reactions.
- Precipitation reactions form insoluble salts.
- Reactions also involve the loss or gain of hydrogen or oxygen by substances. Oxidation is the gain of oxygen or loss of hydrogen. Reduction is the loss of oxygen or gain of hydrogen.

### Intext Exercises

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

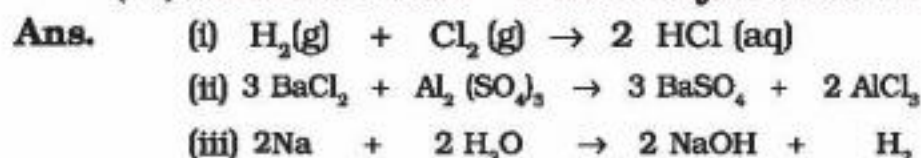
**Ans.** Magnesium ribbon should be cleaned to remove the dust particles found at the upper surface so that the surface comes directly in contact with air.

2. **Write the balanced equation for the following chemical reactions.**

(i) **Hydrogen + Chlorine  $\rightarrow$  Hydrogen chloride**

(ii) Barium chloride + Aluminium sulphate  $\rightarrow$  Barium sulphate + Aluminium chloride

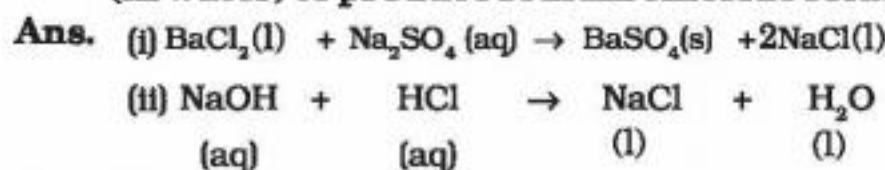
(iii) Sodium + Water  $\rightarrow$  Sodium hydroxide + Hydrogen



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.



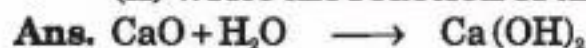
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1. A solution of a substance 'X' is used for white washing.

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

**Ans.** The substance X is lime which is used for white-washing. Its chemical formula is CaO.

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



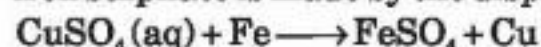
2. Why is the amount of gas collected in one of the test tubes in Activity 1.7 double of the amount collected in the other? Name this gas.

**Ans.** The gas collected in one of the test tubes is double because it is hydrogen gas and the other test tube has oxygen. These two gases are produced by the electrolysis of water. The volume of hydrogen is double than that of oxygen in water.

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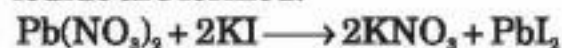
1. Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

**Ans.** The colour of copper sulphate solution is changed when an iron nail is dipped in it because iron sulphate is made by the displacement of copper by iron.



2. Give an example of a double displacement reaction other than the one given in Activity 1.10.

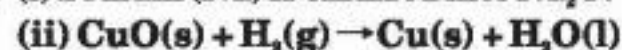
**Ans.** When lead II nitrate is mixed with potassium iodide, then potassium nitrate and lead iodide are formed.



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



**Ans.** (i) Sodium (Na) is oxidised into  $\text{Na}_2\text{O}$ .



**Ans.** (ii) CuO (copper oxide) is reduced into Cu, while  $\text{H}_2$  (Hydrogen) is oxidised into water ( $\text{H}_2\text{O}$ ).



### Exercise

1. 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

Ans. (i) a and b.

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

The above reaction is an example of a

- (a) combination reaction.  
 (b) double displacement reaction.  
 (c) decomposition reaction.  
 (d) displacement reaction.

Ans. (d) displacement reaction.

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

- (a) Hydrogen gas and iron chloride are produced.  
 (b) Chlorine gas and iron hydroxide are produced.  
 (c) No reaction takes place.  
 (d) Iron salt and water are produced.

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

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

Ans. When the number of atoms of different elements on both sides of a chemical equation are equal, it is known as balanced equation. Chemical equations should be balanced because a balanced chemical equation gives us the actual information about the equation and actual number of products and reactants.

5. Translate the following statements into chemical equations and then balance them.

- (a) Hydrogen gas combines with nitrogen to form ammonia.

Ans.  $\text{N}_2\text{(g)} + 3\text{H}_2\text{(g)} \rightarrow 2\text{NH}_3\text{(g)}$

- (b) Hydrogen sulphide gas burns in air to give water and sulphur dioxide.

Ans.  $2\text{H}_2\text{S(g)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O(l)} + 2\text{SO}_2\text{(g)}$

- (c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.

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

- (d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

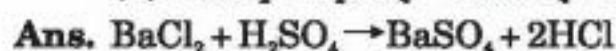
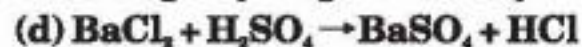
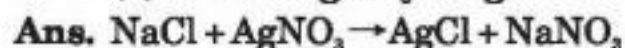
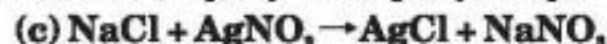
Ans.  $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2\text{(g)}$

6. Balance the following chemical equations.

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

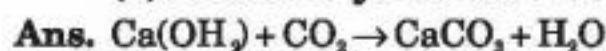
Ans.  $2\text{HNO}_3 + \text{Ca(OH)}_2 \rightarrow \text{Ca(NO}_3)_2 + 2\text{H}_2\text{O}$

- (b)  $\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$

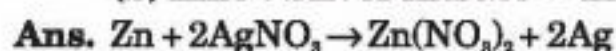


7. Write the balanced chemical equations for the following reactions.

(a) Calcium hydroxide + Carbon dioxide  $\rightarrow$  Calcium carbonate + Water



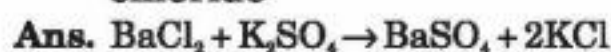
(b) Zinc + Silver nitrate  $\rightarrow$  Zinc nitrate + Silver



(c) Aluminium + Copper chloride  $\rightarrow$  Aluminium chloride + Copper

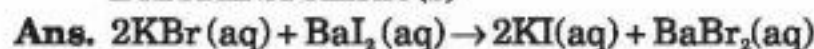


(d) Barium chloride + Potassium sulphate  $\rightarrow$  Barium sulphate + Potassium chloride

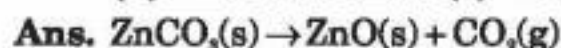


8. Write the balanced chemical equation for the following and identify the type of reaction in each case.

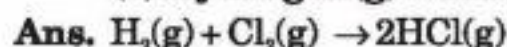
(a) Potassium bromide(aq) + Barium iodide(aq)  $\rightarrow$  Potassium iodide(aq) + Barium bromide(s)



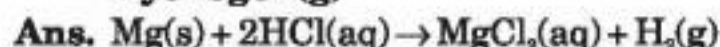
(b) Zinc carbonate(s)  $\rightarrow$  Zinc oxide(s) + Carbon dioxide(g)



(c) Hydrogen(g) + Chlorine(g)  $\rightarrow$  Hydrogen chloride(g)



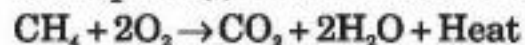
(d) Magnesium(s) + Hydrochloric acid(aq)  $\rightarrow$  Magnesium chloride(aq) + Hydrogen(g)



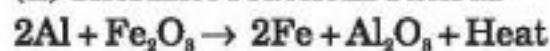
9. What does one mean by exothermic and endothermic reactions? Give examples.

**Ans. Exothermic reactions :** Those reactions in which energy is released are known as exothermic reactions.

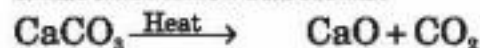
Examples : (i) All combustion reactions such as



(ii) Thermite reactions such as



**Endothermic reactions :** Those reactions in which energy is utilised are known as endothermic reactions.



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

**Ans.** In respiration, food is broken in the presence of oxygen inhaled. In this process, energy is liberated. So respiration is known as an exothermic reaction.



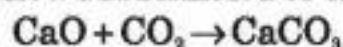
11. Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

**Ans.** Decomposition reactions are those reactions in which a compound is broken into two or more new compounds. For example –





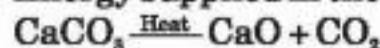
Combination reactions are those reactions in which two substances are combined to make a new substance. For example –



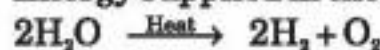
In above example, both the reactions are same but show opposite directions, so decomposition reaction is known as the opposite of combination reactions.

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

**Ans.** Energy supplied in the form of heat :

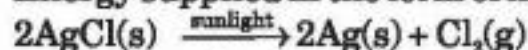


Energy supplied in the form of electricity :



(Electrolysis of water)

Energy supplied in the form of light :



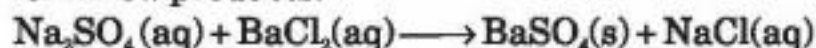
- 13. What is the difference between displacement and double displacement reactions?**

**Write equations for these reactions.**

**Ans.** In displacement reaction, one element from its salt is displaced by a more reactive element. For instance Cu is displaced by Zn from  $\text{CuSO}_4$  as Zn is more reactive.

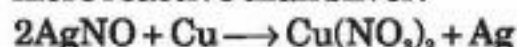


In double displacement reaction, exchange of ions takes place between two reactants to form new products.



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

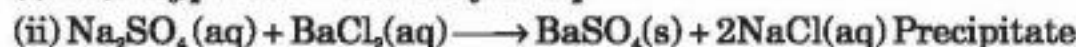
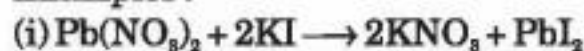
**Ans.** When copper is mixed in silver nitrate solution then it displaces the silver because it is more reactive than silver.



- 15. What do you mean by a precipitation reaction? Explain by giving examples.**

**Ans.** The reactions in which a precipitate is formed are known as precipitation reactions.

Examples :

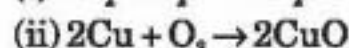
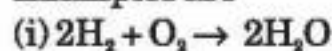


- 16. Explain the following in terms of gain or loss of oxygen with two examples each.**

**(a) Oxidation (b) Reduction**

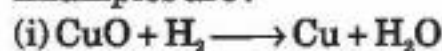
**Ans. (a) Oxidation :** The reactions in which gain of oxygen takes place are known as oxidation.

Examples are

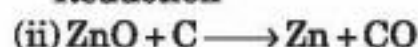


**(b) Reduction :** The reactions in which loss of oxygen takes place are known as reduction.

Examples are :



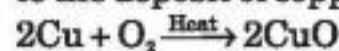
Reduction



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



**Ans.** The shiny brown coloured element X is copper. When it is heated in air, it turns black due to the deposit of copper oxide.



Brown      Black

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

**Ans.** We use paint on iron articles to protect these from corrosion. Paint disconnects the relation between iron and air or water.

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

**Ans.** Fat and oil containing food items are flushed with nitrogen to prevent them from damage. When these items come in contact of air, then they get oxidised and become rancid. Their taste and smell change.

**20. Explain the following terms with one example each.**

(a) Corrosion

(b) Rancidity

**Ans.** (a) **Corrosion** : The process of damaging or chemically eaten up the surface of some metals when they are left for some time in moist air is known as corrosion.

Conditions of corrosion are :

(i) Presence of air

(ii) Presence of moisture (water)

Example : Rusting of iron.

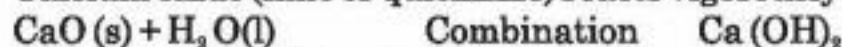
(b) **Rancidity** : When oils and fats are oxidised, they become rancid and their taste and smell change. This phenomenon is known as rancidity.

### Additional Questions

**1. Define a combination reaction. Give one example of combination which is also exothermic.**

**Ans.** This reactions in which two or more substances combine to form a single substance, are called combination reactions.

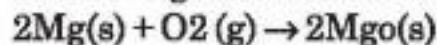
Calcium oxide (lime or quicklime) reacts vigorously with water to form calcium hydroxide.



A large amount of heat is released when calcium oxide reacts with water to form calcium hydroxide. Therefore, this combination is also exothermic.

**2. What do you observe when a magnesium ribbon is burnt in air? Is magnesium oxidised or reduced in this reaction? Justify your answer.**

**Ans.** When magnesium ribbon is burnt in air, it gives intense heat and light to form a basic oxide called magnesium oxide which is a white powder.



Magnesium is oxidised in this reaction because there is addition of oxygen to magnesium.

**3. Give reason**

(i) A magnesium ribbon should be cleaned before burning it in air

(ii) The blue colour of copper sulphate solution changes when iron nails are dipped in it.

**Ans.** (i) Magnesium ribbon should be cleaned before burning it in air because the oxide layer deposited over the magnesium ribbon makes it passive and as such difficult to ignite.

(ii) The blue colour of copper sulphate turns light green due to the formation of ferrous sulphate.

**4. Write balanced equation for the reactions of**

(a) iron with steam



**(b) calcium with water**

**Ans.** (a)  $3\text{Fe(s)} + 4\text{H}_2\text{O(g)} \rightarrow \text{Fe}_3\text{O}_4\text{(s)} + 4\text{H}_2\text{(g)}$

(b)  $\text{Ca(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Ca(OH)}_2\text{(aq)} + \text{H}_2\text{(g)}$

**5. Respiration is considered an exothermic reaction. Explain why?**

**Ans.** The food that we eat like rice, potato bread, etc., contain carbohydrates. On digestion, carbohydrates are converted to glucose. During respiration, the air we breathe in, oxidizes the glucose into carbon dioxide, water and heat which provides our body sufficient energy.

**6. Using a suitable equation justify that some chemical reactions are determined by**

(i) **Change in colour**

(ii) **Change in temperature**

**Ans.** (i) The chemical reaction between citric acid and purple-coloured potassium permanganate solution is characterized by a change in colour from purple to colourless.

(ii) The chemical reaction between quick lime and water to form slaked lime is characterised by a change in temperature which is rise in temperature.

**7. A zinc plate was put into a solution of copper sulphate kept in glass container. It was found that blue colour of this solution gets fader and fader with the passage of time. After few days when zinc plate was taken out of the solution, a number of holes were observed on it.**

(i) **State the reason for changes observed on the zinc plate.**

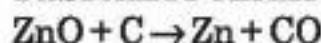
(ii) **Write the chemical equation for the reaction involved.**

**Ans.** (i) Zinc is more reactive than copper, so when zinc plate was put into a solution of copper sulphate, zinc gets dissolved. This causes holes in the zinc plate.

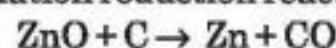
(ii)  $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$

The Blue colour of  $\text{CuSO}_4$  solution fades gradually due to the formation of colourless zinc sulphate solution.

**8. What is an oxidation reduction reaction. Identify in the following reaction the substance oxidised and the substance reduced.**



**Ans.** Oxidation reduction reaction is that in which oxidation and reduction occur together.



(i) In this reaction  $\text{ZnO}$  is losing oxygen and being reduced.

(ii) Carbon is gaining oxygen and is being oxidised.

**9. Write any two preventive measures used to prevent food stuff to get rancid.**

**Ans.** (i) Rancidity can be retarded by keeping food in refrigerator.

(ii) Rancidity can be retarded by storing food in air-tight containers.

**10. A small amount of ferrous sulphate crystals were heated in a hard glass test tube.**

(i) **Write the equation involved in the above reaction.**

(ii) **Name the type of reaction that take place.**

**Ans.** (i)  $2\text{FeSO}_4\text{(s)} \rightarrow \text{Fe}_2\text{O}_3\text{(s)} + \text{SO}_2\text{(g)} + \text{SO}_3\text{(g)}$

(ii) This is a decomposition reaction.

**11. Why do fire flies glow at night?**

**Ans.** Fire flies have a protein which in the presence of an enzyme undergo aerial oxidation. This is a chemical reaction which involves emission of visible light. Therefore, fire flies glow at night.

**12. Grapes hanging on the plant do the ferment but after being plucked from the plant can be fermented. Under what conditions do these grapes ferment? Is it a chemical or a physical change?**



**Ans.** Grapes when attached to the plants are living and therefore their own immune system prevents fermentation. The microbes can grow in the plucked grapes and under anaerobic conditions these can be fermented. This is a chemical change.

### Multiple Choice Questions

1. Which of the following is not a physical change?

- (a) Boiling of water to give water vapour
- (b) Melting of ice to give water
- (c) Dissolution of salt in water
- (d) Combustion of liquefied petroleum gas (LPG)

**Ans.** (d) Combustion of liquefied petroleum gas (LPG)

2. Which of the following are exotherm processes?

- (i) Reaction of water with quicklime
  - (ii) Dilution of an acid
  - (iii) Evaporation of water
  - (iv) Sublimations of camphor (crystals)
- (a) (i) and (ii)      (b) (ii) and (iii)  
(c) (iii) and (iv)    (d) (iii) and (iv)

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

3. Which among the following statement(s) is/are true? Exposure of silver chloride to sunlight for a long duration turns grey due to:

- (i) the formation of silver by decomposition of silver chloride.
  - (ii) sublimation of silver chloride
  - (iii) decomposition of chlorine gas from silver chloride
  - (iv) oxidation of silver chloride
- (a) (i) only      (b) (i) and (iii)  
(c) (ii) and      (d) (iv) only

**Ans.** (a) (i) only

4. Solid calcium oxide reacts vigorously with water to form calcium hydroxide accompanied by liberation of heat. This process is called slaking of lime. Calcium hydroxide dissolves in water to form its solution called lime water. Which among the following is/are true about slaking of lime and the solution formed?

- (i) It is an endothermic reaction.
  - (ii) It is an exothermic reaction.
  - (iii) The pH of the resulting solution will be more than seven.
  - (iv) The pH of the resulting solution will be less than seven.
- (a) (i) and (ii)      (b) (ii) and (iii)  
(c) (i) and (iv)      (d) (iii) and (iv)

**Ans.** (b) (ii) and (iii)

5. Barium chloride on reacting with ammonium sulphate forms barium sulphate and ammonium chloride. Which of the following correctly represents the type of the reaction involved?

- (i) Displacement reaction
  - (ii) Precipitation reaction
  - (iii) Combination reaction
  - (iv) Double displacement reaction
- (a) (i) only      (b) (ii) only



- (c) (iv) only                      (d) (ii) and (iv)

Ans. (a) (ii) and (iv)

**6. Electrolysis of water is a decomposition reaction. The mole ration of hydrogen and oxygen gases liberated during electrolysis of water is :**

- (a) 1 : 1                              (b) 2 : 1  
(c) 4 : 1                              (d) 1 : 2

Ans. (b) 2 : 1

**7. Which of the following is/are an endothermic process(es)?**

- (i) Dilution of sulphuric acid  
(ii) Sublimation of dry ice  
(iii) Condensation of water vapours  
(iv) Evaporation of water  
(a) (i) only (ii)                      (b) (ii) only  
(c) (iii) only                          (d) (ii) and (iv)

Ans. (d) (ii) and (iv)

**8. In the double displacement reaction between aqueous potassium iodide and aqueous lead nitrate, a yellow precipitate of lead iodide is formed. While performing the activity if lead nitrate is not available, which of the following can be used in place of lead nitrate?**

- (a) Lead sulphate (insoluble)  
(b) Lead acetate  
(c) Ammonium nitrate  
(d) Potassium sulphate

Ans. (b) Lead acetate.

**9. Which of the following gases can be used for storage of fresh sample of an oil for a long time?**

- (a) Carbon dioxide or oxygen  
(b) Nitrogen or oxygen  
(c) Carbon dioxide or helium  
(d) Helium or nitrogen

Ans. (d) Helium or nitrogen

**10. Which one of the following processes involve chemical reactions?**

- (a) Storing of oxygen gas under pressure in a gas cylinder  
(b) Liquefaction of air  
(c) Keeping petrol in a china dish in the open  
(d) Heating copper wire in presence of air at high temperature

Ans. (d) Heating copper wire in presence of air at high temperature