NCERT CBSE Solutions for Class 10 Science Chapter 1

Chemical Reactions and Equations

Back of Chapter Questions

1. Which of the statements about the reaction below are incorrect?

$$2PbO(s) + C(s) \rightarrow 2Pb(s) + CO_2(g)$$

(i) Lead is getting reduced.

(ii) Carbon dioxide is getting oxidised.

(iii) Carbon is getting oxidised.

(iv) Lead oxide is getting reduced.

(A) (i) and (ii)

(B) (i) and (iii)

(C) (i), (ii) and (iii)

(D) All statements are incorrect

Solution: (A)

In the above reaction, lead oxide is getting converted to lead and carbon is getting converted to carbon dioxide. Lead oxide is losing oxygen whereas carbon is gaining oxygen. Loss of oxygen is known as reduction while gaining oxygen is called oxidation. Hence, Lead oxide is getting reduced and carbon is getting reduced. Thus statements (iii) and (iv) are correct whereas statements (i) and (ii) are incorrect.

2. $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

The above reaction is an example of a:

(A) Combination reaction.

(B) Double displacement reaction.

(C) Decomposition reaction.

(D) Displacement reaction.

Solution: (D)

In the given reaction, Ferric oxide is getting converted to Iron while aluminium is getting oxidized to aluminium oxide. Thus, iron is going from combined state to free state whereas aluminium is going from free state to combined state. Such a

reaction is called displacement reaction as in displacement reactions, the more reactive metal (Al in this case) displaces the less reactive metal (Fe in this case) from its compound.

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.

Solution: (A)

When metals react with acids, H_2 gas is evolved along with the formation of the respective salt of metal.

$$Fe(s) + 2HCl(aq) \rightarrow FeCl_2(s) + H_2(g) \uparrow$$

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

Solution:

A chemical reaction in which the number of atoms of each element is equal on both, the reactant's side and product's side, is called a balanced chemical equation. An example of a balanced chemical reaction is given below:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

As we can see, there are 2 atoms of N and 6 atoms of H on both the sides and hence, this reaction is called a balanced chemical equation.

A reaction should always be written in the balanced form as an unbalanced reaction violates the fundamental principle of law of conservation of mass. According to the law of conservation of mass, the total mass of reactants should be equal to the total mass of the products

The law of charge conservation: total sum of charge in both sides i.e. reactant or product side must be zero. 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 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.

NCERT CBSE Solutions for Class 10 Science Chapter 1

5. 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.

Solution:

(a) $3H_2(g) + N_2(g) \rightarrow 2NH_3(g)$

(b) $2H_2S(g) + 3O_2(g) \rightarrow 2H_2O(l) + 2SO_2(g)$

(c) $3BaCl_2(aq) + Al_2(aq) \rightarrow 2AlCl_3(aq) + 3BaSO_4(ppt)$

(d) $2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$

6. Balance the following chemical equations.

(A) $HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + H_2O$

(B) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

(C) $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

(D) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + HCl$

Solution:

(a) $2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$

(b) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

(c) $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

(d) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$

7. 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

Solution:

(A) $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

(B) $Zn + 2AgNO_3 \rightarrow Zn(NO_3)_2 + 2Ag$

(C) $2Al + 3CuCl_2 \rightarrow AlCl_3 + 3Cu$

(D) $BaCl_2 + K_2SO_4 \rightarrow BaSO_4 + 2KCl$

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) → 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)

Solution:

(a) $2KBr(aq) + BaI_2(aq) \rightarrow 2KI(aq) + BaBr_2(s)$; In this reaction there is an exchange of ions between the reactant so it is double displacement reaction

(b) $ZnCO_3(s) \rightarrow ZnO(s) + CO_2(g)$; In this reaction the single reactant breaks down to give simpler products so it is decomposition reaction

(c) $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$; In this reaction the single product is formed from two reactants so it is combination reaction

(d) $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$; In this reaction magnesium as displaced or removed Cl^- ion so it is displacement reaction.

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

Solution:

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

Example 1:

Mixture of sodium and chlorine to yield table salt

$Na(s) + \frac{1}{2}Cl_2(g) \rightarrow NaCl(s) + 411\ kJ$ of energy

Example 2:

Combustion reaction or burning of nature gas:

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

Example 3:

Respiration reaction:

$$C_6H_{12}O_6(aq)_{(Glucose)} + 6O_2(aq) \rightarrow 6CO_2(aq) + 6H_2O(l) + energy$$

Endothermic reaction: Reactions that absorb energy or require energy in order to proceed are called endothermic reactors.

Example:

White silver chloride turns grey in sunlight. This is due to the decomposition of silver chloride in presence of sunlight and silver and chlorine formed. The energy is required (Sunlight) so it is endothermic reaction.

$$2AgCl(s)\ sunlight \rightarrow\ 2Ag(s) + Cl_2(g)$$

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

Solution:

The carbohydrates are broken down to form glucose. This glucose combines with oxygen in the cell of our body and provides energy so it is a exothermic reaction.

$$C_6H_{12}O_6(aq)_{(Glucose)} + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l) + energy$$

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

Solution:

Decomposition reactions are those in which a compound breaks down to form two or more substances. While in the combination reaction single product is formed from two or more reactants. Thus decomposition reaction is exact opposite of combination reactions.

Example:

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l) + energy$$

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

Solution:

(a) Thermal decomposition of ferrous sulphate:

$$2FeSO_4(s)_{Ferroussulphate} \xrightarrow{\Delta} Fe_2O_3(s)_{Ferricoxide} + SO_2(g)_{sulphurdioxide} + SO_3(g)_{suphurtrioxide}$$

(b) Decomposition of AgCl in presence of light:

$$2AgCl(s)_{Silverchloride} \text{ Light} \rightarrow 2Ag(s)_{Silver} + Cl_2(g)_{Chlorine}$$

(c) Decomposition of AgBr in presence of light:

$$2AgBr(s)_{Silverbromide} \text{ Light} \rightarrow 2Ag(s)_{Silver} + Br_2(l)_{Bromine}$$

(d) Decomposition by electricity:

$$2Al_2O_3(aq)_{Aluminium\ oxide} \text{ Electricity} \rightarrow 4Al(s)_{Aluminium} + 3O_2(g)_{Oxygen}$$

13. What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Solution:

Displacement reaction: A more reactive element replaces a less reactive element from a compound.

Example of displacement reaction:

$$CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$$

Zinc is more reactive metal as compare to copper so zinc displace the copper ion in copper.

Double displacement reaction:

In the double displacement reaction two compounds react and the positive ion (cation) and the negative ion (anion) of the two reactants switch place forming two new compounds or products.

Example:

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

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

Solution:

$$2AgNO_3(aq)_{\text{Silver Nitrate}} + Cu(s)_{\text{Copper}} \rightarrow Cu(NO_3)_2(aq)_{\text{Copper Nitrate}} + 2Ag(s)_{\text{Silver}}$$

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

Solution:

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

Example:

$$Na_2CO_3(aq)_{\text{Sodium carbonate}} + CaCl_2(aq)_{\text{Calcium chloride}} \rightarrow CaCO_3(s)_{\text{Calcium Carbonate}} + 2NaCl(aq)_{\text{Sodium chloride}}$$

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

$$Na_2SO_4(aq)_{\text{Sodium sulphate}} + BaCl_2(aq)_{\text{Barium chloride}} \rightarrow BaSO_4(s)_{\text{Barium sulphate}} + 2NaCl(aq)_{\text{Sodium sulphate}}$$

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

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

(a) Oxidation

(b) Reduction

Solution:

(a) Oxidation is the gain of oxygen

Example:

(i) $CO_2 + H_2 \rightarrow CO + \underbrace{H_2O}_{\text{Addition of oxygen}-\text{oxidation}}$

(ii) $2Cu + O_2 \rightarrow \underbrace{2CuO}_{\text{Gass of oxygen}-\text{oxidataion}}$

In equation (i), H_2 is oxidized to H_2O and in equation (ii), Cu is oxidised to CuO.

(b) Reduction is the loss of oxygen.

Example:

(i) $CO_2 + H_2 \rightarrow \underbrace{CO}_{\text{Removal of oxygen}-\text{reduction}} + H_2O$

(ii) $CuO + H_2\,\Delta \rightarrow \underbrace{Cu}_{\text{Loss of oxygen}-\text{reduction}} + H_2O$

In equation (i), CO_2 is reduced to CO and in equation (i), CuO is reduced to Cu.

NCERT CBSE Solutions for Class 10 Science Chapter 1

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.

Solution:

'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.

$$2Cu + O_{2\,(\text{Shiny brown in colour})} \rightarrow 2CuO_{(\text{Black in colour})}$$

18. Why do we apply paint on iron articles?

Solution:

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

$$4Fe + 3O_2 + nH_2O \rightarrow 2Fe_2O_3.nH_2O_{\text{Hydrated iron oxide}}$$

This hydrated iron oxide is rust

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 using to take place.

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

Solution:

Nitrogen is an inert gas and does not easily 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.

20. Explain the following terms with one example each.

(a) Corrosion

(b) Rancidity

Solution:

(a) Corrosion:

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.

$$4Fe + 3O_2 + nH_2O \rightarrow 2Fe_2O_3.nH_2O_{\text{Hydrated iron oxide}}$$

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.

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In-text Questions

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

Solution:

A magnesium ribbon should be cleaned before burning in air to remove the layer of magnesium oxide formed due to reaction of magnesium with oxygen present in the air. The layer of magnesium oxide is usually removed by rubbing the ribbon with sand paper.

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

(I) Hydrogen + Chlorine → Hydrogen chloride

(II) Barium chloride + Aluminium sulphate → Barium sulphate + Aluminium chloride

Solution:

The balanced equations for the chemical reactions are:

(I) $H_2 + Cl_2 \rightarrow 2HCl$

(II) $3BaCl_2 + Al_2(SO_4)_3 \rightarrow 3BaSO_4 + 2AlCl_3$

NCERT CBSE Solutions for Class 10 Science Chapter 1

3. Write the 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.

Solution:

(I) $BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$

(II) $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

4. 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.

Solution:

(I) The substance X is quick lime (calcium oxide) which is used for white washing. Its chemical formula is CaO.

(II) Calcium oxide on reaction with water gives calcium hydroxide.

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$$

5. Why is the amount of a gas collected in one of the test tubes in 'Electrolysis of water' activity double of the amount collected in the other? Name this gas.

Solution:

Water is formed when hydrogen and oxygen combine in the ratio of $2:1$ by volume. So, the volume of hydrogen gas is double of oxygen gas. Thus, on decomposition of water during electrolysis, the volume of hydrogen formed is twice than that of oxygen gas.

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

Solution:

Copper sulphate solution is initially blue in colour. When an iron nail is dipped in it, the blue colour changes to green. This happens due to a displacement reaction where iron being more reactive than Cu, displaces Cu to form a green coloured iron sulphate solution while copper metal gets precipitated. Hence the colour changes from blue to green.

$$Fe(s) + CuSO_4(aq)_{(blue)} \rightarrow FeSO_4(aq)_{(green)} + Cu(s)$$

NCERT CBSE Solutions for Class 10 Science Chapter 1

7. Give an example of a double displacement reaction?

Solution:

Example of a double displacement reaction is the reaction of lead nitrate and hydrochloric acid. When aqueous solutions of both compounds are mixed, lead chloride precipitates out along with the formation of Nitric Acid. The chemical equation can be given as:

$$Pb(NO_3)_2\ (aq)_{(\text{Lead nitrate})} + 2HCl\ (aq)_{(\text{Hydrochloric acid})} \rightarrow PbCl_2(s)_{(\text{Lead chloride})} + 2HNO_3(aq)_{(\text{Nitric acid})}$$

8. Identify the substances that are oxidized and the substances that are reduced in the following reactions.

(i) $4Na(s) + O_2(g) \rightarrow 2Na_2O(s)$

(ii) $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(l)$

Solution:

Oxidation is addition of oxygen and reduction is removal of oxygen. Therefore:

In reaction (i).Sodium metal is oxidized to Na_2O as oxygen is added to it. Oxygen is reduced to Na_2O as the number of oxygen atoms per molecule becomes less (from 2 to 1). Hence, Sodium gets oxidized while Oxygen gets reduced.

In reaction (ii) Copper oxide is reduced to copper (loss of oxygen) and hydrogen is oxidized to H_2O (gain of oxygen).