Chemical Reactions and Equations

CHAPTER 1

EXAM DRILL

ANSWERS

1. $ZnCO_{3(s)} \longrightarrow ZnO_{(s)} + CO_{2(g)}$

2. $AgNO_{3(aq)} + NaCl_{(aq)} \longrightarrow AgCl_{(s)}\downarrow + NaNO_{3(aq)}$

3(i) $H_2O_2 + Cl_2 \longrightarrow 2HCl + O_2$

In this reaction, H_2O_2 is oxidised to O_2, hence acts as a reducing agent.

3(ii) $4Na_{(s)} + O_{2(g)} \longrightarrow 2Na_2O_{(s)}$ (oxidised: Na; reduced: O_2)

Na is oxidised and O_2 is reduced.

3(iii) Yes, a displacement reaction can be a redox reaction.

3(iv) Combustion reaction is an oxidation reaction because it is always carried out in the presence of air or oxygen.

$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

4(i) The reaction in which two or more substances combine to form a single substance under suitable conditions.

4(ii) The process by which green plants and some other organisms use sunlight to synthesis nutrients from carbon dioxide and water.

4(iii) (b) : Photodecomposition

4(iv) (a) : $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$

5. (a) : $BaCl_{2(aq)} + Na_2SO_{4(aq)} \longrightarrow BaSO_{4(s)}\downarrow + 2NaCl_{(aq)}$

6. (d) : Zinc and aluminium, being more reactive than iron, will displace iron from iron sulphate.

7. (b) : Dissolution of sugar in water is not a chemical reaction.

OR

(b) : $FeSO_4 \cdot 7H_2O_{(s)} \xrightarrow{Heat} FeSO_{4(s)} + 7H_2O$

$2FeSO_{4(s)} \xrightarrow{Heat} Fe_2O_{3(s)} + SO_{2(g)} + SO_{3(s)}$ (Reddish brown)

8. (b) : *M* is oxidized to M_2O.

9. (c) : Because nitrogen is an unreactive gas and prevent oxidation.

OR

(a) : PCl_3 is acting as reductant.

10. (d) : $CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)} + Heat$

11. (b) : $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + CO_2\uparrow + H_2O$

12. (b) : $CaCO_3 + HCl \longrightarrow CaCl_2 + H_2O + CO_2\uparrow$

$Zn + HCl \longrightarrow ZnCl_2 + H_2\uparrow$

OR

(b) (A)-q, (B)-p, (C)-t, (D)-s

13. (b) : In displacement reactions, a more active element displaces a less active element from its compounds.

14. (b) : Nitrogen prevents the food items from oxidation.

15. (a) An endothermic reaction occurs when energy is absorbed from the surroundings. Example : photosynthesis, where light energy is absorbed to convert carbon dioxide to glucose. An exothermic reaction occurs when energy is released to the surroundings. Example : burning of fuel.

(b) (i) The iron nail turns brown.

(ii) Rusting

16. (a) $2KBr_{(aq)} + BaI_{2(aq)} \longrightarrow 2KI_{(aq)} + BaBr_{2(aq)}$

This reaction is a double displacement reaction.

(b) $3H_{2(g)} + N_{2(g)} \longrightarrow 2NH_{3(g)}$

This reaction is a combination reaction.

OR

The two necessary conditions for corrosion to take place are :

(i) Presence of air (or oxygen)

(ii) Presence of moisture (water vapour)

Both corrosion and rusting are very harmful and cause damage to the buildings, railway tracks, automobiles and other objects/ materials where metals are used. We quite often hear that on old building has collapsed of its own causing of loss of both lives and property. This is on account of the rusting of iron which is used in making the structures particularly the roof.

17. (i) $2HgO_{(s)} \xrightarrow{Heat} 2Hg_{(l)} + O_{2(g)}$

(ii) $2H_2O_{2(l)} \longrightarrow 2H_2O_{(l)} + O_{2(g)}$

(iii) $2C_2H_{2(g)} + 5O_{2(g)} \longrightarrow 4CO_{2(g)} + 2H_2O_{(l)} + Heat$

18. (i) When lead nitrate is added to potassium iodide then yellow precipitate of lead iodide is formed along with potassium nitrate.

(ii) Balanced chemical reaction is as follows :

$Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \longrightarrow PbI_{2(s)}\downarrow + 2KNO_{3(aq)}$ (Yellow ppt.)

(iii) This type of reaction is called precipitation reaction in which one of the products formed is an insoluble substance. This is also called double displacement reaction.

19. Thermal decomposition reactions : These reactions occur in the presence of heat.

$$\underset{\text{Ferrous sulphate (Green)}}{2FeSO_{4(s)}} \xrightarrow{\text{Heat}} \underset{\text{Ferric oxide (Reddish brown)}}{Fe_2O_{3(s)}} + \underbrace{\underset{\text{Sulphur dioxide}}{SO_{2(g)}} + \underset{\text{Sulphur trioxide}}{SO_{3(g)}}}_{\text{(Smell of burning sulphur)}}$$

Electrolytic decomposition reactions : These reactions occur in the presence of electric current.

$$2H_2O_{(l)} \xrightarrow[\text{Current}]{\text{Electric}} 2H_{2(g)} + O_{2(g)}$$

Photodecomposition reactions : These reactions occur in the presence of sunlight.

$$\underset{\text{Silver bromide}}{2AgBr_{(s)}} \xrightarrow{\text{Sunlight}} \underset{\text{Silver}}{2Ag_{(s)}} + \underset{\text{Bromine}}{Br_{2(g)}}$$

OR

To demonstrate thermal decomposition of ferrous sulphate : Take a small amount of ferrous sulphate crystals in a dry test tube. Holding the test tube in a test holder, heat the test tube strongly over a flame of a spirit lamp or a burner.

Observation : The green coloured ferrous sulphate crystals ($FeSO_4.7H_2O$) on heating first lose water and the colour changes to form anhydrous $FeSO_4$.

$$\underset{\text{Ferrous sulphate crystals}}{FeSO_4 \cdot 7H_2O} \xrightarrow{\text{Heat}} \underset{\text{Anhydrous ferrous sulphate}}{FeSO_{4(s)}} + 7H_2O_{(s)}$$

This on further heating gives out a characteristic smell of burning sulphur leaving behind a reddish brown residue of ferric oxide.

Conclusion : This is due to the following decomposition reaction :

$$\underset{\substack{\text{Ferrous sulphate}\\\text{(Green)}}}{2FeSO_{4(s)}} \xrightarrow{\text{Heat}} \underset{\substack{\text{Ferric oxide}\\\text{(Reddish brown)}}}{Fe_2O_{3(s)}} + \underbrace{\underset{\substack{\text{Sulphur}\\\text{dioxide}}}{SO_{2(g)}} + \underset{\substack{\text{Sulphur}\\\text{trioxide}}}{SO_{3(g)}}}_{\substack{\text{(Having smell of}\\\text{burning sulphur)}}}$$

20. (a) When white silver chloride is left exposed to sunlight, its colour changes to grey as it decomposes to silver in the presence of sunlight.

$$\underset{\text{White}}{2AgCl_{(s)}} \xrightarrow{\text{Sunlight}} \underset{\text{Grey}}{2Ag_{(s)}} + Cl_{2(g)}$$

This type of reaction is called photodecomposition reaction.

(b) (i) Single displacement reaction

(ii) Combination reaction

(iii) Double displacement reaction

21. (i) Reddish brown residue is Fe_2O_3.

(ii) Sulphur dioxide (SO_2), sulphur trioxide (SO_3).

(iii) $FeSO_4 \cdot 7H_2O$

22. (a) As iron is more reactive than copper, it displaces copper from copper sulphate solution and iron sulphate is obtained. The reddish brown copper particles are deposited on the surface of iron and blue colour of the solution turns to pale green.

$$Fe_{(s)} + CuSO_{4(aq)} \longrightarrow FeSO_{4(aq)} + Cu_{(s)}$$

(b) $CuSO_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Cu(OH)_{2(s)} + Na_2SO_{4(aq)}$

23. (a) $\underset{\text{Silver nitrate}}{AgNO_{3(aq)}} + \underset{\text{Potassium chloride}}{KCl_{(aq)}} \longrightarrow \underset{\substack{\text{Silver chloride}\\\text{(white, insoluble)}}}{AgCl_{(s)}} + \underset{\text{Potassium nitrate}}{KNO_{3(aq)}}$

It is a double displacement reaction.

(b) $\underset{\text{Ferrous sulphate}}{2FeSO_{4(s)}} \longrightarrow \underset{\text{Ferric oxide}}{Fe_2O_{3(s)}} + \underbrace{\underset{\text{Sulphur dioxide}}{SO_{2(g)}} + \underset{\text{Sulphur trioxide}}{SO_{3(g)}}}_{\text{(Smell of burning sulphur)}}$

It is a thermal decomposition reaction.

OR

(a) The conditions of temperature, pressure and the presence of catalyst, if any, may be represented by writing these conditions above and/or below the arrow drawn between the reactants and the products. For example,

$$\underset{\text{Nitrogen}}{N_{2(g)}} + \underset{\text{Hydrogen}}{3H_{2(g)}} \xrightarrow[\text{Fe}]{\text{500°C, 200 atm}} \underset{\text{Ammonia}}{2NH_{3(g)}}$$

This shows that to get maximum yield of ammonia (NH_3), the most suitable conditions for the above reaction are a temperature of 500°C, pressure of 200 atmosphere and presence of iron as catalyst.

(b) Yes, we can store zinc sulphate solution in a copper vessel. Copper is less reactive than zinc, hence copper cannot displace zinc from zinc sulphate solution.

24. (a) An equation in which the number of atoms of one or more elements is not equal on the both sides of the equation is called a skeletal (or unbalanced) equation.

Solution of barium chloride and aluminium sulphate in water react to give insoluble barium sulphate and aluminium chloride solution. The skeletal equation is

$$BaCl_2 + Al_2(SO_4)_3 \longrightarrow BaSO_4 + AlCl_3$$

The balanced equation is

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

(b) The refrigeration of food stuffs, slows down the oxidation of food stuffs due to low temperatures. So, we keep food in refrigerator.

25. (i) $BaCl_{2(aq)} + CuSO_{4(aq)} \rightarrow BaSO_{4(s)} + CuCl_{2(aq)}$

It is an example of double displacement and precipitation reaction.

(ii) The surface of copper becomes black due to the formation of black copper oxide.

$$2Cu_{(s)} + \underset{\text{From air}}{O_{2(g)}} \longrightarrow \underset{\text{Copper oxide (Black)}}{2CuO}$$

Since copper is oxidisied to copper oxide, it is an oxidation reaction. This is also an example of combination reaction.

(iii) In this reaction, ferrous sulphate crystals ($FeSO_4.7H_2O$) decompose to form brown solid, ferric oxide (Fe_2O_3) and gases SO_2 and SO_3 are produced.

$$\underset{\substack{\text{Ferrous sulphate}\\\text{(Green)}}}{2FeSO_4.7H_2O_{(s)}} \xrightarrow{\text{Heat}} \underset{\substack{\text{Ferric oxide}\\\text{(Brown)}}}{Fe_2O_{3(s)}} + \underset{\text{Sulphur dioxide}}{SO_{2(g)}} + \underset{\text{Sulphur trioxide}}{SO_{3(g)}} + 7H_2O_{(l)}$$

This is an example of decomposition reaction.

(iv) Iron nails displace copper from copper sulphate solution and as a result solution becomes pale green due to the formation of ferrous sulphate and blue colour of copper sulphate fades. The reddish brown copper particles are deposited on iron surface.

$$\underset{\text{Iron}}{Fe_{(s)}} + \underset{\substack{\text{Copper sulphate}\\\text{(Blue)}}}{CuSO_{4(aq)}} \longrightarrow \underset{\substack{\text{Ferrous sulphate}\\\text{(Pale green)}}}{FeSO_{4(aq)}} + \underset{\text{Copper}}{Cu_{(s)}}$$

This is an example of displacement reaction.

(v) Quick lime (CaO) reacts with water forming slaked lime, $Ca(OH)_2$ and releasing a large amount of heat.

$$\underset{\text{Quick lime}}{CaO_{(s)}} + H_2O_{(l)} \longrightarrow \underset{\substack{\text{Calcium hydroxide}\\\text{(Slaked lime)}}}{Ca(OH)_{2(aq)}} + \text{Heat}$$

This is an example of combination reaction.

OR

(a) (i) (A) is a combination reaction in which compounds combine while (B) is also combination reaction but here elements combine.

(ii) (A) is single displacement reaction while (B) is double displacement reaction.

(iii) (A) is thermal decomposition reaction while (B) is electrolytic decomposition reaction.

(b) Decomposition reaction. $2AgCl_{(s)} \xrightarrow{\text{Light}} 2Ag_{(s)} + Cl_{2(g)}$

26. (i) The slow oxidation of oils and fats present in food materials resulting in compounds with unpleasant smell is known as rancidity.

Food becomes stale because of rancidity, the stale food develops bad taste and smell.

(ii) Oxidation is responsible for rancidity.

(iii) Following measures can be adopted to prevent or slow down rancidity :

(a) Food materials are often packed in air tight containers. So, oxygen has no access to them and rancidity is prevented. These days, preference is given vacuum packing.

(b) Refrigeration of food also slows down rancidity because the temperature inside refrigerator is very low and direct contact with air or oxygen is avoided.

(c) In bags containing potato chips and other similar stuff, the air is quite often replaced by nitrogen. This prevent their oxidation as well as rancidity.

(d) It is always advisable to place food materials and cooked food in places away from direct sunlight. This will slow down the process of rancidity.

27. (a) The blue colour salt becomes white due to loss of water of crystallization on heating. It regains its blue colour on adding water to it. The salt is copper sulphate and the formula is, $CuSO_4 \cdot 5H_2O$.

(b) There are a number of redox reactions taking place around us which affect our everyday life, *e.g.*,

(i) Corrosion of metals

(ii) Rancidity of food

(c) Oxidation or reduction cannot take place alone. This is because if one substance loses oxygen, *i.e.*, undergoes reduction, there must be another substance to take up this oxygen, *i.e.*, undergoes oxidation. Similarly, if one substance loses hydrogen, *i.e.*, undergoes oxidation, there must be another substance to take up this hydrogen, *i.e.*, undergoes reduction. Hence, oxidation and reduction always take place together. That is why, these reactions are called redox reactions.

OR

(a) The substance that oxidises another substance is called an oxidising agent. Thus, an oxidising agent can remove electrons from the other substance and itself gets reduced.

$$\underset{\text{Oxidation}}{Zn_{(s)}} + CuSO_{4(aq)} \rightarrow ZnSO_{4(aq)} + \underset{\text{Reduction}}{Cu_{(s)}}$$

Here, $CuSO_4$ oxidises Zn atom to $ZnSO_4$ and itself gets reduced to Cu. So in this reaction, $CuSO_4$ is an oxidising agent and Zn gets oxidised to $ZnSO_4$.

(b) The conditions for the reaction of photosynthesis to take place are the presence of sunlight and chlorophyll. So, we can write a chemical equation for photosynthesis alongwith conditions as follows.

$$\underset{\substack{\text{Carbon}\\\text{dioxide}}}{6CO_{2(g)}} + \underset{\text{Water}}{6H_2O_{(l)}} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \underset{\text{Glucose}}{C_6H_{12}O_{6(aq)}} + \underset{\text{Oxygen}}{6O_{2(g)}}$$

28. Corrosion may be defined as the chemical process of slow eating up of the surfaces of certain metals when kept in open for a long time.

Rust is a chemical substance brown in colour and is formed by

the chemical action of moist air (containing CO_2 and H_2O) on iron. It is basically an oxidation reaction and formula of rust is $Fe_2O_3 \cdot xH_2O$. It is very slow in nature and once started keeps on occurring.

$$2Fe + \frac{3}{2}O_2 + xH_2O \longrightarrow \underset{\text{Hydrated ferric oxide (Rust)}}{Fe_2O_3 \cdot xH_2O}$$

Aluminium is placed high in the activity series and is expected to be quite reactive. It combines with oxygen present in air to form its oxide called aluminium oxide (Al_2O_3) and this is a case of corrosion. The metal oxide formed slowly gets deposited on the surface of aluminium and forms a protective coating on the surface. This coating makes the metal passive to the attack by water, air, acids and alkalies, etc. As a result aluminium articles and containers are not corroded.

29. (a) (i) When barium hydroxide is added into ammonium chloride, the bottom of test tube is found to be cooler.

(ii) It is an endothermic reaction.

(iii) $Ba(OH)_2 + 2NH_4Cl \longrightarrow BaCl_2 + 2NH_4OH$

(b) (i) Photodecomposition reaction

(ii) Double displacement reaction

(iii) Combination reaction

30. (a) (i) Displacement reaction

(ii) Combination reaction

(b) The activity of the halogens decreases from top to bottom in the periodic table. We see that Br is above I and Cl is above Br in the periodic table. Therefore neither combination (a) nor combination (c) could result in reaction. Cl is above I in the periodic table, and so combination (b) results in a displacement reaction.

The more active halogen, Cl_2 displaces the less active halogen, I_2, from its compounds.

$$2NaI_{(aq)} + Cl_{2(g)} \longrightarrow I_{2(s)} + 2NaCl_{(aq)}$$

OR

(i) Based on the given information, solid *A* can be assumed to be manganese dioxide (MnO_2) and solid *B* can be assumed to be aluminium powder (Al). When manganese dioxide is heated with aluminium powder, the following reaction takes place.

$$\underset{(A)}{3MnO_{2(s)}} + \underset{(B)}{4Al_{(s)}} \xrightarrow{\text{Heat}} \underset{(C)}{2Al_2O_{3(s)}} + \underset{(D)}{3Mn_{(l)}} + \text{Heat}$$

(ii) The reaction can be classified as :

(a) Displacement reaction

(b) Redox reaction

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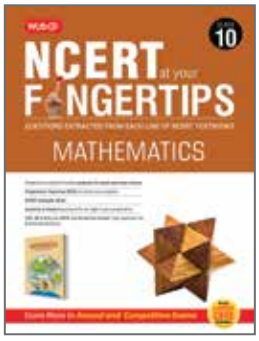

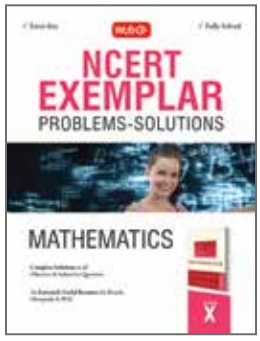

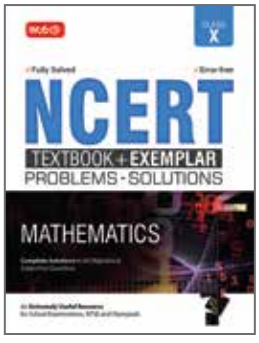

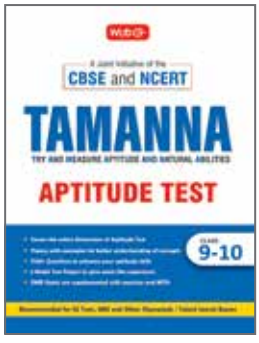

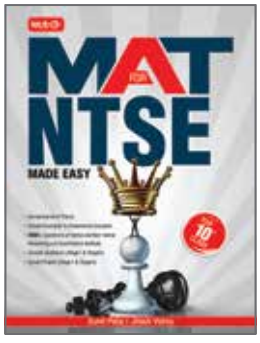

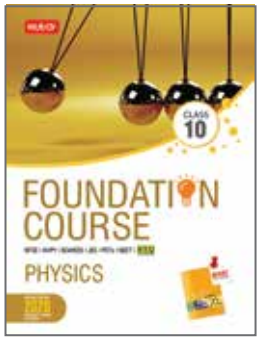

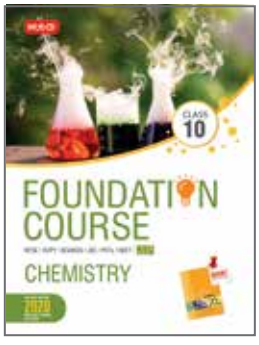

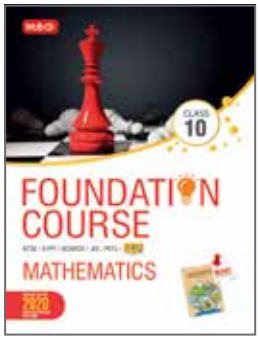

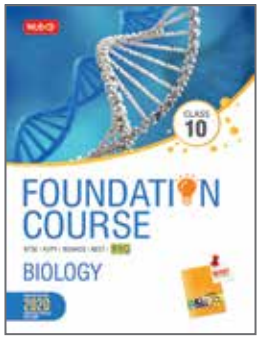

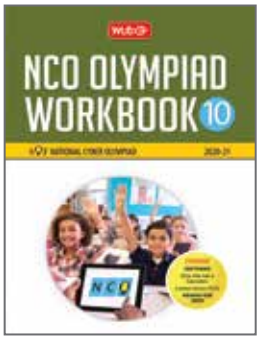

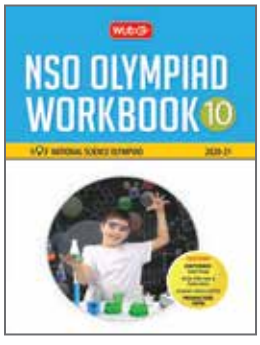

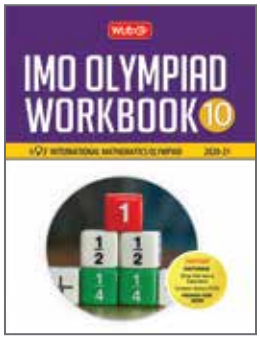

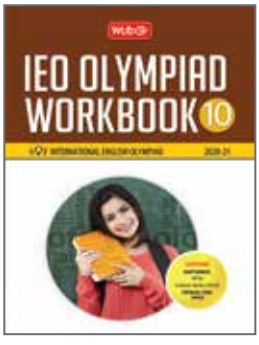

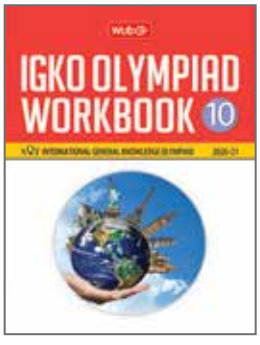

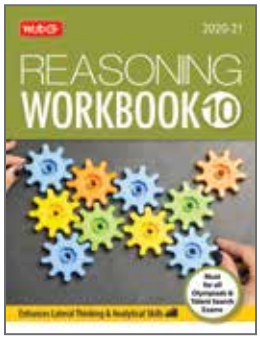

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