CHEMICAL REACTIONS AND EQUATIONS

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1. $H_2 + O_2 \rightarrow H_2O$

Step 1: $\boxed{H_2} + \boxed{O_2} \rightarrow \boxed{H_2O}$ skeletal

Step 2:

E	LHS	RHS
H	2	2
O	2	1×2=2

$H_2 + O_2 \rightarrow 2H_2O$

Step 3:

E	LHS	RHS
H	2×2=4	4
O	2	2

>>> $2H_2 + O_2 \rightarrow 2H_2O$ balanced

2. $AgCl \rightarrow Ag + Cl_2$

Step 1: $\boxed{AgCl} \rightarrow \boxed{Ag} + \boxed{Cl_2}$ unbalanced

Step 2:

E	LHS	RHS
Ag	1	1
Cl	1×2=2	2

$2AgCl \rightarrow Ag + Cl_2$

Step 3:

E	LHS	RHS
Ag	2	1×2=2
Cl	2	2

>>> $2AgCl \rightarrow 2Ag + Cl_2$ balanced

3. $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

E	LHS	RHS
Fe	1	3
H	2	2
O	1×4=4	4

$Fe + 4H_2O \rightarrow Fe_3O_4 + H_2$

E	LHS	RHS
Fe	1	3
H	8	2×4=8
O	4	4

$Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

E	LHS	RHS
Fe	1×3=3	3
H	8	8
O	4	4

⋙ $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

4. $ZnCO_3 \rightarrow ZnO + CO_2$
$ZnCO_3 \rightarrow ZnO + CO_2$ is already balanced.

5. $PbO + C \rightarrow 2Pb + CO_2$

E	LHS	RHS
Pb	1×2=2	2
O	1×2=2	2
C	1	1

⋙ $2PbO + C \rightarrow 2Pb + CO_2$

6. $MnO_2 + HCl \rightarrow MnCl_2 + H_2O + Cl_2$

E	LHS	RHS
Mn	1	1
O	2	1
H	1	2
Cl	1×4=4	4

$MnO_2 + 4HCl \rightarrow MnCl_2 + H_2O + Cl_2$

E	LHS	RHS
Mn	1	1
O	2	1×2=2
H	4	2×2=4
Cl	4	4

» $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

1.

2. $1\ CH_4 + 2\ O_2 \rightarrow 1\ CO_2 + 2\ H_2O$

3. $1\ SiCl_4 + 2\ H_2O \rightarrow 1\ SiO_2(s) + 4\ HCl(aq)$

4. $2\ AgI + 1\ Na_2S \rightarrow 1\ Ag_2S + 2\ NaI$

5. $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

6. $1\ FeO_3 + 3\ CO \rightarrow 1\ Fe + 3\ CO_2$

7. $1\ SiO_2 + 4\ HF \rightarrow 1\ SiF_4 + 2\ H_2O$

8. $2\ NaBr + 1\ Cl_2 \rightarrow 2\ NaCl + 1\ Br_2$

Notes:

* Introduction:-

»» Whenever a chemical change occurs, we say that a chemical reaction has taken place

»» Following observations determine a chemical reaction:
- change in state
- change in colour
- evolution of a gas
- change in temperature

* Chemical equations:

»» Reactants: The substances that undergo a chemical change

»» Product: The new substance formed during a reaction

Equation format –

LHS RHS

Reactant 1 + Reactant 2.. ⟶ Product 1 + Product 2.

(+ : plus sign; ⟶ : arrow showing direction; + : plus sign)

* Writing a chemical equation:

»» Chemical equation can be written as chemical formulae to make it short. It represents a chemical reaction.

»» Unbalanced: Mass is not same on both sides
Known as "~~skelital~~ skeletal chemical equation"

»» Balanced: Mass is same on both sides

* Balancing Chemical equations: (3 steps written in beginning in ~~es~~ questions 1. to 5.)

»» Symbols of Physical States: Eg: $3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$

(S) = Solid | (l) = liquid

(g) = gaseous | (aq) = aqueous [reactant/product present as a solution in water]

» Reaction conditions: Reaction conditions like temperature, pressure, catalyst, etc. are indicated above and/or below the arrow.

Eg. $6CO_2(aq) + 12H_2O(l) \xrightarrow[\text{chlorophyll}]{\text{sunlight}} C_6H_{12}O_6(aq) + 6O_2(aq) + 6H_2O(l)$

* Types of Chemical Reactions

1. Combination reaction – Reaction in which a single product is formed from two or more reactants.

Examples:

(i) Burning of coal – $C(s) + O_2(g) \longrightarrow CO_2(g)$

(ii) Formation of water from H_2 and O_2 – $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

» Exothermic reactions – Reactions in which heat is released with the formation of products

Examples:

(i) Burning of natural gas – $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

(ii) Respiration –

- We get energy from the food we eat (rice, potatoes, bread contains carbohydrates)
- During digestion, food is broken down into simpler substances
- Carbohydrates break down to form glucose
- Glucose combines with oxygen in the cells of our body and provides energy

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

(iii) The decomposition of vegetable into compost

2. Decomposition reaction – Single reactant breaks down to give simpler products

$2FeSO_4(s) \xrightarrow{\text{Heat}} Fe_2O_3(s) + SO_2(g) + SO_3(g)$

Ferrous sulphate → Ferric oxide; sulphur dioxide; sulphur trioxide

$CaCO_3(s) \xrightarrow{Heat} CaO(s) + CO_2(g)$

Calcium carbonate (lime stone) — Calcium oxide (Quick lime) — carbon dioxide

used in manufacturing cement

$2Pb(NO_3)_2(s) \xrightarrow{Heat} 2PbO(s) + 4NO_2(g) + O_2(g)$

Lead nitrate — Lead oxide — Nitrogen dioxide — Oxygen

Kept in boiling tube — observation → emits brown fumes

Silver chloride* and silver bromide# turn grey in Sunlight.

Photolysis – Reactions in which a compound decomposes due to sunlight

* $2AgCl(s) \xrightarrow{sunlight} 2Ag(s) + Cl_2(g)$ } decomposition of silver chloride into silver and chlorine

\# $2AgBr(s) \xrightarrow{sunlight} 2Ag(s) + Br_2(g)$ } (similar thing happens here)

These reactions are used in black and white photography.

Decomposition reactions require heat, light or electricity to break down the reactions.

Endothermic reactions: Reactions in which energy is absorbed

3. Displacement Reaction – Reactions in which one reactant displaces or removes another element

high reactive — low reactive

$Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$

Iron — Copper sulphate — Iron sulphate — Copper

Iron displaced copper from copper sulphate

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

$Pb(s) + CuCl_2(aq) \longrightarrow PbCl_2(aq) + Cu(s)$

More reactive elements displace less reactive ones.

4. Double Displacement Reactions – Reactions in which there is an exchange of ions between the reactants.

white precipitate

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

Sodium sulphate — Barrium Chloride — Barrium sulphate — Sodium Chloride

$BaSO_4$ is formed by reaction of SO_4^{2-} and Ba^{2+}.

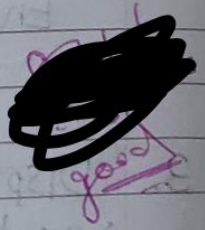
a.k.a - Precipitation reaction: Reaction that produces a precipitate (insoluble substance formed)

Reactivity series

↑ High

(Potassium)	K	Katrina
(Sodium)	Na	Na
(Calcium)	Ca	Car
(Magnesium)	Mg	Mangi
(Aluminium)	Al	Alto
(Zinc)	Zn	Zen
(Iron)	Fe	Ferrari
(lead)	Pb	Phir bhi
(Hydrogen)	H	Haaye
(Copper)	Cu	Cu
(Mercury)	Hg	Mili
(Silver)	Ag	Silver
(Platinum)	Pt	Platied
(Gold)	Au	Audi

↓ Low



5. Oxidation and Reduction

Oxidation	Reduction
Gain of oxygen +	Loss of oxygen -
Loss of hydrogen -	Gain of hydrogen +
Loss of electrons -	Gain of electrons +
$2Cu + O_2 \xrightarrow{\Delta} 2CuO$ (gain of oxygen)	$CuO + H_2 \xrightarrow{\Delta} Cu + H_2O$ (loss of oxygen)

» Oxidation and Reduction always occur together.

» Redox Reaction:

(i) When both oxidation and reduction take place simultaneously, it is said to be a redox reaction

OR

(ii) A reaction in which one reactant gets oxidised while the other gets reduced is called redox reaction.

Examples of Redox Reaction

loss of oxygen (Reduction)

$CuO + H_2 \xrightarrow{\Delta} Cu + H_2O$

Oxidation (gain of oxygen)

~~$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 H$~~

~~loss of O_2~~ (Reduction)

$ZnO + C \longrightarrow Zn + CO$

Oxidation (gain of O_2)

$MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$

Effects of Oxidation

Corrosion

» The process of slow conversion of metals into undesirable compounds due to reaction with moisture, acids, etc. present in the atmosphere.

Examples:

» Reddish brown powder on iron [rusting]
» Black coating on silver
» Green coating on copper

Problems: ~~causes~~

» causes damage to -
- car bodies
- bridges
- iron railings
- ships
- other metal objects

» lots of money spent every year to replace damaged iron

Rancidity

» The process of change of taste and odour of food materials containing fats and oils when they are exposed to air for a long time.

Mind Map

Chemical Reactions and Equations

- **Chemical Reaction Indicators**
  - Change in state
  - Change in colour
  - Evolution of gas
  - Change in temperature
- **Chemical Equation**
  - Word Equation
  - Symbolic Equation
- **Balancing Equations**
  - Draw boxes
  - Make table
  - Keep multiplying to get both sides equal
  - Write symbols of physical states
  - "hit and trial"
- **Balanced or Unbalanced**
  - Balanced: equal atoms
  - Unbalanced: unequal atoms a.k.a "skeletal"

Types of Reactions

- **Combination** $A + B \rightarrow AB$ [combine]
- **Decomposition** $AB \rightarrow A + B$ [break down]
- **Displacement** $AB + C \rightarrow AC + B$ "
  - high reactive displaces low reactive
- **Double Displacement** $AB + CD \rightarrow AC + BD$
- **Redox**
  - Oxidation ← occur together always → Reduction

Effects of Oxidation
- Corrosion
- Rancidity

Oxidation
- Add:
  - Oxygen
- Loss:
  - Hydrogen
  - Electrons

Reduction
- Add:
  - Hydrogen
  - Electrons
- Loss:
  - Oxygen