OXIDATION AND REDUCTION

OXIDATION

Definition 1 ***(In terms of oxygen)***	**Definition 2** ***(In terms of hydrogen)***	**Definition 3** ***(In terms of electrons)***
Oxidation is the addition of oxygen to a substance.	Oxidation is the removal of hydrogen from a substance.	Oxidation is the loss of electrons from a substance.

Illustration of oxidation by Definition 1

$2Cu_{(s)} + 0_{2(g)} \longrightarrow 2CuO_{(s)}$

Questions

a) What was observed in the equation above?

The brown solid formed a black residue.

b) Explain your observation?

The brown copper metal was oxidized to copper (ii) oxide which is black in colour.

Illustration of oxidation by Definition 2

$H_2S_{(g)} + Cl_{2(g)} \longrightarrow S_{(s)} + HCl_{(g)}$

Questions

c) What was observed in the equation above?

A yellow solid was formed and a white fuming gas was evolved

d) Explain your observation?

Hydrogen sulphide was oxidized to sulphur due to the removal of hydrogen.

Illustration of oxidation by Definition 3

$Na_{(s)} \longrightarrow Na^{+}_{(aq)} + \bar{e}$

In this equation, sodium atom loses an electron to form sodium ion. By this, its said that sodium atoms have been oxidized to sodium ions.

REDUCTION

Definition 1 ***(In terms of oxygen)***	**Definition 2** ***(In terms of hydrogen)***	**Definition 3** ***(In terms of electrons)***
Reduction is the removal of oxygen from a substance.	Reduction is the addition of hydrogen to a substance.	Reduction is the addition of electrons to a substance.

Illustration of reduction by Definition 1

$CuO_{(s)} + H_{2(g)} \longrightarrow 2Cu_{(s)} + H_2O_{(l)}$

Questions

e) What was observed in the equation above?

The black solid formed a brown residue and a colorless liquid.

f) Explain your observation?

The copper (ii) oxide was reduced to copper and hydrogen gas was oxidized to water.

Illustration of reduction by Definition 2

$H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$

Questions

g) What was observed in the equation above?

The greenish- yellow gas formed white fuming gas.

h) Explain your observation?

Chlorine gas was reduced to hydrogen chloride by addition of hydrogen.

Illustration of reduction by Definition 3

$Cl_{2(g)} + 2e^- \longrightarrow Cl^-_{(aq)}$

In this equation, chlorine atoms gain electrons to form chloride ions. By this, its said that chlorine atoms have been reduced to chloride ions.

Oxidizing agents	Reducing agents
Oxidizing agents are electron acceptors.	Oxidizing agents are electron donors.
Elements which readily accept electrons in order to complete a full energy level will possess oxidation properties.	Elements which readily donate electrons in order to achieve a full energy level will possess reduction properties.
Elements on the extreme right of the periodic table are oxidizing agents.	Elements on the extreme left of the periodic table are reducing agents.
Oxidizing agents are found in Group VI and Group VII	Reducing agents are found in Group I and Group II
Oxidizing agents in Group VI are OXYGEN and SULPHUR Oxidizing agents in Group VII are FLOURINE and CHLORINE	Reducing agents in Group I are SODIUM and POTASSIUM Reducing agents in Group II are CALCIUM and MAGNESIUM

REDOX REACTIONS

Redox reactions are reactions in which oxidation and reduction occur simultaneously.

REDOX is a short form of two processes;

RED-	REDUCTION
OX-	OXIDATION

Consider the following equations

Equation 1	$CuO_{(s)} + H_{2(g)} \longrightarrow 2Cu_{(s)} + H_2O_{(l)}$
Equation 2	$2Fe^{2+}{}_{(aq)} + Cl_{2(g)} \longrightarrow 2Fe^{3+}{}_{(aq)} + 2Cl^{-}{}_{(aq)}$

In equation 1, copper (ii) oxide is *reduced* to copper and hydrogen is *oxidized* to water.

In equation 2, iron (ii) ions are *oxidized* to iron (iii) ions and chlorine gas is *reduced* to chloride ions.

DISPLACEMENT REACTIONS AS REDOX REACTIONS

Why displacement reactions are called redox reactions.

It's because in a displacement reaction, there is a transfer of electrons from the atoms of one substance to the ions in solution.

NOTE; the more electropositive elements (elements higher in activity series) can displace the less electropositive ones (elements lower in activity series)

Powdered zinc was added to copper (ii) sulphate solution	
Question 1	What was observed? *The blue solution turned to colourless and a brown solid was formed.*
Question 2	Explain your observation? *Zinc loses electrons and dissolves into the solution. These electrons are gained by copper (ii) ions forming copper metal*
Question 3	Write equation(s) for the reaction(s) $Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + 2e^-$ (OXIDATION) $Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$ (REDUCTION)
Question 4	Write the overall equation for the reaction. $Zn_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$

Iron filings were added to copper (ii) sulphate solution	
Question 1	What was observed? *The blue solution turned to green and a brown solid was formed.*
Question 2	Explain your observation? *Iron filings lose electrons and dissolve into the solution. These electrons are gained by copper (ii) ions forming copper metal*
Question 3	Write equation(s) for the reaction(s) $Fe_{(s)} \longrightarrow Fe^{2+}_{(aq)} + 2e^-$ (OXIDATION) $Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$ (REDUCTION)
Question 4	Write the overall equation for the reaction. $Fe_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Fe^{2+}_{(aq)} + Cu_{(s)}$

A Copper foil was suspended in a solution of silver nitrate	
Question 1	What was observed? *The solution gradually turned to blue and a grey metal was formed*
Question 2	Explain your observation? *Copper was oxidized to copper (ii) ions and silver ions were reduced to silver metal.*
Question 3	Write equation(s) for the reaction(s) $Cu_{(s)} \longrightarrow Cu^{2+}_{(aq)} + 2e^-$ (OXIDATION) $Ag^{+}_{(aq)} + e^- \longrightarrow Ag_{(s)}$ (REDUCTION)
Question 4	Write the overall equation for the reaction. $Cu_{(s)} + 2Ag^{+}_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$

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TOPIC	OXIDATION AND REDUCTION (O' LEVEL)
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