OXIDES

Is a compound containing **two** elements only one being oxygen.

CLASSIFICATION OF OXIDES

Oxides are classified as;

- Basic oxide
- Acidic oxides
- Amphoteric oxides
- Neutral oxides
- Mixed oxides
- peroxides

BASIC OXIDES

Is an oxide of a metal which reacts with an acid to produce water and a salt only.

Some basic oxides dissolve in water to form alkaline solution [hydroxide] which turns red litmus paper blue.

Examples of basic oxides

Sodium oxides

Calcium oxides

Potassium oxide

Magnesium oxide

Copper(II) oxide

Reactions of these oxides with acids

Basic oxide + Acid →salt + water

Sodium oxide + hydrochloric acid → sodium chloride + water

Copper(II) oxide + sulphuric acid → copper(II) sulphate + water

Magnesium oxide + nitric acid → magnesium nitrate + water

Reaction of basic oxides with water

Potassium oxide + water → potassium hydroxide

NB:

Most of the basic oxides are insoluble in water

Examples of soluble basic oxides

Sodium oxide, potassium oxide, calcium oxide and magnesium oxide.

Quiz

Write the balanced chemical equation of the above word equations

ACIDIC OXIDES

Are oxides of non-metals which form acids with water.

Acidic oxides are formed when a non-metal burns in oxygen.

Examples of acidic oxides

Carbon dioxide
Sulphur dioxide
Sulphur trioxide
Phosphorus(V) oxide
Nitrogen dioxide

Reaction of Acidic oxides with water

Carbon dioxide + water → carbonic acid
Sulphur dioxide + water → sulphorus acid
Sulphurtrioxide + water → sulphuric acid
Phosphorus (V) oxide + water → phosphoric acid
Nitrogen dioxide +water⟶ nitric acid +nitrous acid
Acidic oxides or acid anhydride react with alkalis like sodium hydroxide or potassium hydroxide to form a salt and water only.
Sulphur trioxide + sodium hydroxide → sodiumsulphate + water

AMPHOTERIC OXIDES

Is a metallic oxide which have both basic and acidic properities i.e. they react with both acids and bases to form water and a salt only.

Examples of amphoteric oxides

Zinc oxide
Aluminium oxide
Lead(II) oxide

BASIC PROPERTY

Zinc oxide + sulphuric acid →zinc sulphate + water
Aluminium oxide + hydrochloric acid → aluminum chloride + water
Lead(II) oxide + nitric acid →lead nitrate + water

ACIDIC PROPERTY [reaction with alkalis]

Zinc oxide reacts with sodium hydroxide forming sodium zincate
Aluminium oxide reacts with sodium hydroxide forming salt called sodium aluminate

NEUTRAL OXIDES

These are oxides which do not show acidic or basic properties [they are neither acidic nor basic] i.e. they do not react with water to form acids and neither do they react with acids to form salts.
Examples include; carbon monoxide, nitrogen monoxide, dinitrogen oxide, water.

MIXED OXIDES

These are oxides that react like mixture of two simpler oxides.
E.g.Tri- lead tetra oxide(Pb_3O_4) reacts like a mixture of 2PbO, and PbO
,Triiron tetraoxide(Fe_3O_4), reacts like FeO, Fe_2O_3

REACTIVITY SERIES

This is the arrangement of elements from the most reactive to the least reactive. The order of the arrangement is based on their reactivity with other substances like oxygen and water.

Competition for oxygen

Elements react differently with oxygen; some react very fast and vigorously while others react slowly.

This shows that some metals have different affinities for oxygen. In terms of affinity for oxygen, the most common metals are ranked in descending order of affinity for oxygen starting with the one with the highest affinity and ending with one with the lowest affinity. This ranking, gives a list called reactivity series.

Reactivity series of metals

Sometimes carbon and hydrogen are included in the list.

Potassium Sodium Calcium	most reactive
Magnesium Aluminum Zinc Carbon Iron Lead	moderately reactive
Hydrogen Copper Silver Mercury Gold	least reactive

NB: The reactivity series helps us to know the possible and impossible reactions

Any metal higher up in the series can displace another metal below it from its salt solution

E.G

Zinc can displace copper from copper(II) sulphate solution.

Zinc + copper(II) sulphate →zinc sulphate + copper

Magnesium can displace iron from iron(II) sulphate solution.

Magnesium + iron(II) sulphate →magnesium sulphate + iron

Any metal higher than hydrogen in the series can displace hydrogen from the solution of the acid (dilute acid)

e.g.

Zinc + dilute hydrochloric → zinc chloride + hydrogen gas

Copper does not react with dilute acids because it's lower than hydrogen in the series. It cannot displace hydrogen from the dilute acid.

More displacement series reaction

1. When a mixture of magnesium powder and copper(II) oxide is heated, a white solid of magnesium oxide and a brown solid of copper are formed.

   Magnesium + copper(II) oxide → magnesium oxide + copper
2. When burning magnesium is placed in a gas jar containing carbon dioxide, it continues to burn and eventually stops forming a white solid of magnesium oxide and black solid particles of carbon.

   Magnesium + carbon dioxide → magnesium oxide + carbon
3. When a mixture of carbon and copper[ii]oxide is heated, carbon dioxide which is colourlesss gas which turns limewater milky and copper which is brown are formed.

   Carbon + copper(II) oxide → carbon dioxide + copper.

Note; write the chemical equations for each of the word equations given and balance them.

1. (a). Name

(i). **two** major components of air

(ii). the process by which the components of air are separated.

(b). Explain why the process you have named in a (ii) can be used to separate the components of air.

(c). Which one of the two components of air are useful as a plant nutrient?

2. (a). A clean sample of steel wool was placed in a test tube containing some water and the test tube was inverted in a trough of water. After three days the volume of air in the test tube changed from 20 cm^3 to 16 cm^3 and a brown layer formed on the steel wool.

(i). Write the formula of the brown solid.

(ii). Calculate the percentage decrease in the volume of air in the tube.

3. Oxygen can be prepared in the laboratory using hydrogen peroxide and a substance X.

(a). Name X.

(b). Write equation leading to the formation of oxygen.

(c). State

(i). the role of X.

(ii). the conditions for the reaction

(d). Name one process that increases the amount of oxygen in the atmosphere.

4. (a). State **three** properties which show that air is a mixture.

` (b). Name two gases, other than oxygen, that are constituent of air and give their approximate percentages in air.

(c). Describe an experiment to determine the percentage of oxygen in air.

(d). (i). State what is observed when burning sulphur is lowered into a jar of oxygen.

(ii). Write the name and formula of the product of the reaction between sulphur and oxygen.

5. (a). Draw a diagram of the setup of the apparatus that can be used to show that iron does not rust in the absence of moisture.

(b). State one other conditions necessary for rusting to take place.

(c). Name two methods for preventing rusting.

6. (a). State the approximate percentage of oxygen in the atmosphere.

(b). Name the process by which oxygen is

(i). used up from the atmosphere.

(ii). replaced in the atmosphere.

(c). State what would be observed if a piece of burning phosphorus is lowered into a jar of oxygen.

7. (a). With the aid of diagram describe an experiment you would carry out to show that rusting requires both oxygen and water in order to occur.

(b). Describe four ways of preventing rusting.

8. When hydrogen peroxide was exposed to sunlight, a gas was formed.

(a). (i). Name the gas.

(ii). State how the gas could be identified

(iii). Write an equation for the reaction leading to the formation of the gas.

(b). Name **one** reagent that can be used to speed up the rate of formation of the gas.

9. (a). State the conditions necessary for rusting to occur.

(b). State one disadvantage of rusting.

(c). (i). What is galvanised iron?

(ii). State **one** use of galvanised iron.

10. (a). (i)Draw a labelled diagram to show how a sample of oxygen can be prepared in laboratory from hydrogen peroxide.

(ii)Write the equation for the reaction that takes place.

(b). State and explain what happens when each of the following substances are lowered in a gas jar of oxygen and water added to the products.

(i). burning sodium

(ii). ignited magnesium

(iii). hot iron.

(c). Name one natural process by which oxygen can be obtained

(d). State **two** uses of oxygen.

11. (a). Write the formulae of the oxides of:

(i). sulphur.

(ii). aluminium.

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(b). State the class to which the oxides of the following elements belong.

(i). sulphur.

(ii). aluminium.

12. (a).(i) Describe how a dry sample of oxygen can be prepared in the laboratory using sodium peroxide

(ii) Write equation for the reaction that takes place.

(b). Oxygen was passed over heated zinc.

(i). State what was observed.

(ii). Write an equation for the reaction.

13. (a). Calcium was burnt in air. Write equation(s) for the reaction that took place.

(b). Few drops of water were added to the product in (a).

(i). State what was observed.

(ii). Write equation for the reaction that took place.

(c). Name one compound which when heated forms the same product as that in (a) above.