**HOME-BASED LEARNING-2021**

**YEAR 11B: CHEMISTRY**

**WEEK 4**

**LESSON NUMBER 40**

**STRAND 4 : MATERIALS**

**SUB-STRAND 4.1 METALS AND NON-METALS**

**LEARNING OUTCOME**

* physical and chemical properties and uses of selected metals.

**Metals**

* Metals are group of elements which includes: Alkali metals (Group I elements), Alkaline earth metals (Group II elements), aluminium and transition elements.
* These elements are generally shiny/lustrous, good conductors of electricity, malleable, ductile and some are magnetic.
* Metals are commonly found in the earth’s crust as metal deposits or ores.

**Chemical properties of metals**

* Exposed metal surface will react with air, water and dilute acids.
* The rate of reaction of different metals is determined by the activity series.
* Its reactivity may also determine the uses of the metal.

**Exercise 16**

1. Name three general features of metals.

2. Suggest two reasons why gold is a metal.

3. Why are our daily eating utensils made up of tin or iron or aluminium instead of gold and silver?

4. Why is mercury used in thermometers?

5. Copper is a better conductor than aluminium, however is more widely used in electrical wiring than copper. Suggest two reasons to explain this.

**LESSON NUMBER 41**

**STRAND 4 : MATERIALS**

**SUB-STRAND 4.1 METALS AND NON-METALS**

**LEARNING OUTCOME**

* Identify the Reactions of Metals

**Displacement Reaction**

* More active metals will displace the less active metals from its solution.
* The active metal will form the solution and the ions of the less active metal will form the metal.

**Reaction of metals with water**

* Highly reactive metals such as sodium and potassium are kept under oil in the laboratory as they react with water vapour in the atmosphere. They react explosively with water so they are not to be reacted in the school laboratory.
* Metals that react with water will release hydrogen gas and the hydroxide of the metal will form. The hydroxide is basic in nature.
* 1. Sodium is a highly reactive metal. It is kept under oil/paraffin in the laboratory to protect the metal from reacting with moist air. Sodium reacts explosively with water to form strong alkali solution, caustic soda, sodium hydroxide and hydrogen gas is released. The hydrogen

**Reactions with air**

- Exposed metal react with oxygen in air to form metal oxides.

- Some of these metal oxides may combine with water vapour in the atmosphere to form hydroxides.

**Calcium**

* Calcium, when exposed to air easily develops a greyish white layer of calcium oxide over the metal. Through strong heating, it burns with a small white flame to form a white solid, calcium oxide.
* 2Ca + O2 → 2CaO

**Magnesium**

- A layer of greyish black magnesium oxide will form on the metal surface after long period of exposure to air.

- Magnesium burns readily in oxygen with a brilliant flame giving a white smoke and a white powder which are both magnesium oxide.

2Mg + O2 → 2MgO

**Aluminium**

- Aluminium does not corrode as a very thin layer of aluminium oxide coats the exposed metal surface preventing any further reaction. In the absence of the oxide layer, aluminium corrodes rapidly to form aluminium oxide, a white powder

. 4Al + 3O2 → 2Al2O3 Zinc

**Zinc**

- reacts very slowly with air. It burns with a green flame to form a white powder, zinc oxide.

2Zn + O2 → 2ZnO

**Iron**

-Iron will not corrode under the following conditions:

-Kept at room temperature in very dry conditions.

- Iron is pure. Placing it in boiled water and the water is covered with paraffin oil.

- Iron rusts in tap water. In the presence of a lot of moisture, a film of moisture covers the surface of the metal.

- Iron burns in oxygen giving off sparks to form iron oxides.

Iron surfaces can be protected from corrosion by the following methods:

1. Electroplating – The surface of the metal is electroplated with tin, a less reactive metal.
2. Galvanising – The surface of the metal is coated with zinc, a more reactive metal. The iron surface is protected as the zinc will corrode first.
3. Greasing/Painting – The layer of grease or paint are water and air proof so the iron surface is dry and not exposed to air. Rusting will not take place.

**EXERCISE 17**

1. Why is sodium kept under oil or paraffin in the laboratory?
2. Write equations for the reaction of sodium with water and with dilute acids
3. Which of the following metals is less dense that water?

A. Aluminium

B. Magnesium

C. Sodium

D. Lead

4. From the following list, choose a metal(s) that is appropriate for each use given below. Give reasons for your choice.

i. Making a cooking pot

ii. Making electrical wireS

iii. Building an aeroplane

iv. Weights for a fishing net

5. Out of the following four elements, which is the most reactive?

A. Zinc B. Gold C. Sodium D. Magnesium

6. Write balanced chemical equations for the reactions of the following metals with dilute HCl, oxygen and water. If a metal does not react with either dilute HCl, oxygen or water, write ‘no reaction’

i. Aluminium

ii. Copper

iii. Magnesium

iv. Zinc

v. Calcium

**LESSON NUMBER 42**

**STRAND 4 : MATERIALS**

**SUB-STRAND 4.1 METALS AND NON-METALS**

**LEARNING OUTCOME**

* describe the production and uses of iron.

**Iron**

- is the second most abundant metal in the earth’s crust and the fourth most abundant element.

-The two common iron ores are **haematite and magnetite**.

- Iron is industrially produced using the **Blast Furnace**.

-The raw materials used are the iron ore, haematite (iron III oxide, Fe2O3 and the main impurity silica, SiO2), limestone and coke (carbon).

Process:

1. Hot air at a temperature of 1900℃ is introduced at the bottom of the furnace heated coke to form carbon monoxide.

2C(s) + O2(g) → 2CO(g)

1. As the hot air moves up the furnace, the temperature decreases to 550℃. At this temperature, iron III oxide is reduced by the carbon monoxide to molten iron.

Fe2O3(s) + 3CO(g) → 2Fe(S) + 3CO2(g)

1. Limestone (calcium carbonate, CaCO3) decomposes to form calcium oxide. The oxide will react with silica to form calcium silicate, Ca3(SiO4)2, slag. Molten slag floats on the surface of molten iron; they are removed separately through separate taps.
2. **The molten iron is run into casts called Cast iron or Pig iron**. It is impure as it contains 3 – 5% carbon and small amounts of silicon and phosphorus.
3. The impurities in Pig Iron are removed by heating it with an iron ore to molten form. The oxygen contained in the ore combines with the non-metal impurities to form such as carbon monoxide. It is removed **as gases or slag.**

**EXERCISE 18**

1. What is the use of the following substances in the Blast Furnace?

a. Coke b. Limestone

2. The chemical process by which iron is produced from iron ore is called

A. reduction.

B. combustion.

C. melting.

D. oxidation.

9. Inside a blast furnace, carbon monoxide reduces iron oxide to iron metal by

A. removing impurities.

B. melting the iron oxide.

C. adding oxygen to iron oxide.

D. removing oxygen from iron oxide.

**LESSON NUMBER 43**

**STRAND 4 : MATERIALS**

**SUB-STRAND 4.1 METALS AND NON-METALS**

**LEARNING OUTCOME:**

* **Define an alloy, examples and its uses**

**Alloy**

* It is homogenous mixture of two or more metals.
* The metals are mixed in definite proportions.
* The property of one of the metal is improved by the alloy.

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Composition | Properties | Uses |
| Brass | Cu (60 - 80%), Zn (40 -20%) | More colourful, high resistant to corrosion, more malleable, low melting point | For making household utensils |
| Bronze | Cu (75-90%), Sn (25-10%) | Lightweight, high resistant to corrosion, stronger | For making coins, idols, utensils, decorative ornaments, springs, turbines, sculpture |
| Solder | Sn (50-75%), Pb (50-25%) | More tensile strength | Soldering of metals |
| Duralumin | Al (96%), Cu (3.5%), Mg (0.5%) | Strong, hard, light weight | In aircraft manufacturing |
| Steel | Fe (99%), C (1%) | High strength and hard | For making nails, screws, bridges |
| Stainless Steel | Fe (74%),Cr (18%), Ni (8%) | Highly resistant to corrosion, does not react with acid, shiny | For making cooking utensils, knives, surface for making food |

**Exercise 19**

1. State the composition of the following alloys:
2. Brass b. Bronze c. Solder d. Stainless steel.
3. Identify a use of each of the alloys in (a) above and explain how it is better than the constituent element(s).

**LESSON NUMBER 44**

**STRAND 4 : MATERIALS**

**SUB-STRAND 4.1 METALS AND NON-METALS**

**LEARNING OUTCOME**

* Identity the physical and chemical properties and uses of selected non-metals.

**Non- Metals**

- Hydrogen, noble gases and Groups IV – VII elements are non-metals.

-These elements are generally dull, brittle and non-conductors of electricity. Some are solids, others are gases and bromine is a liquid at room temperature.

-Some non-metals may form allotropes.

-This means that they may exist in more than one physical form.

The table below summarises the physical properties of common non-metals

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Element | State | m.pt (℃) | b.pt (℃) | Density (gcm-3) | Conductivity |
| Hydrogen (H2) | Colourless Gas | 259.2 | -259.9 | 0.0899 | Non Conductor |
| Oxygen (O2) | Colourless Gas | -215.4 | -183.0 | 1.43 | Non Conductor |
| Nitrogen(N2) | Colourless Gas | -209.9 | -195.8 | 1.25 | Non Conductor |
| Chlorine (Cl2) | Yellow Gas | -101.0 | -34.6 | 3.21 | Non Conductor |
| Neon (Ne) | Gas | -248.6 | -246.1 | 0.901 | Non Conductor |
| Bromine (Br2) | Red liquid | -7.2 | 58.8 | 3.12 | Non Conductor |
| Phosphorous (P) | White solid | 44.1 | 280.0 | 1.82 | Non Conductor |
| Sulphur (S) | Yellow solid | 112.8 | 444.6 | 2.07 | Non Conductor |
| Carbon (C) | Black Solid | 3500.0 | 4827.0 | 2.62 | Conductor |

**Exercise 20**

1. Explain why Carbon can conduct electricity.