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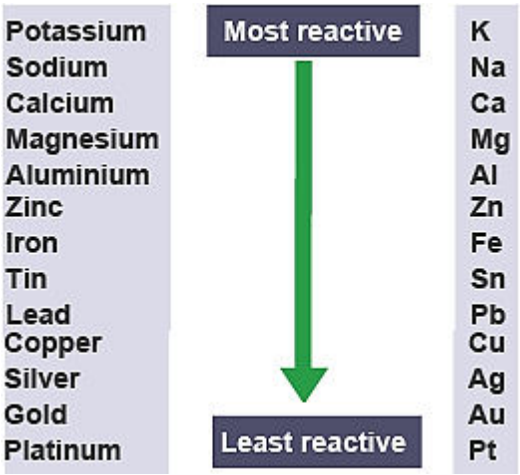
WORKSHEET 13

School: Ba Sangam College **Year:** 11
Subject: Chemistry **Name:**

Strand	**4 - Materials**
Sub strand	**4.1 – Metals and Non-metals**
Content Learning Outcome	**-Examine and explain the physical and chemical properties and uses ofselected metals.**

The Activity Series

The decreasing order ofreactivity is shown in the figure below:



Chemical pproperties of metals

Reactions with air

Exposed metal + oxygen → metal oxides.
metal oxides + water vapour →metal hydroxides.

Calcium

- Calcium, when exposed to air easily develops a greyish white layer of calcium oxide over themetal.
- Through strong heating, it burns with a small white flame to form a white solid, calcium oxide.
- $2Ca + O_2 \rightarrow 2CaO$

Magnesium

- A layer of greyish black magnesium oxide will form on the metal surface after long period ofexposure to air.
- Magnesium burns readily in oxygen with a brilliant flame giving a whitesmoke and a white powder which are both magnesium oxide.
- $2Mg + O_2 \rightarrow 2MgO$

Aluminium

- Aluminium does not corrode as a very thin layer of aluminium oxide coats the exposedmetal surface preventing any further reaction.
- In the absence of the oxide layer, aluminium corrodes rapidly to form aluminium oxide, awhite powder.
- $4Al + 3O_2 \rightarrow 2Al_2O_3$

Zinc

- Zinc reacts very slowly with air. It burns with a green flame to form a white powder,zinc oxide.
- $2Zn + O_2 \rightarrow 2ZnO$

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 will corrode under the following conditions:
  -in tap water
  -in a lot of moisture
  -dissolved ions(seawater) or carbonates.
- Rusting of iron:
  -is destructive
  -dirty yellow flakes of Fe_20_3 falls causing the structure to collapse.
  $Fe + O_2 \rightarrow Fe_2O_3$

Methods to protect iron surface from corrosion

- **Electroplating** – The surface of the metal is electroplated with tin, a less reactive metal.The iron surface is protected as tin does not corrode.
- **Galvanising** – The surface of the metal is coated with zinc, a more reactive metal. Theiron surface is protected as the zinc will corrode first.
- **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.

- **Bluing** – When strongly heated, a blue iron oxide form. It forms a layer on the surfaceof the iron preventing it from corrosion.

Copper

- Exposed shiny copper surface kept in dry air at room temperature turns dull but no furtherreaction will occur. In damp air condition, a green coat, copper hydroxide with other coppersalts slowly forms on the surface of the metal.

Displacement Reaction

- More active metals will displace the less active metals from its solution.
- $Fe(s) + CuSO_4\ (aq) \rightarrow FeSO_4(aq) + Cu(s)$
  Pale green reddish
  brown

Reaction of metals with water

- Highly reactive metals (Na, K) are kept under oil in the laboratory. They react *explosively* with water sothey are not to be reacted in the school laboratory.
- Metals + water → hydrogen gas and the hydroxide (basic in nature)

1. Sodium

- Sodium is a highly reactive metal. It is kept under oil/paraffin in the laboratory to protectthe metal from reacting with moist air. Sodium reacts explosively with water to form strongalkali solution, caustic soda, sodium hydroxide and hydrogen gas is released. The hydrogengas released instantly combust in air.
- $2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$

2. Calcium

- It reacts vigorously with water.
- The hydrogen released istested by placing a lit splint at the mouth of the jar. The gas burns with a 'pop' sound. Thesolution formed turns phenolphthalein pink rapidly.
- $Ca_{(s)} + 2H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)} + H_{2(g)}$

3. Aluminium

- It does not react with water as the surface of the metal is protected by coating of aluminiumoxide.

4. Magnesium

- It reacts slowly with water. Water bubbles may form on the surface of the metal and changein colour of the phenolphthalein indicator is detected after sometime around the metal.
- $Mg_{(s)} + H_2O_{(l)} \rightarrow MgO_{(s)} + H_{2(g)}$

5. Zinc

- It does not react with cold water but redhot zinc will react with steam to form zinc oxideand hydrogen gas.
- $Zn_{(s)} + H_2O_{(l)} \rightarrow ZnO_{(s)} + H_{2(g)}$

6. Iron

- It does not react with cold water, but steam passed over heated iron will form black magnetic oxide of iron.
- $3Fe_{(s)} + 4H_2O_{(g)} \rightarrow Fe_3O_{4(s)} + 4H_{2(g)}$

7. Lead and Copper

- Both metals do not react with water.

Exercise

1. Write equations for the reaction of sodium with water and with dilute acids.**(1 mark)**

   _____
   _____
   _____

2. Metals X, Y and Z were reacted with metals and the gases collected were tested forhydrogen. The results were shown in the table below.

	Observations		
Metals	**Effect on water**	**Effect of solution on phenolphthalein**	**Test for Hydrogen Gas**
X	Reacted vigorously forming bubbles rapidly	Colour changed from colourless to pink	Gas burns with a pop sound
Y	Very slow reaction. Bubbles formed on the surface of the metal	Solution around the metal turned pink	No change
Z	No reaction	No change	No change

(a) Predict what will happen to the size of metal X and give a reason for your answer.

_____
_____

(b) Why did the phenolphthalein change colour?

_____
_____

(c) What can you conclude from the pop sound given off?

_____
_____

(d) Explain why the pop sound was not produced in the other two test tubes.

_____
_____

(4marks)