DAV PUBLIC SCHOOL, PTPS PATRATU

CLASS: 8 SUBJECT: Chemistry *(NOTES)*

LESSON: METALS AND NON METALS

Classification of Elements:

Elements are broadly classified into two groups, viz. metals and non-metals. This classification is done on the basis of their physical and chemical properties.

Occurrence of Elements:

1. Occurrence of Metals: Metals are present in the earth's crust in abundance. Aluminium is the most abundant metal and iron is the next. Highly reactive metals are found in the form of their oxides, sulphides and carbonates, e.g. sodium, potassium, aluminium and zinc. Less reactive metals are found in their elemental or native state, e.g. gold, silver and platinum.
2. Occurrence of Non-metals: Many non-metals are found in their free state in the atmosphere. Some of them also exist in the form of compounds; such as sulphides and sulphates.
3. **Mineral**: A naturally occurring inorganic substance found deep under the surface of the earth is called mineral.
4. **Ore**: A mineral from which one or more metals can be profitably extracted is called ore.Eg. **Bauxite ore of Aluminium, Magnetite ore of Iron.**

Metallurgy: The sequence of processes for obtaining a metal from its ore is called metallurgy. Metallurgy involves following steps:

- **Concentration of ore**: In this process, impurities are removed from ore.
- **Reduction**: In this process, ore is subjected to reduction to obtain metal in its free state,
- **Refining of metal**: Process of purification of metal is called refining.

Physical Properties:

1.**Physical state of metals**: All metals are solid at room temperature. Mercury is an exception as it is a liquid at room temperature.

Physical state of non-metals: Non-metals exist in solid, liquid and gaseous state. Carbon, sulphur, phosphorus and iodine are present as solid. Bromine is a liquid. Chlorine, oxygen and nitrogen are gases.

2.**Melting point and boiling point of metals**: Metals have high melting and boiling points. For example; the melting point of iron is 1536°C and its boiling point is 3000°C. Some metals are exceptions as they have low melting point, e.g. caesium's melting point is 28.7°C.

Melting and boiling points of non-metals: Non-metals have low melting and boiling points. Melting point of sulphur is 119°C, but melting point of carbon is 3723°C.

3.**Density**: Metals usually have a high density, while non-metals have low density.

4.**Hardness**: Metals are usually hard. Non-metals, on the other hand, are brittle and can easily break into pieces. Sodium and potassium are metals which are so soft that they can be cut by knife. Graphite is a non-metal which is very hard.

5.**Lustre**: Metals have a shining surface. This property is called metallic lustre. Non-metals have dull appearance.

6. **Malleability**: Metals can be beaten into thin sheets. This property of metals is called malleability. Non-metals are non-malleable.

7. **Ductility**: Metals can be drawn into thin wires. This property of metals is called ductility. Non-metals are non-ductile.

8. **Tensile Strength**: Metals can bear a lot of strain without breaking. This property of metals is called tensile strength. Non-metals do not have tensile strength, but carbon fibres are exception.

9.**Conductivity**: Metals are good conductors of electricity and heat. Non-metals are poor conductors of heat and electricity. Graphite which is a non-metal is a good conductor of electricity.

10. **Sonority**: When a piece of metal is stuck with something, it produces a typical sound. This property of metal is called sonority and metals are called sonorous. Non-metals are not sonorous.

Metalloids: Some elements show properties of metals as well as non-metals. These are called metalloids. Silicon, germanium, arsenic, etc. are examples of metalloid.

Chemical Properties:

1.**Reaction with oxygen**: Metals react with oxygen to form metallic oxides. Metallic oxides are basic in nature:

Metal + Oxygen → Metal Oxide
When magnesium ribbon is burnt, it reacts with oxygen to make magnesium oxide.

$2Mg + O_2 \rightarrow 2MgO$

Non-metals react with oxygen to form non-metallic oxides. Non-metallic oxides are acidic in nature.
Non metal + Oxygen → Non-metal oxide
When charcoal (carbon) is burnt, it reacts with oxygen to form carbon dioxide.

$C + O_2 \rightarrow CO_2$

2.**Reaction with water**: Different metals react at different rate with water. Sodium and potassium are highly reactive metals. They quickly react with water at normal temperature. The reaction is so vigorous that sodium and potassium catch fire on coming in contact with water. To prevent this, sodium and potassium are stored in kerosene. Most of the metals do not react with water at room temperature. Zinc reacts with boiling water. Iron reacts with steam. Copper, silver and gold do not react with water at any temperature. ***Magnesium reacts with water on heating and forms magnesium hydroxide.***

$Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$

Most non-metals do not react with water, whether it is cold, hot, or steam.

3**. Reaction with acids**: Most of the metals react with dilute acids to make metal salts and liberate hydrogen gas. Some metals like copper and lead do not react with dilute hydrochloric acid.

$Mg + 2\,HCl \rightarrow MgCl_2 + H_2$

Non-metals generally do not react with acids. Some non-metals; like sulphur and phosphorus react with hot concentrated sulphuric acid and nitric acid but they do not liberate hydrogen gas.

4.Reaction with alkalies: Metals like aluminium and zinc react with sodium hydroxide and potassium hydroxide to form salt and hydrogen gas.

Reactivity Series

The reactivity series of metals, also known as the activity series, refers to the arrangement of metals in the descending order of their reactivities.

Most Reactive (K, Na, Ca, Mg, Al): React vigorously with air and water.**Least Reactive (Cu, Ag, Au):** Found in nature as free elements and do not easily react with oxygen or water.

Reactivity Series (High to Low)

1. **Potassium (K)** - Most Reactive
2. **Sodium (Na)**
3. **Calcium (Ca)**
4. **Magnesium (Mg)**
5. **Aluminium (Al)**
6. **Zinc (Zn)**
7. **Iron (Fe)**
8. **Lead (Pb)**
9. **Copper (Cu)**
10. **Silver (Ag)**
11. **Gold (Au)**
12. **Platinum (Pt) -** Least Reactive

Displacement Reaction: A reaction in which a more reactive metal displaces a lesser reactive metal from the aqueous solution of its salt is a type of displacement reaction.

1.When magnesium is added to the aqueous solution of copper sulphate, magnesium displaces copper and forms magnesium sulphate.

$Mg(s) + CuSO_4(aq) \rightarrow MgSO_4(aq) + Cu(s)$

In this *displacement reaction*: magnesium becomes coated with copper, the blue colour of the solution fades as the blue copper(II) sulphate solution is replaced by a colourless magnesium sulphate solution.

2.When an iron object is placed in a blue solution, it turns green forming iron sulphate and a brownish copper layer deposits on the metal.

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

Noble Metals: Some metals are least reactive. These are called noble metals, e.g. gold, silver and platinum. These metals retain their lustre for a long time. Due to this, these metals are preferred for making jewellery.

Uses of Metals:

- Metals are used for making cooking utensils, vessels, water boilers, toys, tools, furniture, machines, etc.
- Metals like copper and aluminium are used for making electrical wires.
- Iron is used for making bridges, buildings and machines.
- Gold, silver and platinum are used for making jewellery.

Uses of Non-metals:

- Nitrogen is an important plant nutrient.
- Phosphorus is used in making matchboxes.
- Iodine is used as antiseptic.
- Sulphur is used for making firecrackers, gun powder and sulphuric acid.
- Oxygen is essential for respiration in all living beings.
- Diamond is used in jewellery and in cutting and grinding tools.
- Graphite is used in batteries and pencils.

ALLOY

An alloy is mixture of more than two metals or a metal and non-metal. Alloys are more durable and resistant to corrosion. Alloys are used for making utensils, machines, engines, etc.

Key Examples of Alloys

Steel (Iron + Carbon): Very strong and hard; used in construction, automobiles, and machinery.

Stainless Steel (Iron + Chromium + Nickel): Resistant to rust and corrosion; used in kitchen utensils, surgical instruments, and pipes.

Brass (Copper + Zinc): Malleable and corrosion-resistant; used in musical instruments, plumbing fittings, and decorative items.

Bronze (Copper + Tin): Hard and durable; used for making statues, medals, and bearings.

Duralumin (Aluminum + Copper + Magnesium): Lightweight and strong; used extensively in aircraft parts.

Solder (Lead + Tin): Low melting point; used for joining electrical components.
Amalgam (Silver/Mercury): Used in dentistry to fill cavities.

WORKSHEET
MCQ

Q-1: Which of the following acids is formed when sulphur dioxide is dissolved in water?
a) Sulphuric acid
b) Sulphurous acid
c) Thiosulphurous acid
d) None of the above
Answer: b) Sulphurous acid

Explanation: When sulphur dioxide is dissolved in water, sulphurous acid is formed.
The reaction can be given as follows: Sulphur dioxide (SO_2) + Water (H_2O) → Sulphurous acid (H_2SO_3).
Q-2: What kind of sound does hydrogen gas make when a lit candle is placed close to the mouth of the test tube where it is evolved?
a) Tinkling
b) Pop
c) Bell tone
d) Sizzle
Answer: b) Pop
Explanation: When a lit candle is held close to hydrogen gas, which is combustible, the hydrogen gas ignites with a pop sound.
Q-3: Which of the following is a non-metal that can be stored in the water?
a) Sodium
b) Potassium
c) Phosphorous
d) Calcium
Answer: c) Phosphorous
Explanation: The non-metal phosphorus is very reactive. If it is exposed to air, it burns.
Phosphorus is held in water to avoid coming into touch with the oxygen in the atmosphere.

Q-4: Which of the following causes blue litmus paper to turn red?
a) Lubricating grease
b) Baking Soda
c) Vinegar
d) Soap
Answer: c) Vinegar
Explanation: Acids cause the blue litmus paper to turn red. Acetic acid can be found in vinegar. As a result, it causes red on blue litmus paper.
Q-5: Which gas results from the reaction of metals and sodium hydroxide?
a) Oxygen gas
b) Hydrogen gas
c) Carbon dioxide gas
d) All of the above
Answer: b) Hydrogen gas
Q-6: Which of the following can displace copper from copper sulphate?
a) Silver
b) Zinc
c) Platinum
d) Gold
Answer: b) Zinc
Explanation: A more reactive metal can displace a less reactive metal, but a less reactive one cannot displace a more reactive metal. Since zinc is more reactive than copper, it can displace copper from copper sulphate.
Q-7: Which of the following, when hammered, can become a powdery mass?
a) Aluminium
b) Carbon
c) Magnesium
d) Iron
Answer: b) Carbon
Explanation: Non-Metals are not malleable. When non-malleable materials are hammered, they become a powdery mass. When hammered, carbon, as a nonmetal, turns into a powdery mass.

Q-8: Some materials have properties such as hardness, lustrousness, malleability, ductility, sonority, and good conductivity of heat and electricity. Identify the material.
a) Non-metals
b) Metals

c) Semiconductors

d) Insulators

Answer: b) Metals

Explanation: The listed properties are the characteristic properties only for metals.

Q-9: Which of the following is not a non-metal?

a) O

b) Cl

c) Be

d) Graphite

Answer: c) Be

Q-10: What is the correct formula for the product formed when magnesium reacts with oxygen?

a) Mg_2O

b) MgO

c) MgO_2

d) Mg_2O_2

Answer: b) MgO

Explanation: When magnesium reacts with oxygen, the following reaction occurs:

$2Mg + O_2 \rightarrow 2MgO + heat$

Q-11: Which of the following oxide is acidic in nature?

a) CaO

b) Al_2O_3

c) SO_2

d) K_2O

Answer: c) SO_2

Explanation: Oxides that are made from non-metals have an acidic nature. Since SO_2 is an oxide of a non-metal, it has an acidic nature.

Q-12: Which of the following is not a metal and is solid?

a) Chlorine

b) Iodine

c) Bromine

d) Sodium

Answer: b) Iodine

Explanation: Iodine exists in a solid state and is not a metal. While chlorine and bromine have gaseous and liquid states, respectively, and are non-metal. Sodium is a metal.

Q-13: Which of the following non metals is lustrous?

a) Oxygen

b) Bromine

c) Iodine

d) Chlorine

Answer: c) Iodine

Explanation: Lustrous is the state of being shiny. Iodine is the only non metal which is lustrous in nature.

Q-14: Metals are typically solid by nature. At room temperature, which of the following metals is in a liquid state?

a) Br

b) Hg

c) Na

d) I

Answer: b) Hg

Explanation: At room temperature, mercury is the only metal that is liquid. Br and I are nonmetals that exist as gases and solids, respectively. Sodium is a metal that is solid.

Q-15: Which of the following characteristics of aluminium makes it appropriate as a wire?

a) Ductility and a good conductor of electricity

b) Only good conductor of electricity

c) Only ductility

d) Malleability

Answer: a) Ductility and good conductor of electricity

Explanation: A substance must be able to be transformed into thin wire while maintaining a high tensile strength in order to qualify as wire. The term “ductility” refers to this quality. Additionally, it should be a good conductor of electricity and conducting in nature.

QUESTION-ANSWER

1. Give reasons for the following.

(a) Aluminium foils are used to wrap food items.

(b) Immersion rods for heating liquids are made up of metallic substances.

(c) Copper cannot displace zinc from its salt solution.

(d) Sodium and potassium are stored in kerosene

Answer:

a) Aluminium is malleable and can be drawn into thin sheets; hence aluminium foils are used to wrap food items

b) Immersion rods for heating liquids are made up of metallic substances because metals are good conductors of heat and electricity.

c) Copper cannot displace zinc from its salt solution because zinc is more reactive than copper.

d) Sodium and Potassium are highly reactive metals which readily reacts with atmospheric oxygen to catch fire; hence sodium and potassium are stored in kerosene.

2. Can you store lemon pickle in an aluminium utensil? Explain.

Answer:

Pickle contains acids which react with aluminium metal to produce salt and hydrogen. Hence pickle is not stored in aluminium utensil.

3. What happens when

(a) Dilute sulphuric acid is poured on a copper plate?

(b) Iron nails are placed in a copper sulphate solution?

Write word equations of the reactions involved.

Answer:

(a) No reaction occurs when dilute sulphuric acid is poured on a copper plate. However, when concentrated sulphuric acid is poured on a copper plate, hydrogen gas evolves along with the formation of blue coloured copper sulphate crystals. The chemical reaction for the reaction between concentrated sulfuric acid and copper is:

$Cu + H_2SO_4$ (conc.) $\rightarrow CuSO_4 + H_2$

(b) Iron, being more reactive, displaces copper from copper sulphate. In this reaction, the blue colour of copper sulphate fades and there is a deposition of copper on the iron nail.

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

4 .Name the property due to which metals shine.

Answer: Lustre

5. Name two metals which are soft enough to be cut.

Answer: Potassium and sodium

6. Name the property due to which metals can be beaten into thin sheets.

Answer: Malleability

7. **How do metals and non-metals react with water?**
Answer: Metals produce their hydroxides or oxides and hydrogen when they react with water. Sodium and potassium react with cold water along with the production of a large amount of heat. Magnesium react with boiling water and iron with steam. Gold, silver and platinum do not react with water. Non-metals do not react with water.

8. Zinc sulphate forms a colourless solution in water. Will you observe any colour on adding copper turning in it?

Answer: Copper has a lower reactivity. As a result, adding it to a zinc sulphate solution does not remove zinc from the salt solution. As a result, the displacement reaction does not occur.

9. **Which of the following metals can displace the other two metals from their salt solutions? Zinc , iron, copper.**

Answer: The given reactive order is Zinc > Iron > Copper

As shown, zinc is the most reactive metal and copper is the least reactive metal of the three metals, with iron's reactivity falling in between these. As a result, zinc metal can displace the other two metals from salt solutions.

10. Paheli prepared a blue coloured solution of copper sulphate in beaker A and placed an iron nail in it. Boojho prepared a yellowish-green solution of ferrous sulphate in beaker B and placed a copper wire in it. What changes will they observe in the two beakers after an hour?

Answer: A reddish-brown layer of copper will form on the iron nail in beaker A, and the blue solution will turn yellowish-green. Beaker B, on the other hand, shows no signs of alteration .Because Fe is more reactive than Cu, it displaces the Cu from the $CuSO_4$ solution in beaker A. As a result of the production of $FeSO_4$, the solution's blue colour changes to green. Because Cu is less reactive than Fe, it cannot displace Fe from $FeSO_4$ solution in beaker B.