



☛ Dear students: - Copy the note and do the given homework on your exercise book!

Subject: - Chemistry

Grade and section 12 (B-D)

Unit: - 5

Main topic: - recycling of Elements

Sub topic: - The Phosphorus Cycle

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Monday, April, 13/2020

The Recycling of Elements in Nature

The Phosphorus Cycle

- ❖ It differs from the nitrogen and carbon cycles primarily in that phosphorus is not found in the atmosphere in the gaseous state.
- ❖ It is an essential nutrient for plants and animals in the form of PO_4^{3-} and HPO_4^{2-} ions.
- ❖ It is part of DNA, ATP and fats of cell membranes.
 - ✓ Phosphate salts are released when phosphate rocks are eroded by rainfall, weathering and runoff. The release of phosphate salts into the soil results in a constant phosphorus supply for plants.
 - ✓ Phosphate salts are absorbed through the roots of plants and are used to make organic compounds.
 - ✓ Animals absorb phosphates by eating plants or plant-eating animals.
 - ✓ When plants and animals die, they decompose and return phosphorus into the soil or water and complete the cycle.
- ❖ In comparison to the nitrogen and carbon cycles, the rate at which phosphate salts are released is extremely slow. Phosphorus can remain in rocks or sediments for millions of years. As a result, the need of phosphate salts for plant growth outweighs the amount of phosphate salts being released. To alleviate the phosphate demand, the addition of phosphate fertilizers has been devised by humans to maintain and increase crop production.

Tuesday: - April, 14/2020

Some Elements in Industry

Metallurgy

- ❖ Metallurgy is the science and technology of extracting metals from their natural sources and preparing them for practical use.
- ❖ The principal steps that are carried out to obtain a metal from its ore are: Concentrating the ore, pre-treatment, extracting the metal and refining (purifying) the crude metal.

1. Concentrating the Ore

- Concentrating an ore increases the fraction of metal-bearing ore by eliminating most of the accompanying rock and soil, called gangue.
- A gangue is undesired material or impurity, which is found together with the ore. The gangue, can be removed in a number of ways.

i) Gravity Separation

- Gravity separation depends on the difference in density between the mineral and the gangue. For example, since gold has a very large density (19.3 g/mL), it can be separated from its gangue by this method.

ii) Magnetic Separation

- Magnetic separation can be used for separating ferromagnetic minerals from their impurities. For example, the mineral magnetite (Fe_3O_4) can be separated from gangue by using a strong electromagnet.

iii) Froth Floatation

- In this process, the ore is finely ground and added to water containing oil and detergent.
- Because of the differences in the surface characteristics of mineral particles and the silicate rock particles, the oil wets only the mineral particles.
- A stream of air blown through the mixture causes tiny bubbles to form on the oil-covered pieces, which then float to the surface in the form of froth or foam, while the gangue settles to the bottom.
- The froth is skimmed off, allowed to collapse, and then is dried to recover the mineral particles. For example, sulphide ores are concentrated by froth flotation.

iv) Amalgamation

- An amalgam is an alloy of mercury with another metal or metals.
- Mercury forms amalgams with a number of metals and can be used to extract these metals from their ores. For example, mercury dissolves silver and gold in an ore to form a liquid amalgam, which is easily separated from the remaining ore.
- The gold or silver is recovered by distilling off the mercury.

v) Leaching

- Leaching is a chemical process of concentrating ore. In this method, the ore is treated with a reagent that dissolves the target substance, leaving the impurities undissolved. For example, aluminium oxide, Al_2O_3 , is separated from bauxite ($\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$) and oxides of iron and silicon impurities by this method.

Exercise

1. Define metallurgy.
2. Describe and give an example of each of the following methods of concentrating ores.
 - A. Gravity separation d Amalgamation
 - B. Magnetic separation e Leaching
 - C. Froth flotation
 - D. Amalgamation
 - E. Leaching

Wednesday, April 15/2020

2. Pre-treatment

- ❖ Pre-treatment converts a mineral to a form that is easy to reduce.

For example, sulfides are converted to reducible oxides by heating them in dry air, a process called roasting: $2\text{PbS(s)} + 3\text{O}_2\text{(g)} \xrightarrow{\text{heat}} 2\text{PbO(s)} + 2\text{SO}_2\text{(g)}$
- ❖ If a metal is to be obtained by electrolytic reduction, its oxide, hydroxide, or carbonate is often treated with HCl to convert it to chloride.
- ❖ Chlorides are preferred for electrolytic reductions because they usually melt at low temperatures, except for aluminium chloride, to form conductive liquids. Molten aluminium chloride is a poor conductor of electricity.

Exercise

1. Why is aluminium containers used to transport nitric acid?
2. Carbonates and sulphide ores are usually converted into oxide ores. Why?
3. The following questions are from the electrolysis of aluminium oxide.
 - A. Why does the anode need to be replaced regularly?
 - B. Write an equation to show how aluminium ions are changed in to aluminium metal.
 - C. Why can't the blast furnace be used to make aluminium?
 - D. Why is cryolite added to the aluminium ore during electrolysis?

Thursday, April 16/2020

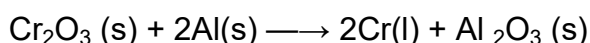
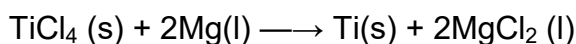
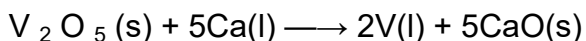
3. Production of Metals

- ❖ Because metals in their combined form always have positive oxidation numbers, the production of a free metal usually involves a reduction process.
- ❖ The production of metals by reduction may be accomplished either chemically or electrolytically.

A. Chemical Reduction

- ❖ A more electropositive metal can be used as a reducing agent to separate a less electropositive metal from its compound at high temperatures.

For example:

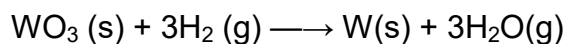


- ❖ The less electropositive metals like copper, tin, lead, zinc, manganese, cobalt, nickel and iron are obtained by reducing their oxides with coke (carbon) at high temperature.



- ❖ Carbon is used as a reducing agent because it is readily available and is cheap. However, it cannot be used to reduce all the metal oxides.

- ❖ Hydrogen may also be used to reduce metals that are lower than itself in the reactivity series. But since hydrogen is more expensive than carbon, it is only used on a large scale for the extraction of tungsten because this process avoids the formation of tungsten carbide.



B. Electrolytic Reduction

- Electrolytic reduction is suitable for highly electropositive metals, such as sodium, magnesium and aluminium.
- Aluminium is extracted by the electrolysis of molten aluminium oxide (Al_2O_3) with cryolite (Na_3AlF_6). Cryolite is added to aluminium oxide to enhance electrical conductivity and to lower the melting point. However, the many metals are extracted by the electrolysis of anhydrous molten halides. At the cathode, metal ions are reduced and at the anode, anions are oxidized.

4. Refining and Alloying

- Metals prepared by reduction usually need further treatment to remove impurities.
- The extent of purification depends on how the metal will be used.
- The three common purification procedures are **distillation**, **electrolysis**, and **zone refining**.

EXERCISE

1. Discuss the main steps in obtaining a pure metal from its ore.
2. What is meant by pre-treatment of an ore? Give some examples of pre-treatment.
3. Describe, with examples, the chemical and electrolytic reduction processes used in the production of metals.

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A. Distillation

- Metals that have low boiling points, such as mercury, magnesium, and zinc, can be separated from other metals by fractional distillation

B. Electrolysis

- The more electropositive metals are removed by an electrolysis process in which the impure one acts as anode and the pure one acts as the cathode. Unit 4).

C. Zone Refining

- In this process, a metal rod containing a few impurities is drawn through an electrical heating coil that melts the metal in the metal rod. Most impurities dissolve in the molten metal. As the metal rod comes out from the heating coil, it cools and the pure metal crystallizes, leaving the impurities in the molten metal portion that is still in the heating coil.
- Purification of the metal occurs because as the crystal reforms, the metal ions are likely to fit much better in the crystal lattice than are atoms of impurities. Several repetitions of this process give a very pure metal. Characteristics as the parent metals. However, because the alloy is a mixture in the form of solid solutions, it is stronger than its parent metals. Form a group. Discuss the following questions in your group. After the discussion, share your ideas with the rest of class.

Exercise

1. Discuss the main steps in obtaining a pure metal from its ore.
2. What is meant by pre-treatment of an ore? Give some examples of pre-treatment.
3. Describe, with examples, the chemical and electrolytic reduction processes used in the production of metals.
4. Describe the process by which a metal is purified by zone refining.