

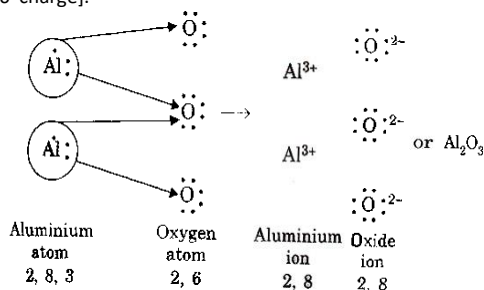
SCIENCE

METALS AND NON-METALS

Answer the following questions

45. How many aluminium atoms would combine with oxygen atoms to form aluminium oxide? Explain.

Ans:- An aluminum atom (2, 8, 3) loses 3 electrons to achieve noble gas configuration of neon gas and forms an aluminum cation [2, 8] having three positive charges. An oxygen atom [2, 6] attains noble gas configuration of neon gas after accepting two electrons and forms an oxide anion with two negative charges. As the final compound is electrically neutral, the positive charges in aluminum oxide compound must be balanced by equal number of negative charges. This is possible when 2 aluminum cations [6⁺ charge] combine with 3 oxide anions [6⁻ charge].



Thus, the ratio between aluminum cations and oxygen anions to form aluminum oxide is 2 : 3. This is indicated by the chemical formula $2\text{Al}^{3+} \cdot 3\text{O}^{2-}$ or Al_2O_3 .

OCCURRENCE OF METALS

1. How is an ore different from a mineral?

Ans:- The metals found in nature in combined state are called minerals.

If some minerals contain a very high percentage of a particular metal and the metals can be profitably and economically extracted, then it is called ore.

2. Explain the following terms: i) Mineral, ii) Ore.

Ans:- i) Mineral: A mineral is a naturally occurring inorganic solid that has a definite composition and a definite structure. Talc and granite are minerals.

ii) Ore: An ore is defined as a mineral from which a metal can be extracted economically. A rock or a natural product serving as a source of non-metallic elements like sulphur and fluorine is also called an ore.

3. Explain with examples the occurrence of metals in [i] free state; and [ii] combined state.

Ans:- i) Free state: A few metals occur in native or in free nature in the earth. Gold, platinum and silver are some of the metals occurring in the free state. They have low chemical reactivity and are not affected by the action of the chemicals or atmospheric conditions. These are the metals at the bottom of activity series.

ii) Combined state: The metals having appreciable reactivity are found in the combined state. They occur as oxides, halides, sulphides, phosphates, silicates etc. the highly electropositive elements [Na, K, Mg, etc.], are found as compounds of highly electronegative elements [chlorine, oxygen etc.]. Weakly electropositive [Fe, Cu] metals are found in combination with weakly electronegative elements [sulphur]. Many metal ores are found as oxides. This is because oxygen is very reactive

and very abundant on earth.

4. Name a metal that occurs in free state in nature.

Ans:- Gold

5. Aluminium occurs in combined state in nature whereas gold is found in free state. Why?

Ans:- Gold has low reactivity and so occurs in free state. Aluminium is electropositive metal and has high reactivity and occurs as oxide or chloride.

6. What is metallurgy?

Ans:- The extraction of a metal from a suitable ore and its refining for use is called metallurgy.

7. In what form pure non-metals exist in nature? Explain.

Ans:- Due to the tendency of the atoms of non-metals to achieve noble gas configuration by covalent bonding, similar atoms tend to combine and thus pure non-metals exist in a variety of molecular stages of aggregation.

eg:- chlorine atoms combine to form a chlorine molecule which is a gas, two bromine atoms combine to form a bromine molecule which being heavier exists as liquid, eight sulphur atoms combine to form S_8 which exists as a solid.

8. Describe the general metallurgical operations briefly.

Ans:- The metallurgical operations mainly involve four steps -

a) Enrichment of ores – Ores are found mixed with many impurities like earthy materials, rocky material, sand, limestone, mica etc. These impurities are known as gangue.

Removal of gangue is based on the differences between physical or chemical properties of ore and the gangue. The separation of gangue from the ore of a metal is called concentration of ore.

Following methods may be used for this purpose. Depending on the chemical composition of the ore and impurities associated with it, suitable methods may be chosen –

(i) Hydraulic washing – In hydraulic washing, the advantage of differences in density is taken into account. The lighter gangue particles are washed away in a stream of water while the heavier minerals stay behind. Ores of tin and lead are very heavy so that they are concentrated by this method.

(ii) Magnetic separation – Some ores are attracted by a magnet whereas gangue is not attracted. The magnetic ores like iron pyrites, FeS and magnetite, Fe_3O_4 are concentrated by this method. The crushed ore is allowed to pass through electromagnetic belts. The mineral particles are retained and gangue particles are thrown away.

(iii) Froth floatation process – is employed for the concentration of sulphide ores. The finely powdered ore is added to water in a tank containing pine or eucalyptus oil. The mixture is agitated by blowing a blast of air. The ore particles preferentially wetted by oil come to the surface with froth while impurities which are wetted with water become heavier and settle at the bottom. The oil froth containing mineral particles which floats on the surface of the water can be skimmed off easily.

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