Oxygen O

General Information

Discovery

For many centuries, workers occasionally realised that air was composed of more than one component. The behaviour of oxygen and nitrogen as components of air led to the advancement of the phlogiston theory of combustion. Oxygen was prepared by several workers, including Bayen and Borch, but they did not recognise it as an element. Its discovery is generally credited to J. Priestley in 1774, in Leeds, and independently to C.W. Scheele in Uppsala, Sweden.

Appearance

Oxygen is a colourless, odourless, tasteless gas.

Source

Oxygen, as a gaseous element, forms 21% of the atmosphere by volume from which it can be obtained by liquefaction and fractional distillation. The element and its compounds make up 49.2%, by weight, of the earth's crust. About two thirds of the human body and nine tenths of water is oxygen. In the laboratory it can be prepared by the electrolysis of water or by heating potassium chlorate with manganese dioxide (manganese (IV) oxide) as a catalyst.

Uses

Oxygen is very reactive and capable of combining with most other elements. It is a component of thousands of organic compounds, and is essential for the respiration of all plants and animals and for almost all combustion.

The greatest commercial use of gaseous oxygen is oxygen enrichment of steel blast furnaces. Large quantities are also used in making synthesis gas for ammonia and methanol, ethylene oxide, and for oxy-acetylene welding.

Biological Role

Oxygen is the basis of all life as part of the DNA molecule. It is breathed in by animals and restored to the air by the photosynthesis mechanism of plants.

General Information

The liquid and solid forms of oxygen are pale blue in colour and strongly paramagnetic. Ozone is a highly active allotropic form of oxygen, and is formed by the action of an electrical discharge or ultraviolet light on oxygen. The presence of ozone in the atmosphere (amounting to the equivalent of a layer 3mm thick at ordinary temperatures and pressures) is of vital importance in preventing harmful ultraviolet rays of the sun from reaching the surface of the earth. Recently, concern has mounted that the use of aerosols is reducing the thickness of this ozone layer.

Physical Information

Atomic Number		8
Relative Atomic Mass (^{12}C=12.000)		15.999
Melting Point/K		54.8
Boiling Point/K		90.188
Density/kg m^{-3}		1.429 (gas, 273K)
Ground State Electron Configuration		$[He]2s^2 2p^4$
Electron Affinity (M-M^-)/kJ mol^{-1}	$O \rightarrow O^-$	141
	$O^- \rightarrow O^{2-}$	-703

Key Isotopes

Nuclide	^{16}O	^{17}O	^{18}O
Atomic mass	1994	16.999	17.999
Natural abundance	99.76%	0.038%	0.200%
Half-life	stable	stable	stable

Ionisation Energies/kJ mol^{-1}

M	- M^+	1313.9
M^+	- M^{2+}	3388.2
M^{2+}	- M^{3+}	5300.3
M^{3+}	- M^{4+}	7469.1
M^{4+}	- M^{5+}	10989.3
M^{5+}	- M^{6+}	13326.2
M^{6+}	- M^{7+}	71333.3
M^{7+}	- M^{8+}	84076.3

Other Information

Enthalpy of Fusion/kJ mol^{-1}	0.444
Enthalpy of Vaporisation/kJ mol^{-1}	6.82

Oxidation States

Main	O^{-II}
Others	O^{-I}, O^{O}, O^{I}, O^{II}

Covalent Bonds/kJ mol^{-1}

O - O	146
O = O	498
N - O	200