Nitrogen *N*

General Information

Discovery

Nitrogen was discovered by Daniel Rutherford in 1772 in Edinburgh, Scotland, but Scheele, Cavendish, Priestley and others about the same time studied “burnt or dephlogisticated air”, as air without oxygen was then called.

Appearance

Nitrogen is a colourless, odourless gas.

Source

Nitrogen makes up 78% of the air, by volume. From this inexhaustible source it can be obtained by liquefaction and fractional distillation.

Uses

The largest consumer of nitrogen in our society is the ammonia industry - the Haber Process - to manufacture fertilisers. Large amounts of gas are also used by the electronics industry, which uses the gas as a blanketing medium during production of such components as transistors, diodes etc. Large quantities of nitrogen are used in annealing stainless steel and other steel mill products. The drug industry also uses large quantities. Nitrogen is used as a refrigerant both for the immersion freezing of food products and for the transportation of food. Liquid nitrogen is also used in missile work and by the oil industry to build up great pressures in wells to force crude oil upwards.

Biological Role

Nitrogen is the basis of life as it is part of the DNA molecule and of proteins.

General Information

The element nitrogen is so inert that Lavoisier named it ‘azote’, meaning ‘without life’, yet its compounds are so active as to be most important in many essential foods, fertilisers, poisons and explosives—as well as in all living organisms.

When nitrogen is heated it combines directly with magnesium, lithium and calcium. When mixed with oxygen and subjected to electric sparks, it forms first nitrogen monoxide and then nitrogen dioxide. When mixed with hydrogen and heated under pressure, ammonia is formed (the Haber Process).

Physical Information

Atomic Number	7
Relative Atomic Mass (^{12}C=12.000)	14.007
Melting Point/K	63.29
Boiling Point/K	77.4
Density/kg m^{-3}	1.25 (gas, 273K)
Ground State Electron Configuration	$[He]2s^2 2p^3$
Electron Affinity (M-M^-)/kJ mol^{-1}	+31

Key Isotopes

Nuclide	^{14}N	^{15}N
Atomic mass	14.003	15.000
Natural abundance	99.63%	0.37%
Half-life	stable	stable

Ionisation Energies/kJ mol^{-1}

M - M^+	1402.3
M^+ - M^{2+}	2856.1
M^{2+} - M^{3+}	4578.0
M^{3+} - M^{4+}	7474.9
M^{4+} - M^{5+}	9440.0
M^{5+} - M^{6+}	53265.6
M^{6+} - M^{7+}	64358.7

Other Information

Enthalpy of Fusion/kJ mol^{-1}	0.720
Enthalpy of Vaporisation/kJ mol^{-1}	5.577

Oxidation States

N^{-3}, N^{-2}, N^{-1}, N^0, N^{+2}, N^{+3}, N^{+4}, N^{+5}

Covalent Bonds/kJ mol^{-1}

N - H	390
N - N	160
N = N	415
N ≡ N	946
N - Cl	193
N - C	286
N = C	615
N ≡C	887