

## General Information

### Discovery

The use of iron was known to ancient civilisations.

### Appearance

Iron is a lustrous, silvery and soft metal. It can be worked relatively easily.

### Source

Iron is the fourth most abundant element, by mass, in the crust of the Earth. The core of the Earth is thought to be largely composed of iron with about 10% occluded hydrogen. The commonest iron-containing ore is haematite, but iron is found widely distributed in other minerals such as magnetite and taconite.

Commercially, iron is produced in a furnace by the reduction of haematite or magnetite with carbon monoxide and carbon, the carbon monoxide being produced *in situ* by the burning of coke.

### Uses

Iron is the most useful of all metals. It is also the cheapest available metal. Most is used to manufacture steel. Ordinary carbon steel is an alloy of iron with carbon (about 1.5%), with small amounts of other elements. Alloy steels are carbon steels with other additives such as nickel and chromium.

Wrought iron is iron containing a very small amount of carbon, and is tough, malleable and less fusible than pure iron.

Pig iron is an alloy containing about 3% carbon with varying amounts of sulphur, silicon, manganese and phosphorus. It is hard, brittle, fairly fusible and is used to produce other alloys including steel.

### Biological Role

Iron is an essential and non-toxic element. It is part of the active site of haemoglobin, and carries oxygen in the bloodstream. Insufficient iron in the blood is the cause of anaemia.

## General Information

Pure iron is very reactive chemically and rapidly rusts, especially in moist air or high temperatures. It reacts with dilute acids.

Iron exists as four allotropic forms, one of which is magnetic. The relationship between these forms is not properly understood.

A remarkable wrought iron pillar which dates from A.D. 400 still stands today in Delhi, India. It is 7.25m high and 40cm in diameter. Corrosion to the pillar has been minimal although it has been constantly exposed to the weather.

## Physical Information

Atomic Number	26
Relative Atomic Mass ( $^{12}\text{C}=12.000$ )	55.847
Melting Point/K	1808
Boiling Point/K	3023
Density/kg m <sup>-3</sup>	7874 (293K)
Ground State Electron Configuration	[Ar]3d <sup>6</sup> 4s <sup>2</sup>
Electron Affinity (M-M <sup>-</sup> )/kJ mol <sup>-1</sup>	-44

## Key Isotopes

Nuclide	<sup>52</sup> Fe	<sup>54</sup> Fe	<sup>55</sup> Fe	<sup>56</sup> Fe	<sup>57</sup> Fe	<sup>58</sup> Fe
Atomic mass		53.940	54.938	55.935	56.935	57.933
Natural abundance	0%	5.8%	0%	91.7%	2.2%	0.3%
Half-life	8.2 h	stable	2.6 yrs	stable	stable	stable
Nuclide	<sup>59</sup> Fe	<sup>60</sup> Fe				
Atomic mass	58.935					
Natural abundance	0%	0%				
Half-life	45.1 days	3x10 <sup>5</sup> yrs				

## Ionisation Energies/kJ mol<sup>-1</sup>

M - M <sup>+</sup>	759.3
M <sup>+</sup> - M <sup>2+</sup>	1561
M <sup>2+</sup> - M <sup>3+</sup>	2957
M <sup>3+</sup> - M <sup>4+</sup>	5290
M <sup>4+</sup> - M <sup>5+</sup>	7240
M <sup>5+</sup> - M <sup>6+</sup>	9600
M <sup>6+</sup> - M <sup>7+</sup>	12100
M <sup>7+</sup> - M <sup>8+</sup>	14575
M <sup>8+</sup> - M <sup>9+</sup>	22678
M <sup>9+</sup> - M <sup>10+</sup>	25290

## Other Information

Enthalpy of Fusion/kJ mol <sup>-1</sup>	14.9
Enthalpy of Vaporisation/kJ mol <sup>-1</sup>	340.2
<b>Oxidation States</b>	
Main	Fe <sup>+2</sup> , Fe <sup>+3</sup>
Others	Fe <sup>-2</sup> , Fe <sup>-1</sup> , Fe <sup>0</sup> , Fe <sup>+1</sup> , Fe <sup>+4</sup> , Fe <sup>+5</sup> , Fe <sup>+6</sup>