Sub-Chapter I

CHEMICAL ELEMENTS

## GENERAL

Chemical elements can be divided into two classes, non-metals and metals. In general, this sub-Chapter includes all non-metals at least in some of their forms, whereas numerous metals are classified elsewhere : - precious metals (**Chapter 71** and **heading 28.43**), base metals (**Chapters 72** to **76** and **78** to **81**) and radioactive chemical elements and isotopes (**heading 28.44**) and stable isotopes (**heading 28.45**).

An alphabetical list of the various known elements, indicating the appropriate classification, is given below. Some elements, such as antimony, behave both as metals and as non-metals; attention is drawn to their classification in the Nomenclature.

| Element | Symbol | Atomic Number | Classification |
|---|---|---|---|
| Actinium..... | Ac | 89 | Radioactive element (28.44). |
| Aluminium..... | Al | 13 | Base metal (Chapter 76). |
| Americium..... | Am | 95 | Radioactive element (28.44). |
| Antimony..... | Sb | 51 | Base metal (81.10). |
| Argon..... | Ar | 18 | Rare gas (28.04). |
| Arsenic..... | As | 33 | Non-metal (28.04). |
| Astatine..... | At | 85 | Radioactive element (28.44). |
| Barium..... | Ba | 56 | Alkaline-earth metal (28.05). |
| Berkelium..... | Bk | 97 | Radioactive element (28.44). |
| Beryllium..... | Be | 4 | Base metal (81.12). |
| Bismuth..... | Bi | 83 | Base metal (81.06). |
| Boron..... | B | 5 | Non-metal (28.04). |
| Bromine..... | Br | 35 | Non-metal (28.01). |
| Cadmium..... | Cd | 48 | Base metal (81.07). |
| Caesium..... | Cs | 55 | Alkali metal (28.05). |
| Calcium..... | Ca | 20 | Alkaline-earth metal (28.05). |
| Californium..... | Cf | 98 | Radioactive element (28.44). |
| Carbon..... | C | 6 | Non-metal (28.03). (But see 38.01 for artificial graphite.) |
| Cerium..... | Ce | 58 | Rare-earth metal (28.05). |
| Chlorine..... | Cl | 17 | Non-metal (28.01). |
| Chromium..... | Cr | 24 | Base metal (81.12). |
| Cobalt..... | Co | 27 | Base metal (81.05). |
| Copper..... | Cu | 29 | Base metal (Chapter 74). |
| Curium..... | Cm | 96 | Radioactive element (28.44). |
| Dysprosium..... | Dy | 66 | Rare-earth metal (28.05). |
| Einsteinium..... | Es | 99 | Radioactive element (28.44). |
| Erbium..... | Er | 68 | Rare-earth metal (28.05). |
| Europium..... | Eu | 63 | Rare-earth metal (28.05). |
| Fermium..... | Fm | 100 | Radioactive element (28.44). |
| Fluorine..... | F | 9 | Non-metal (28.01). |
| Francium..... | Fr | 87 | Radioactive element (28.44). |
| Gadolinium..... | Gd | 64 | Rare-earth metal (28.05). |
| Gallium..... | Ga | 31 | Base metal (81.12). |
| Germanium..... | Ge | 32 | Base metal (81.12). |
| Gold..... | Au | 79 | Precious metal (71.08). |
| Hafnium..... | Hf | 72 | Base metal (81.12). |
| Helium..... | He | 2 | Rare gas (28.04). |

**28-I**

| Element | Symbol | Atomic Number | Classification |
|---|---|---|---|
| Holmium..... | Ho | 67 | Rare-earth metal (28.05). |
| Hydrogen..... | H | 1 | Non-metal (28.04). |
| Indium..... | In | 49 | Base metal (81.12) |
| Iodine..... | I | 53 | Non-metal (28.01). |
| Iridium..... | Ir | 77 | Precious metal (71.10). |
| Iron..... | Fe | 26 | Base metal (Chapter 72). |
| Krypton..... | Kr | 36 | Rare gas (28.04). |
| Lanthanum..... | La | 57 | Rare-earth metal (28.05). |
| Lawrencium..... | Lr | 103 | Radioactive element (28.44). |
| Lead..... | Pb | 82 | Base metal (Chapter 78). |
| Lithium..... | Li | 3 | Alkali metal (28.05). |
| Lutetium..... | Lu | 71 | Rare-earth metal (28.05). |
| Magnesium..... | Mg | 12 | Base metal (81.04). |
| Manganese..... | Mn | 25 | Base metal (81.11). |
| Mendelevium... | Md | 101 | Radioactive element (28.44). |
| Mercury..... | Hg | 80 | Metal (28.05). |
| Molybdenum... | Mo | 42 | Base metal (81.02). |
| Neodymium..... | Nd | 60 | Rare-earth metal (28.05). |
| Neon..... | Ne | 10 | Rare gas (28.04). |
| Neptunium..... | Np | 93 | Radioactive element (28.44). |
| Nickel..... | Ni | 28 | Base metal (Chapter 75). |
| Niobium..... | Nb | 41 | Base metal (81.12). |
| Nitrogen..... | N | 7 | Non- metal (28.04). |
| Nobelium..... | No | 102 | Radioactive element (28.44). |
| Osmium..... | Os | 76 | Precious metal (71.10). |
| Oxygen..... | O | 8 | Non-metal (28.04). |
| Palladium..... | Pd | 46 | Precious metal (71.10). |
| Phosphorus..... | P | 15 | Non-metal (28.04). |
| Platinum..... | Pt | 78 | Precious metal (71.10). |
| Plutonium..... | Pu | 94 | Radioactive element (28.44). |
| Polonium..... | Po | 84 | Radioactive element (28.44). |
| Potassium..... | K | 19 | Alkali metal (28.05). |
| Praseodymium. | Pr | 59 | Rare-earth metal (28.05). |
| Promethium..... | Pm | 61 | Radioactive element (28.44). |
| Protactinium..... | Pa | 91 | Radioactive element (28.44). |
| Radium..... | Ra | 88 | Radioactive element (28.44). |
| Radon..... | Rn | 86 | Radioactive element (28.44). |
| Rhenium..... | Re | 75 | Base metal (81.12). |
| Rhodium..... | Rh | 45 | Precious metal (71.10). |
| Rubidium..... | Rb | 37 | Alkali metal (28.05). |
| Ruthenium..... | Ru | 44 | Precious metal (71.10). |
| Samarium..... | Sm | 62 | Rare-earth metal (28.05). |
| Scandium..... | Sc | 21 | Classified with the rare-earth metals (28.05). |
| Selenium..... | Se | 34 | Non-metal (28.04). |
| Silicon..... | Si | 14 | Non-metal (28.04). |
| Silver..... | Ag | 47 | Precious metal (71.06). |
| Sodium..... | Na | 11 | Alkali metal (28.05). |
| Strontium..... | Sr | 38 | Alkaline-earth metal (28.05). |
| Sulphur..... | S | 16 | Non-metal (28.02). (But see 25.03 for crude sulphur). |
| Tantalum..... | Ta | 73 | Base metal (81.03). |
| Technetium..... | Tc | 43 | Radioactive element (28.44). |
| Tellurium..... | Te | 52 | Non-metal (28.04). |
| Terbium..... | Tb | 65 | Rare-earth metal (28.05). |
| Thallium..... | Tl | 81 | Base metal (81.12). |
| Thorium..... | Th | 90 | Radioactive element (28.44). |
| Thulium..... | Tm | 69 | Rare-earth metal (28.05). |
| Tin..... | Sn | 50 | Base metal (Chapter 80). |
| Titanium..... | Ti | 22 | Base metal (81.08). |
| Tungsten..... | W | 74 | Base metal (81.01). |
| Uranium..... | U | 92 | Radioactive element (28.44). |
| Vanadium..... | V | 23 | Base metal (81.12). |
| Xenon..... | Xe | 54 | Rare gas (28.04). |
| Ytterbium..... | Yb | 70 | Rare-earth metal (28.05). |
| Yttrium..... | Y | 39 | Classified with the rare-earth metals (28.05). |
| Zinc..... | Zn | 30 | Base metal (Chapter 79). |
| Zirconium..... | Zr | 40 | Base metal (81.09). |

**28.01 - Fluorine, chlorine, bromine and iodine.**

2801.10 - Chlorine

2801.20 - Iodine

2801.30 - Fluorine; bromine

This heading covers the non-metals known as halogens, with the **exception** of astatine (**heading 28.44**).

## (A) FLUORINE

Fluorine is a faintly greenish-yellow gas with a pungent odour; it is dangerous to inhale as it irritates the mucous membranes and is corrosive. It is presented under pressure in steel containers; it is a very active element which ignites organic matter - in particular wood, fats and textiles.

Fluorine is used for the preparation of certain fluorides and organo-fluorine derivatives.

## (B) CHLORINE

Chlorine is usually obtained by electrolysis of alkali chlorides, especially sodium chloride.

Chlorine is a greenish-yellow gas, suffocating, corrosive, two and a half times as dense as air, slightly soluble in water and readily liquefied. It is usually transported in steel cylinders, tanks, railway tank wagons or barges.

Chlorine destroys colouring and organic matter. It is used for bleaching vegetable (but not animal) fibres, and in the preparation of wood pulp. Because of its disinfecting and antiseptic properties, it is also used for sterilising (chlorinating) water. It is used in gold, tin and cadmium metallurgy, in the manufacture of hypochlorites, metal chlorides and carbonyl chloride, in organic syntheses (e.g., synthetic dyes, artificial waxes, chlorinated rubber).

## (C) BROMINE

Bromine can be obtained by the action of chlorine on the alkaline bromides contained in saline mother-liquors, or by electrolysing bromides.

It is a very dense (3.18 at 0 °C), corrosive, reddish or dark brown liquid which, even when cold, gives off suffocating red fumes irritating to the eyes. It inflames the skin, turning it yellow, and ignites organic substances such as sawdust. It is presented in glass or pottery containers. It is slightly soluble in water. The heading **excludes** solutions of bromine in acetic acid (**heading 38.24**).

It is used in the manufacture of medicaments (e.g., sedatives), dyes (e.g., eosins, brominated derivatives of indigo), photographic chemicals (silver bromide), lachrymatory products (bromo-acetone), in metallurgy, etc.

## (D) IODINE

Iodine is extracted either from the mother-liquors of natural sodium nitrates by treatment with sulphur dioxide or sodium hydrogen sulphite, or from marine algae by drying, incinerating and chemical treatment of the ash.

**28.01**

It is a very dense solid (specific gravity 4.95 at 0 °C), with an odour reminiscent of both chlorine and bromine; it is dangerous to inhale. It sublimes at room temperature and turns starch-paste blue. When impure, it occurs in specks or as a coarse powder. When purified by sublimation, it takes the form of brilliant, greyish flakes or crystals with a metallic glint; it is then usually put up in glass.

It is used in medicine, and also in the manufacture of photographic chemicals (sodium iodide), dyes (e.g., erythrosines) and medicaments, as a catalyst in organic synthesis, as a reagent, etc.