SECTION 1

BASIC DEFINITIONS AND VOCABULARY ON STRUCTURE OF MATTER

Chemistry: The study of matter, its composition and properties, and the changes it undergoes.

Matter: Anything that has rest mass.

To develop this topic we need to define the **atom**, the basic unit of common matter.

Atom: A neutral particle consisting of a **nucleus** containing most of its mass, and **electrons** occupying most of its volume.

Electron: a subatomic particle [illegible] (Atom)Tj7TT4 1 Tf2.39 0 TD0.0008 (N6 Tw[(containing m)8icle c

These are the elements between the bold and dashed lines on the periodic table.

Isotopes: Atoms of the same element (same atomic number) but with different numbers of neutrons and hence a different mass number [e.g. all atoms of carbon have six protons but

Mg^{2+}; chloride ion, Cl^{-}; oxide ion, O^{2-}

uniformally in a continuous phase (the dispersion medium). **Aerosols**, liquid in gas [e.g. mist, fog] or solid in gas [e.g. smoke]. **Emulsions**, liquid in liquid [e.g. cream, fat in water, and butter, water in fat]. **Sol** or **colloidal suspension**, solid in liquid; **slurry** or **paste** when concentrated. **Foam**, gas in liquid or gas in solid. **Gel**, a polymeric dispersed phase in a liquid. The dispersed phase has a huge surface area which gives colloids their distinctive properties. Colloids are **heterogeneous mixtures**.

Chemical formulae: Part of the language used by chemists to represent substances and compounds [e.g. H_2O is the formula for water].

Molecular formula: The formula for a discrete molecule. It gives the symbol of each

the ions. [e.g. In NaCl made up of Na^+ and Cl^- the valency of both Na and Cl is one.]

Polymer: A substance having large molecules consisting of repeated units (the **monomers**). Polymers do not have a definite formula as they consist of molecules of different chain length.
[e.g. polyethylene, H-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2- or H-$(CH_2$-$CH_2)_x$-H where *x* is a large number and the monomer is ethylene, C_2H_4; the polymeric silicates above.]

Free-radical: An atomic, molecular, or ionic particle with an unpaired valence electron [e.g. chlorine atom, Cl·]. Usually chemically reactive. See *sections 3 - 4*.

To understand why pure substances have particular compositions and properties we need to know about the "electronic structure" of the atoms (i.e. the way the electrons are arranged about the nucleus of the different elements). Then we can rationalise the ratio in which atoms combine and whether they are molecular, polymeric or ionic, [e.g. why gaseous nitrogen consists of discrete N_2 molecules; methane, ammonia, water and hydrogen fluoride consist of discrete molecules of CH_4, NH_3, H_2O, HF respectively (H_4C, H_3N, OH_2, FH are in principle equally valid formulae, but not normally used); why sodium chloride consists of Na^+ and Cl^- ions; why metals exist in nature mainly as cations, M^{x+}; why free-radicals are reactive]. The topic of electronic structure is covered in *section 3*.

Organic chemistry: The chemistry of the compounds of carbon. Originally meant chemistry of products formed in living systems.

Inorganic chemistry: The chemistry of compounds other than carbon, but includes CO, CO_2 and carbonates.

Nomenclature: The naming of substances. This is covered in *section 6* (organic) and in *section 13* (inorganic).

EXERCISES

From the periodic table give the name and symbol of the element, and the number of neutrons

9. Cystine, molecular, two nitrogens, two sulfurs, twelve hydrogens, four oxygens and six carbons

10. Potassium bromide composed of K^+ and Br^- ions

11. Ammonium nitrate composed of NH_4^+ and NO_3^- ions

12. Magnesium nitrate composed of Mg^{2+} and NO_3^- ions

13. Aluminium sulfate composed of Al^{3+} and SO_4^{2-} ions