Appendix 1 Quantities, units, and notational conventions

A1

The result of a measurement is a **physical quantity** (such as mass or density) that is reported as a numerical multiple of an agreed **unit**:

physical quantity = numerical value × unit

For example, the mass of an object may be reported as $m = 2.5$ kg and its density as $d = 1.010$ kg dm^{-3} where the units are, respectively, 1 kilogram (1 kg) and 1 kilogram per decimetre cubed (1 kg dm^{-3}). Units are treated like algebraic quantities, and may be multiplied, divided, and cancelled. Thus, the expression (physical quantity)/unit is simply the numerical value of the measurement in the specified units, and hence is a dimensionless quantity. For instance, the mass reported above could be denoted m/kg = 2.5 and the density as d/(kg dm^{-3}) = 1.01.

Physical quantities are denoted by italic or (sloping) Greek letters (as in m for mass and Π for osmotic pressure). Units are denoted by Roman letters (as in m for metre).

Names of quantities

A **substance** is a distinct, pure form of matter. The **amount of substance**, n (more colloquially 'number of moles' or 'chemical amount'), in a sample is reported in terms of the **mole** (mol): 1 mol is the amount of substance that contains as many objects (atoms, molecules, ions, or other specified entities) as there are atoms in exactly 12 g of carbon-12. This number is found experimentally to be approximately 6.02×10^{23} (see the endpapers for more precise values). If a sample contains N entities, the amount of substance it contains is $n = N/N_A$, where N_A is the Avogadro constant: $N_A = 6.02 \times 10^{23}$ mol^{-1}. Note that N_A is a quantity with units, not a pure number.

An **extensive property** is a property that depends on the amount of substance in the sample. Two examples are mass and volume. An **intensive property** is a property that is independent of the amount of substance in the sample. Examples are temperature, mass density (mass divided by volume), and pressure.

A **molar property**, X_m, is the value of an extensive property, X, of the sample divided by the amount of substance present in the sample: $X_m = X/n$. A molar property is intensive. An example is the **molar volume**, V_m, the volume of a sample divided by the amount of substance in the sample (the volume per mole). The one exception to the notation X_m is the **molar mass**, which is denoted M. The molar mass of an element is the mass per mole of its atoms. The molar mass of a molecular compound is the