Resource 1 – Chapter 1

An alternative expression for the ideal gas equation

The ideal gas equation ($PV = nRT$) can be rearranged to give the relationship between molar mass (M) and density (ρ).

Insert the expression $n = \frac{m}{M}$ (where m is the mass of a substance) into the ideal gas equation to get:

$$PV = \frac{mRT}{M}$$

which rearranges to:

$$M = \frac{mRT}{PV}$$

Now consider the expression for density:

$$\rho = \frac{m}{V} \qquad \text{or} \qquad m = \rho V$$

Inserting this expression into the formula above gives:

$$\boldsymbol{M = \frac{\rho RT}{P}}$$

This equation must be used with caution, as it requires ρ to have units of g m^{-3}.