

F1 Developing a model of the atom

Revision: rearranging equations

In chemistry, you need to use equations to calculate different values.

1. The amount of substance in moles (n) in a solution can be calculated when the concentration given in mol/dm³ (c) and volume (v) in cm³ are known by using the equation:

$$n = \frac{cv}{1000}$$

- (a) Complete the rearranged equation below, where c is the subject of the equation.

$$c =$$

- (b) Rearrange this equation making v the subject of the equation.

2. The density of a substance can be calculated from its mass (m) and volume (v) using the equation:

$$d = \frac{m}{v}$$

- (a) Rearrange this equation so that the mass of a substance can be calculated given its density and volume.

- (b) Chemists usually work with masses expressed in grams (g) and volumes in cubic centimetres (cm³). However, the SI unit for density is kilograms per cubic metre (kg m⁻³). Write an expression for the calculation of density in the SI unit of kg m⁻³ when the mass (m) of the substance is given in g and the volume (v) of the substance is given in cm³.

3. The de Broglie relationship relates the wavelength of a moving particle (λ) to its momentum (p) through Planck's constant (h):

$$\lambda = \frac{h}{p}$$

- (a) Rearrange this equation to make momentum (p) the subject of the formula.

Momentum can be calculated from mass and velocity using the following equation.

$$p = mv$$

(b) Using this equation **and** the de Broglie relationship, deduce the equation for the velocity of the particle.

4. Finally, to check your calculator use, calculate the value of x if:

$$x = \frac{2.2 \times 10^7}{5.07 \times 10^{-13}} \quad x =$$

New content: subatomic particles

In this lesson, you will learn how the atomic model we use now was developed over time. You'll need to appreciate the sizes of the subatomic particles.

1. Research the following masses and charges to complete the table (keep to four significant figures):

Particle	Proton	Neutron	Electron
Mass (in kg)			9.109×10^{-31}
Charge (in coulombs, C)	$+1.602 \times 10^{-19}$		

- How many times heavier is a proton than an electron?
- If a proton has a mass of 1 unit, what is the mass of a neutron in the same units?
- How many electrons would be the same mass as 2 neutrons?
- Comment on the charge of the electron versus the proton.
- If a proton is given a relative charge of +1, what is the relative charge of the electron?