Motion, forces and energy

P1.4 Density

Density

- Density is the mass per unit volume of a substance.
- It shows how much matter (mass) is packed into a given space.
- A substance is more dense if:
  - its particles are heavier (greater mass), or
  - its particles are packed more closely together (less space between them).

  E.g. lead is denser than wood as its particles are heavier *and* more tightly packed.
- Symbol for density: ρ (Greek letter rho).

Equation: $\rho = \frac{m}{V}$ where $\boldsymbol{\rho}$ = density (kg/m^3 or g/cm^3), $\boldsymbol{m}$ = mass (kg or g), and $\boldsymbol{V}$ = volume (m^3 or cm^3)

Determining density

Density of a Liquid	**Density of a Regularly Shaped Solid**
• Measure mass of empty measuring cylinder. • Pour in liquid and measure new mass. **Mass of liquid = total mass – mass of empty cylinder**. • Read volume of liquid in measuring cylinder. • Calculate density using $\rho = m \div V$.	• Measure mass of object using a balance. • Measure its dimensions (e.g. length, width, height for a cube). • Calculate volume using formula. Cube/block: V = l × w × h Sphere: V = 4/3 π r^3 • Calculate density using $\rho = m \div V$.

Density of an Irregularly Shaped Solid (that *sinks* in water)

- Measure mass of solid object.
- Fill measuring cylinder with water and record initial volume.
- Carefully place the solid in the water.
- Record new volume of water. **Volume of solid = change in water volume**.
- Calculate density using $\rho = m \div V$.
- For **floating objects**, you must ensure the whole object is submerged to measure the correct volume.

Floating and sinking

- An object **floats** if its density is **less than** the liquid's density. An object **sinks** if its density is **greater than** the liquid's density. E.g. Water's density = 1.0 g/cm^3
  Iron = 7.9 g/cm^3 → sinks Wood ≈ 0.7 g/cm^3 → floats