P1.6.4 Power

Power

Power is a measure of **how fast work is done** or **how fast energy is transferred**.

- If something has **high power**, it does work quickly or transfers energy quickly.
- If something has **low power**, it does work slowly or transfers energy slowly.

Equations:

- Power = Work done ÷ Time
- $P = \frac{W}{t}$

  where P = power (watts, W), W = work done (joules, J) and t = time (seconds, s)

  E.g. A car engine doing 3000 J of work in 2 seconds has a power of 3000/2 =1500 W

- Power = Energy transferred ÷ Time

  $P = \frac{\Delta E}{t}$ where ΔE = change in energy (joules, J), and t = time (seconds, s)

  E.g. A 60 W light bulb transfers 60 J of energy every second.

Key idea: Work and energy are basically the same thing here - power just tells you the amount of work done or energy transferred per time.

Questions:

A crane lifts a 500 kg load 10 m in 20 s. Calculate the power developed.

- Step 1: Calculate work done (force × distance)
  W = Fd = ΔE = 500 × 9.8 × 10 = 49,000 J
- Step 2: Calculate power
  P = W/t = 49,000/20 = 2,450 W or 2.5 kW

An electric kettle uses 2000 W of power and is switched on for 3 minutes. Calculate the energy transferred.

- Convert time to seconds: 3 min = 3 ×60 = 180 s
- $E = P \times t$ E = 2000 × 180 = 360,000 J or 360 kJ