Motion, forces and energy

P1.2 Motion

Speed

- Definition: Speed = distance travelled per unit time. Equation: $v = \frac{s}{t}$
  where v = speed (m/s), s = distance (m), t = time (s).
- Average speed: total distance travelled ÷ total time taken

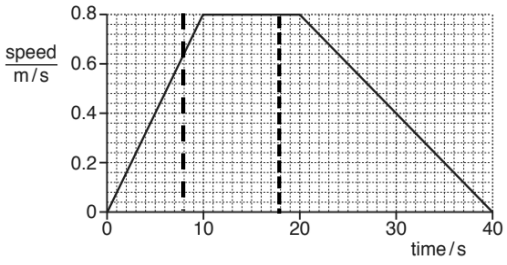
Distance–Time Graphs

- Gradient (slope) = speed.
- Horizontal line: object at rest.
- Straight diagonal line: constant speed.
  - Calculating speed from a distance–time graph. Gradient (slope) = speed
  - Speed = change in distance ÷ change in time $s = \frac{\Delta d}{\Delta t}$
- Steeper line: faster speed.
- Curved line getting steeper: object is accelerating (speeding up). Curved line getting flatter: object is decelerating (slowing down).

Speed–Time Graphs

- Horizontal line: constant speed.
- Upwards slope, straight line: constant acceleration - speed rises at a steady rate
  - Acceleration is the change in speed per unit time for an object moving in a straight line.
  - $a = \frac{\Delta v}{\Delta t}$ where a = acceleration (m/s^2), Δv = change in speed (m/s) and Δt = time taken for change (s)
- Downwards slope: straight line: constant negative acceleration or constant deceleration.
- Area under the line: distance travelled
  - Rectangles: base x height
  - Triangles: ½ base x height

  e.g. (1/2 x 10 x 0.8) + (10 x 0.8) + (1/2 x 20 x 0.8) = 20 m



Free fall

- Near the Earth's surface: acceleration due to gravity g ≈ 9.8 m/s^2. All free-falling objects accelerate downward at roughly this rate (ignoring air resistance).