

Speed

$v = d/t$ Units: distance time⁻¹ e.g. ms⁻¹

Instantaneous speed. Looking at the speedometer of a car at regular intervals, you would notice it changes often. It gives the instantaneous speed, the speed at a particular instant in time.

Average speed. If you travelled a distance of 5 km and the trip lasted 0.1 hours, the **average** speed would be $5/0.1 = 50$ km h⁻¹. During your trip, there may be times that you were stopped and other times the speedometer was reading 45, 65 or even 80 km h⁻¹ but, *on average*, you moved with a speed of 50 km h⁻¹.

Acceleration

$a = \frac{\Delta v}{\Delta t}$ is change in speed / time;

The Δ means change
Units: distance time⁻² e.g. ms⁻²

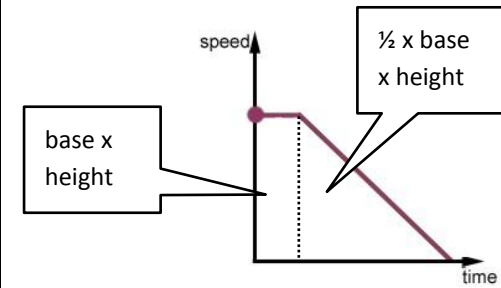
Don't say "going faster" or "going slower" but instead say "increasing speed" or "decreasing speed".

Acceleration can be calculated by the gradient or slope of a speed-time graph.

Gradient = rise/run

Speed-time graphs

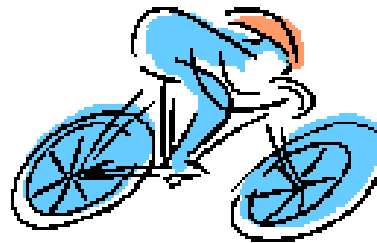
On a **speed-time** graph, the area under the graph is the distance travelled.



Distance-time graphs

- Horizontal line = stopped / stationary
- Straight line = constant speed
 - The steeper the slope or gradient of the line the greater the speed
 - Downward sloping line means going back to where you came from – **not** reversing / slowing.
- Curve – accelerating decelerating

MECHANICS



SURVIVAL SHEET – PART 1 OF 2

Mass and weight

- Mass is amount of stuff, measured in kg.
- Weight is a force, measured in N, so to turn mass into weight use $F = m g$ where $g = 10 \text{ ms}^{-2}$
- A 80 kg boy has a weight of 800N. A 650N girl has a mass of 65 kg.

Energy

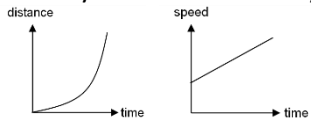
$E_k = \frac{1}{2}mv^2$ $E_p = mg\Delta h$

Energy can neither be created nor destroyed.

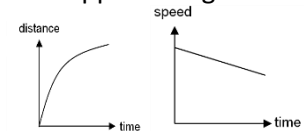
Dropping a ball; (at top) $mg\Delta h = \frac{1}{2}mv^2$ (just before hits ground) as air resistance is negligible.

The same motion can be shown on 2 different graphs.

A car, initially travelling at 30 km h⁻¹, accelerates steadily to overtake a lorry.



A car approaching red traffic lights, intending to stop!



Speed-time graphs

On a **speed-time** graph

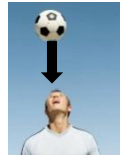

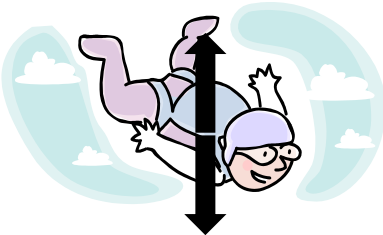

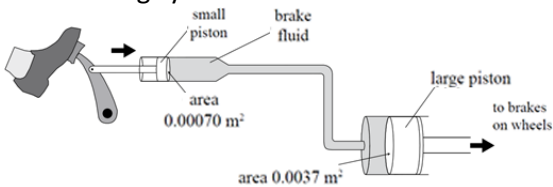
- Horizontal line = constant speed
- Straight line = constant acceleration or deceleration
 - The steeper the line the greater the acceleration or deceleration

Sliding/skiing/snowboarding/free-wheeling down a hill!

Total conversion of E_p to E_k would occur only in a frictionless world! $E_p = E_k$ (E_p) $mg\Delta h = \frac{1}{2}mv^2$ (E_k)
At the top, the only type of energy is gravitational potential energy, E_p , if the person is not moving. The E_p at the top is more than E_k gained on the way down because some of the E_p will be changed to heat (and some sound) by friction with air he is moving through & the surface he is sliding, skiing or rolling over. $E_p = E_k + \text{heat}$



(Frictional force may be calculated by Heat = Fd)

<p>Work & Power</p> <p>$W = Fd$ Where W is work in J, F is force in N and d is distance in m.</p> <p>e.g. A ramp for a wheelchair allows the same work to be done with a smaller force exerted over a greater distance.</p> <p>$P = \frac{W}{t}$ Where P is power in W or Js⁻¹, W is work in J and t is time in s.</p> <p>Power is the rate at which work is done.</p> <p>A more powerful person/thing does more work in the same time or the same work in less time.</p>	<p>Force diagrams – use arrows to show some or all of... Horizontal forces ← and → & Vertical forces ↓ and ↑</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">  <p>A falling thing & a thing thrown vertically</p> <p>straight up only have one force acting on them – weight (as long as air resistance is small).</p> </div> <div style="width: 45%;"> <p>As some things fall they experience an upward force called air resistance. Objects with large surface areas (e.g. parachutes) fall more slowly since they experience more air resistance.</p>  </div> </div>	<p>Balanced & unbalanced forces</p> <p>If forces are unbalanced, things accelerate.</p> <p>If forces are balanced, things move at constant speed/ remain stationary. (For the effect of balanced forces, you must clearly indicate no acceleration. "stays on the ground", "does not move", "stays still", "doesn't change speed", could all be descriptions of the effect of balanced forces).</p> <p>A sky diver at terminal velocity - the downward force (weight) equals the upwards force (air resistance). The forces are balanced so the sky diver falls at a constant speed.</p>
<p>Work done: Lifting vs carrying or dragging</p> <p>If you are <u>carrying</u> something "along" there are NO forces acting on <u>it in the direction of motion</u> (no change in speed so no change in energy) so no work is done.</p> <ul style="list-style-type: none"> BUT if you are <u>dragging</u> something "along" there are friction forces acting on it so work is done. $W = Fd$ where F is the force used to drag/push and d is the distance. BUT if you are lifting something, work is done against the force of gravity which is pulling the "something" downwards. $W = Fd$ where F is weight and d is height. 	<div style="text-align: center;">  <p>SURVIVAL SHEET – PART 2 OF 2</p> </div>	<p>Pressure</p> <p>$P = \frac{F}{A}$</p> <p>where Pressure is in Nm⁻² or Pa, Force (weight) is in N and Area is in m²</p> <p>e.g. A person of weight 600 N wears smooth-soled shoes each with an area of 16 cm² (1.6 x 10⁻³ m²).</p> <p>The pressure exerted by the person is: 600/(1.6 x 10⁻³ x 2) = 190 000 Pa</p> 
<p>F(net) = ma</p> <p>Force (N) = mass (kg) x acceleration (ms⁻²)</p> <p>Net forces; If forces are unbalanced, things <u>accelerate</u> because a single force – the net force – seems to act.</p> <p>Adding two forces to find the net force: 10 N (←) and 30 N (→) = 20 N (→) 10 N (←) and 30 N (←) = 40 N (←)</p> <p>Names for forces ↑ reaction/upthrust /air resistance, ↓ weight, ←/→ drag OR thrust depending on their direction.</p>	<p>Uses of Pressure</p> <p>Pressure can be used to change forces e.g. cars use a hydraulic braking system.</p>  <p>The pressure is the same at both pistons. The piston with a larger area exerts a greater force. So a small force at the small piston is magnified into a large force at the large piston.</p>	<p>Pressure continued...</p> <p>Pressure is inversely related to area of contact so pressure is greater if force acts over a smaller area.</p> <ul style="list-style-type: none"> Wearing knee pads to play volleyball – this does not affect the force when you land, but increases the area that the force of impact acts on. Pads increase the area, reducing the pressure on your knees. Smooth-soled shoes exert less pressure than moulded soles with ridges on them (assuming the same weight person is wearing both). 