

# Physics Knowledge Organiser

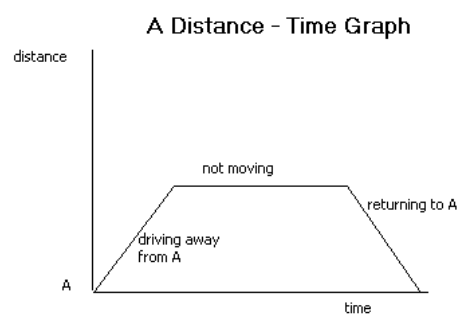
## P9 - Motion

### Speed vs. Velocity

Speed and velocity are both quantities that measure the rate of change of distance, but velocity includes the direction. This makes velocity a vector quantity, so we can show velocity with an arrow. Typical speeds are walking: 1.5 m/s, running 3m/s, cycling 6 m/s.

### Distance-time Graphs

A distance-time (DT) graph shows how far an object has gone from its starting point at a certain time. A slope means the object is moving, because distance is changing as time changes. If the line of the graph is horizontal, the object cannot be moving because distance is not changing with time. The gradient (steepness of the slope) tells you the speed of the object.

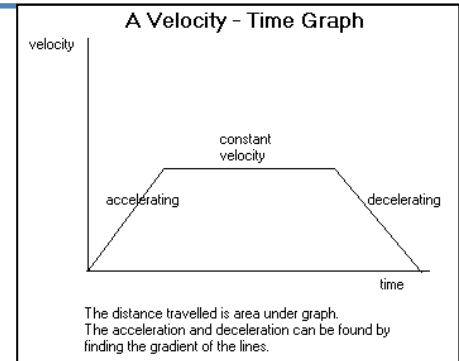


### Acceleration

Acceleration is the measure of how quickly velocity changes. It is a vector quantity, because direction is included. (see equation)  
Acceleration is shown on a DT graph by a line whose gradient *changes* – i.e. a curve, rather than straight line.

### Velocity-time Graphs

A velocity-time (VT) graph shows the velocity of an object at any particular time on its journey. Using the gradient of a slope, you can find the acceleration. The distance travelled during the journey is also shown on a VT graph – but you have to work it out by calculating the area under the line on the graph. Sometimes the area can be found by counting squares, other times you'll need to use area of a rectangle/triangle to find the area and therefore distance.



Key Terms	Definitions
Speed	The measure of how quickly distance changes. Speed does not include direction, so it's a scalar quantity. It is measured in metres per second (m/s).
Velocity	Velocity is a vector quantity. Like speed, it is a measure of how quickly distance changes BUT it includes the direction of movement. It is measured in m/s <b>HT:</b> moving in a circle, even if speed is the same, involves a constantly changing velocity because the <b>direction</b> is constantly changing.
Gradient	Gradient means slope. The gradient of a line on a graph is found by dividing the vertical (y-axis) change by the horizontal (x-axis) change.
Acceleration	Acceleration is the rate of change in velocity. It usually means speeding up, because we use the term <b>deceleration</b> for slowing down. You must recall that objects in freefall near Earth's surface have an acceleration of 10 m/s <sup>2</sup> .
Deceleration	A <b>negative</b> acceleration – slowing down.

Equation	Meanings of terms in equation and units
$s = v t$	$s = \text{distance (m)}$ $v = \text{speed (m/s)}$ $t = \text{time (s)}$
$a = \frac{\Delta v}{t}$	$a = \text{acceleration (metres per second squared, m/s}^2\text{)}$ $\Delta v = \text{change in velocity (m/s)}$ $t = \text{time (s)}$
$v^2 - u^2 = 2 a s$	$v = \text{final velocity (m/s)}$ $u = \text{initial (starting) velocity (m/s)}$ $a = \text{acceleration (m/s}^2\text{)}$ $s = \text{distance travelled (m)}$

### Freefall through a fluid (gas, like air, or a liquid)

Freefalling object initially accelerate due to gravity, but friction (/air resistance) increases with speed until the forces are balanced (resultant force = 0 N). Then, the object is falling at its **terminal velocity**.

