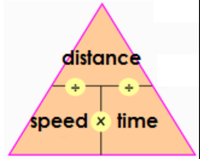
9P2 Motion Knowledge Organiser

Week 1: SPEED



Speed calculated by the following formula: **Speed = Distance / Time**

We measure speed using different devices, based upon the object and the precision required. Therefore we can use different units however as scientists, internationally we prefer to use metres/second

Light gate	Measures the time by an object breaking a laser line and then passing past it.	Falling object and precise measurements of small objects
Stopwatch	Measures time between two points	Runner doing a lap, covering ground
Ruler	Measures the distance between two points	Reaction tests, moving trolleys
Motion Sensors	Uses the echo of ultrasound to measure distance	Plotting instantaneous graphs over distance/time

Remember **SI units** for time = seconds, distance = metres. Calculations often involve converting units such as speeds of car (measured in miles/hour).

Car Speedometer

Units then need to be converted in **SI units** for the answers.
E.g. 50 miles per hour into m/s
50 (miles) x 1609 (m/mile) = 80,450 metres
1 (hour) x 60 (mins) x 60 (secs) = 3600 seconds

Speed = 80,450 metres / 3600 seconds
= 22.35 m/s

Distance v Time graph

A graph of distance against time tells you about the speed of an object on its journey. The speed is equal to the **gradient** or **slope** of the graph.

- A straight line means the object's speed is constant because the gradient is not changing.
- A horizontal line means that the object is not moving.
- The steeper the line, the faster the object is travelling.

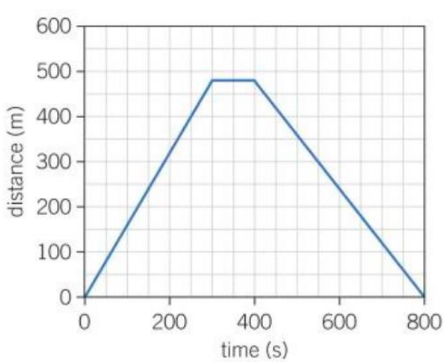


Figure 6 *A graph to represent a journey.*

Week 2: VECTOR, SCALAR & ACCELERATION

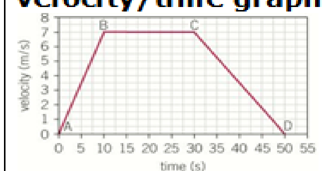
In physics, we have 2 different types of quantities to measure. Those which only have a size or magnitude and others which have both a magnitude AND a direction.
SCALAR quantities only measure SIZE e.g. SPEED (remember the S's)
VECTOR quantities measure the SIZE & DIRECTION e.g. VELOCITY (remember the V's)
They often have arrows to show the direction e.g. all forces are vector quantities.

SCALAR QUANTITIES	VECTOR QUANTITIES
speed, distance, mass, volume, density, energy, time, pressure, area,	velocity, displacement, weight, force, momentum, acceleration,

How far a car travels in 2 hours

Scalar: The car travels 60 mph for 2 hours
Vector: The car travels 60 mph east, then south, then west, then north
Distance travelled: the car has travelled 120 m
Displacement: =0 as the car has gone back to the starting location.

velocity/time graph



Points A to B show the **initial velocity**. Points B to C show movement without change in speed or direction, and points C to D show the **final velocity**. The **Displacement** is the area underneath the line.
Comparatively on a speed/time graph, the area under the line is the total **distance** travelled

We use these measurements to calculate the **constant acceleration** of an object using the following formulas (called **SUVAT**), where by the following applies:

s = **displacement** (used because in this case distance is the same)
u = **initial velocity**
v= **final velocity**
a= **acceleration**
t= time

1) $v = u + at$
2) $v^2 - u^2 = 2as$

These equations can be re-arranged according to the data provided and the answer needed.

E.g. When dropped a tennis ball falls a distance of 1.5 m with an acceleration of 10 m/s (gravity). Calculate the final velocity.

- Make **final velocity** the subject of the equation and pick the correct equation based upon the info you have (do not have time so you pick equation 4 instead of 1).
- Write down what you know and input into equation

S = 1.5 m/s
U = 0 (starts with 0 velocity)
V = ?
A = 10 m/s²
T = ?

$v^2 = u^2 + 2as$
$v^2 = 0^2 + (2 \times 10 \times 1.5)$
$v = \sqrt{30.0}$
final velocity = 5.4772 m/s = 5.5 m/s

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Week 3: KEYWORDS

acceleration
The change in velocity/change in time, measured in m/s^2
average speed
Total distance/total time, usually measured in m/s
constant acceleration
An object's acceleration which is linear and increases/decreases its velocity by the same amount each second
deceleration
Negative acceleration or slowing down - the change in velocity/change in time, measured in - m/s^2
displacement
The distance from a point in a particular direction (vector)
distance
The total distance travelled by an object between two points (scalar)
final velocity
Symbol – *v* – the velocity of an object *after* acceleration causes a change
gradient
The degree of steepness of a graph at any point. Also called slope
initial velocity
Symbol – *u* – the velocity of an object *before* acceleration causes a change
scalar
A quantity that has magnitude (size) but no direction
SI units
International system of units. The set of standardised units that all scientists use around the world to calculation equations. These are metre, kilogram, second, ampere, kelvin, candela, and mole. All other units are derived from these.
slope
Slope measures the steepness of a line on a graph. Also called gradient
speed = distance / time
The standard equation you are expected to remember to calculate any of these subjects
scalar
A quantity that has direction as well as a magnitude (size)
SUVAT
The most common technique used to solve acceleration and displacement calculations where s = displacement; u = initial velocity; v = final velocity; a = acceleration and t = time.
velocity
The speed in a particular direction, a vector