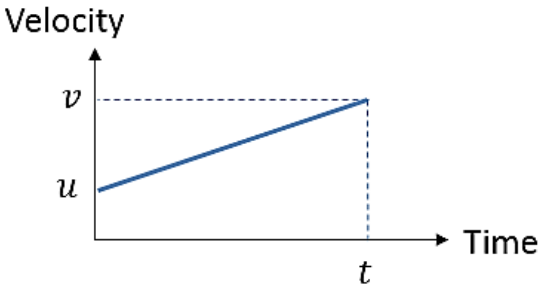
3-4. Constant Acceleration Formulae (SUVAT Equations)

These formulae are used to solve problems where the object is moving in a **straight line with constant acceleration for a specific period of time**. You should memorise these and know how to derive them.



$$Acceleration = \frac{change\ in\ velocity}{time}$$

$$v =$$

(Equation 1)

For uniform acceleration, the average velocity is the average of v and u. Using the area of the graph (which we know gives distance):

$$s =$$

(Equation 2)

Eliminating v - sub for v from equation 1 into equation 2:

$$s =$$

(Equation 3)

Eliminating t - sub for t from equation 1 into equation 2:

$$v^2 =$$

(Equation 4)

Eliminating u – sub for u from equation 1 into equation 2:

$s =$

(Equation 5)

- Work out what you know
- Work out what you need
- Choose the appropriate equation
- Diagrams help!
- Work out which direction will be positive
- Check that your units are consistent

Example

A stone slides in a straight line across a horizontal sheet of ice. It passes a point, A with velocity $14ms^{-1}$ and a point, B 2.5 seconds later. Assuming the deceleration is uniform and that AB = 30m, find:

a) The deceleration

b) The velocity at B

c) How long after passing A the stone comes to rest

Example – Deceleration Leading to a Change in Direction

A particle travels with uniform deceleration $2ms^{-2}$ in a horizontal line. The points A and B lie on the line and AB = 32m. At time t = 0, the particle passes through A with velocity $12ms^{-1}$ in the direction AB. Find:

a) The values of t when the particle is at B

b) The velocity of the particle for each of these values of t.

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A lorry is moving along a straight horizontal road with constant acceleration. The lorry passes a point A with speed u m s^{-1}, ($u < 34$), and 10 seconds later passes a point B with speed 34 m s^{-1}. Given that $AB = 240$ m, find

(a) the value of u,

(3)

(b) the time taken for the lorry to move from A to the mid-point of AB.

(6)

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5. Vertical Motion Under Gravity

The downwards acceleration under gravity is $g = 9.8$ ms^{-2}.
ALWAYS state the positive direction in your calculations.
Quote final answers to 2 or 3 s.f. – you may be penalised if you quote more.

Example

A ball is thrown vertically upwards with a velocity of 14.7ms^{-1} from a platform 19.6m above the ground. Find:

a) The time taken for the ball to reach the ground

b) The velocity of the ball when it hits the ground

Example

A ball is projected vertically upwards from ground level at a speed of 20 ms^{-1}.
Determine the amount of time the ball is at least 10m above ground level.

Example – When Two Particles are in Motion

Two stones are thrown from the same point at the same time - one vertically upwards with speed $30ms^{-1}$ and one vertically downwards at $30ms^{-1}$. Find how far apart the stones are after 3 seconds.

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