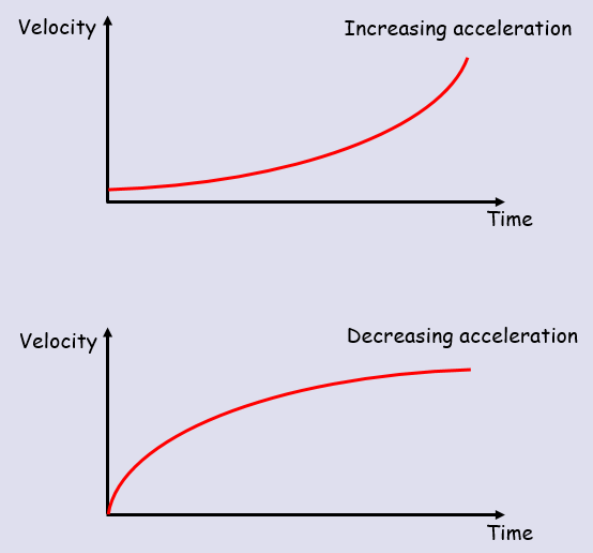
11A Functions of Time



1. A body moves in a straight line, such that its displacement, s metres, from a point O at time t seconds is given by $s = 2t^3 - 3t$ for $t > 0$

a) Find the value of s when $t = 2$

b) Find the time taken for the body to return to O.

2. A toy train travels along a straight track, leaving the start of the track at time $t = 0$. It then returns to the start of the track. The distance, s metres, from the start of the track at time t seconds is modelled by:

   $s = 4t^2 - t^3$ where $0 \leq t \leq 4$

   Explain why there is a time restriction on this model

3. A body moves in a straight line such that its velocity, $v\, ms^{-1}$, at time t seconds is given by:

   $v = 2t^2 - 16t + 24$ for $t \geq 0$

   Find:

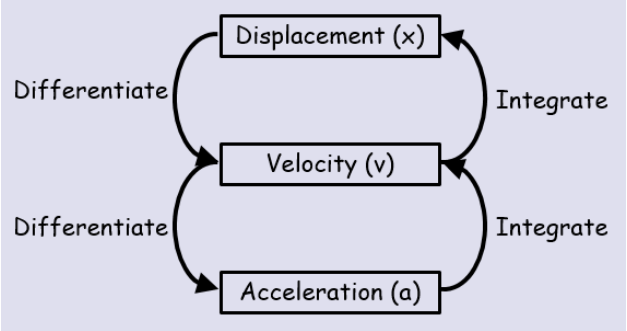
a) The initial velocity

b) The values of t when the body is instantaneously at rest

c) The value of t when the velocity is 64ms^{-1}

d) The greatest speed of the body in the interval $0 \leq t \leq 5$

11B Differentiating between x, v, a



1. A particle P is moving along the x-axis. At time t seconds, the displacement x metres from O is given by:

$$x = t^4 - 32t + 12$$

Find:

a) The speed of P when t = 3

b) The value of t for which P is instantaneously at rest

c) The magnitude of acceleration when t = 1.5

11C Maxima & Minima

1. A child is playing with a yo-yo. The yo-yo leaves the child's hand at time $t = 0$ and travels vertically in a straight line before returning to the child's hand. The distance in metres, s of the yo-yo from the child's hand after time t seconds is given by:

$$s = 0.6t + 0.4t^2 - 0.2t^3, \quad 0 \leq t \leq 3$$

d) Justify the restriction $0 \leq t \leq 3$

e) Find the maximum distance of the yo-yo from the child's hand, to 3sf

11D Integrating between x, v, a

1. A particle is moving on the x-axis. At time $t = 0$, the particle is at the point where $x = 5$. The velocity of the particle at time t seconds ($t \geq 0$) is $(6t - t^2)\ ms^{-1}$. Find:

a) An expression for the displacement of the particle from O at time t seconds

b) The distance of the particle from its starting point when $t = 6$

2. A particle travels in a straight line. After t seconds its velocity, $v\ ms^{-1}$, is given by $v = 5 - 3t^2, \quad t \geq 0$. Find the distance travelled by the particle in the third second of its motion.

11E Deriving SUVAT

1. A particle moves in a straight line with constant acceleration, $a\ ms^{-2}$. Given that its initial velocity is $u\ ms^{-1}$ and its initial displacement is 0m, prove that:

a) The particle's velocity at time t seconds is given by $v = u + at$

b) The particle's displacement, s, at time t is given by $s = ut + \frac{1}{2}at^2$