

Section 1: Using calculus

Exercise level 1

- For each of the following:
 - find an expression for the velocity,
 - calculate the initial position and initial velocity,
 - find the time and position when the velocity is 0.
 - $s = 5 + 3t - 2t^2$
 - $s = 4t^2 - 3t$
 - $s = 2t^3 - 4t^2 - 8t + 3$
- For each of the following:
 - find an expression for the acceleration,
 - calculate the initial velocity and initial acceleration.
 - $v = 3t + 2$
 - $v = 4t^2 - 3t + 5$
 - $v = 4t^3 - 3t^2 + 5$
- Given that $v = 3t + 2$ and that when $t = 0$, $x = 5$,
 - Find x in terms of t .
 - Find x when $v = 26$.
 - Find v when $x = 10$.
 - Find a .
- The displacement of particle P from a fixed point O at time t seconds is given by $s = t^3 + 2t^2 + 3t + 4$. Find expressions for the velocity $v \text{ ms}^{-1}$ and the acceleration $a \text{ ms}^{-2}$ and hence find the values of v and a when $t = 2$.
- The displacement, s m, at time t seconds, of a particle from a fixed point is given by $s = 2t^2 + 3t - 2$.
 - Find the initial displacement and the initial velocity.
 - Find any times at which the velocity is zero.
 - Find any times at which the particle is at the origin.
- For a particle moving in a straight line the displacement at time t from a fixed point O is given by $s = t^3 - 2t^2 - 15t$.
Find:
 - The initial velocity and acceleration.
 - The times at which the velocity is zero.
 - The minimum velocity.
- The velocity of a particle moving in a straight line at time t is given by $v = 2t^3 - 9t^2$.
Given that the initial displacement $s = 20$, find an expression for s in terms of t and the times when the acceleration is zero.

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8. The velocity of a particle moving in a straight line at time t is given by $v = 8t - 3t^2$. The particle is initially at O. Find:
- v when $t = 2$
 - an expression for the acceleration of the body at time t
 - the acceleration when $t = 3$
 - an expression for the displacement of the body from O at time t
 - how far the body is from O when $t = 3$



9. A particle passes through a fixed point O such that its acceleration t seconds later is given by $a = 3 + 2t$. Given that $v = 10$ when $t = 2$, find the displacement attained in the interval $2 \leq t \leq 4$.
10. A body moves so that its displacement, s m, from a fixed point O after t seconds is given by $s = t^3 - 3t^2 - 9t$.
- Find the velocity after t seconds.
 - When is the body instantaneously at rest?
 - Sketch the velocity-time and acceleration-time graphs.
11. An object moving in a straight line has an initial velocity of 2 ms^{-1} at point O on the line. The acceleration t seconds later is given by $a = 2t - 6$.
- Find expressions for the velocity $v \text{ ms}^{-1}$ and the displacement s m in terms of t .
 - Calculate s and v when $t = 5$ and comment on your answers.