VELOCITY AND ACCELERATION AS A RATE OF CHANGE

1 A particle moves in a straight line so that its displacement x m from a fixed point O on the line at any time t seconds ($t \geq 0$) is given by $x = t^2 - 5t + 6$. Find:

(a) its initial displacement **(b)** its initial velocity
(c) when it first passes through O and with what velocity
(d) when it passes through O the second time and with what velocity
(e) when and where its velocity is zero.

2 The displacement x m at time t seconds ($t \geq 0$) of a particle moving in a straight line is given by $x = 2t^3 - t^2 + 4t + 1$. Its acceleration is given by:

A $a = 2t^3 - t^2 + 4t + 1$ **B** $a = 6t^2 - 2t + 4$ **C** $a = 12t - 2$ **D** $a = 12$

3 The displacement x m at time t seconds ($t \geq 0$) of a particle moving in a straight line is given by $x = t^2 - 5t + 4$.

(a) At what time is its velocity zero? **(b)** What is the acceleration at this time?

(c) What is the distance travelled in the first 4 seconds? **(d)** At what time is the velocity $8\,\text{m}\,\text{s}^{-1}$?

4 A point moving in a straight line is distant x m from the origin O at time t, where $x = 2t^3 - 15t^2 + 36t$.

(a) Find the velocity and acceleration at any time t.

(b) Find the initial velocity and acceleration. **(c)** At what times is the velocity zero?

(d) At what time is the acceleration zero? Find the velocity and position at this time.

(e) During what interval of time is the velocity negative?

5 The displacement x m at time t seconds of a particle moving in a straight line is given by $x = 2t^3 - 9t^2 + 12t + 6$. Find:

(a) when its acceleration is zero, and its velocity at this time

(b) when its velocity is zero, and its acceleration at this time.

6 Two bodies move along a straight path, starting at the same time, so that their displacement x m from a fixed point O at any time t is given by $x = t + 6$ and $x = t^2 + 4$ respectively. At what times are they:

(a) together **(b)** travelling with the same velocity?

8 Two cars A and B travel along a straight road in the same direction. Their respective distances x km from a fixed point O at any time t hours are given by the following rules:

A: $x = 50t - 20t^2$ B: $x = 80t^2 + 20t$

(a) Calculate each car's speed at the point O.

(b) At what time are the cars travelling at the same speed?

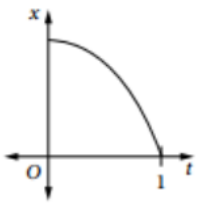
(c) Both cars reach a point Q at the same time. Calculate the distance from O to Q.

(d) A third car, travelling at uniform speed, is 2 km ahead of A and B when they pass the point O. If this car arrives at Q at the same time as A and B, find a rule connecting x and t for it.

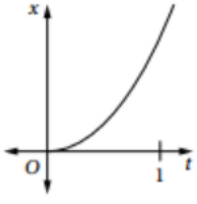
9 A particle moves in a straight line so that its displacement $x(t)$ from a fixed point in the line at time $t \geq 0$ is given by $x(t) = 3 + 4t - 5\sqrt{t^2 + 4}$. Find the particle's displacement when it comes to rest.

10 A particle is moving so that, for $0 < t < 1$, its velocity is positive and its acceleration is negative. Which graph could represent the displacement function of this particle?

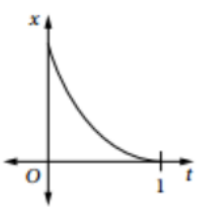
A



B



C



D