Variable Acceleration

(1) A particle P travels along a straight line through a point O so that at time t s after passing through O its displacement from O is x m, where $x = t^3 - 15t^2 + 62t$

Find

(a) the initial velocity of P, (3)

(b) the value of t for which P has zero acceleration. (2)

(2) The acceleration of a particle after t seconds is given by $(4t - 8)$ ms^{-2}. Given the velocity (v) of the particle is 6 ms^{-1} when $t = 0$.

(a) Find v in terms of t. (3)

(b) Find the distance between the two points the particle is instantaneously at rest. (7)

(3) The velocity of a particle after t seconds is given by $v = (6t - 2)$ m s^{-1}. After 5 seconds the displacement is 75m from O.

(a) Find an expression for the displacement. (3)

(b) Find the displacement after 10 seconds. (2)

(4) A particle P moves in a straight line such that at t seconds, $t \geq 0$, its velocity, v ms^{-1} is given by:

$$v = 12 - 2t^2$$

Find:

(a) the distance travelled by P in the first second, (3)

(b) the value of t when P changes direction of motion, (2)

(c) the value of t at the instant P returns to its starting point. (3)

(5) A particle P travels along a straight line through a point O so that at time t s after passing through O its displacement from O is x m, where $x = 2t^3 - 18t^2 + 48t$

Find

(a) the times when P is instantaneously at rest, (3)

(b) the total distance travelled in the first 5 seconds. (5)

6 A particle P moves on the x-axis. At time t seconds the velocity of P is v m s^{-1} in the direction of x increasing, where

$$v = 2t^2 - 14t + 20, \qquad t \geqslant 0$$

Find

(a) the times when P is instantaneously at rest,

(3)

(b) the greatest speed of P in the interval $0 \leqslant t \leqslant 4$

(5)

(c) the total distance travelled by P in the interval $0 \leqslant t \leqslant 4$

(5)

7 A particle travels in a straight line such that its acceleration, a m s^{-2}, at time t seconds is given by $a = 6t + 2$. When $t = 2$ seconds, the displacement, s, is 10 metres and when $t = 3$ seconds the displacement is 38 metres. Find:

a the displacement when $t = 4$ seconds   (6 marks)

b the velocity when $t = 4$ seconds.   (2 marks)

8 A train moves in a straight line along a 4 km test track. The motion of the train is modelled as a particle travelling in a straight line, and the distance, s m, of the train from the start of the track after time t seconds is given by $s = 3.6t + 1.76t^2 - 0.02t^3$, $0 \leqslant t \leqslant 90$. Show that the train never reaches the end of the track.

(7 marks)

9 The print head on a printer moves such that its displacement s cm from the side of the printer at time t seconds is given by:

$$\tfrac{1}{4}(4t^3 - 15t^2 + 12t + 30), \ 0 \leqslant t \leqslant 3$$

Find the distance between the points when the print head is instantaneously at rest, in cm to 1 decimal place.

(6 marks)