Year 2 Chapter 11
Variable Acceleration: Differentiation

Q1.

A particle P moves on the positive x–axis.

The velocity of P at time t seconds is $(2t^2 – 9t + 4)$ m s^{-1}.

When $t = 0$, P is 15 m from the origin O.

Find

(a) the values of t when P is instantaneously at rest,

(3)

(b) the acceleration of P when $t = 5$

(3)

(Total for question = 6 marks)

Q2.

A particle, P, moves along a straight line such that at time t seconds, $t \geq 0$, the velocity of P, v m s^{-1}, is modelled as

$$v = 12 + 4t – t^2$$

Find the magnitude of the acceleration of P when P is at instantaneous rest,

(5)

(Total for question = 5 marks)

Q3.

A fixed point O lies on a straight line.

A particle P moves along the straight line such that at time t seconds, $t \geq 0$, after passing through O, the velocity of P, v m s^{-1}, is modelled as

$$v = 15 – t^2 – 2t$$

(a) Verify that P comes to instantaneous rest when $t = 3$

(1)

(b) Find the magnitude of the acceleration of P when $t = 3$

(3)

(Total for question = 4 marks)

Q4.

At time $t = 0$ a particle P leaves the origin O and moves along the x-axis. At time t seconds, the velocity of P is v m s^{-1} in the positive x direction, where

$$v = 3t^2 - 16t + 21$$

The particle is instantaneously at rest when $t = t_1$ and when $t = t_2$ ($t_1 < t_2$).

(a) Find the value of t_1 and the value of t_2.

(2)

(b) Find the magnitude of the acceleration of P at the instant when $t = t_1$.

(3)

(Total for question = 5 marks)

Q5.

A fixed point O lies on a straight line.

A particle P moves along the straight line.

At time t seconds, $t \geq 0$, the distance, s metres, of P from O is given by

$$s = \frac{1}{3}t^3 - \frac{5}{2}t^2 + 6t$$

Find the acceleration of P at each of the times when P is at instantaneous rest.

(Total for question = 6 marks)

Q6.

A particle P moves along a straight line.

At time t seconds, the velocity v m s^{-1} of P is modelled as

$$v = 10t - t^2 - k \qquad t \geq 0$$

where k is a constant.

(a) Find the acceleration of P at time t seconds.

(2)

The particle P is instantaneously at rest when $t = 6$

(b) Find the other value of t when P is instantaneously at rest.

(4)

(Total for question = 6 marks)

Q7.

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

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

Find

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

(3)

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

(5)

(Total 8 marks

Q8.

Unless otherwise indicated, wherever a numerical value of g is required, take $g = 9.8$ m s^{-2} and give your answer to either 2 significant figures or 3 significant figures.

A particle, P, moves along the x-axis. At time t seconds, $t \geq 0$, the displacement, x metres, of P from the origin O, is given by $x = \frac{1}{2}t^2(t^2 - 2t + 1)$

(a) Find the times when P is instantaneously at rest.

(5)

(b) Find the total distance travelled by P in the time interval $0 \leq t \leq 2$

(3)

(c) Show that P will never move along the negative x-axis.

(2)

(Total for question = 10 marks)