



Scan for the solutions

Name: _____ **Date:** _____ **Score:** _____ / 88

- 1** A particle P moves along a straight line. At time t seconds, $t \geq 0$, the displacement of P from a fixed point O on the line is x metres, where

$$x = 2t^3 - 9t^2 + 12t + 1$$

- Find an expression for the velocity of P at time t seconds.
- Find the two times at which P is instantaneously at rest.
- Find the acceleration of P when $t = 3$
- Find the displacement of P from O when $t = 2$

(6 marks)

Answer _____

- 2** A particle moves along the x -axis. At time t seconds the velocity of the particle is $v \text{ m s}^{-1}$ in the positive x direction, where

$$v = 3t^2 - 4t + 2, \quad t \geq 0$$

When $t = 0$ the particle is at the origin O .

- Find the displacement of the particle from O when $t = 3$
- Find the acceleration of the particle when $t = 3$
- Show that the particle is never at rest.

(6 marks)

Answer _____

3

A particle moves in a straight line. At time t seconds its acceleration is $a \text{ m s}^{-2}$, where

$$a = 6 - 2t, \quad t \geq 0$$

When $t = 0$ the velocity of the particle is 4 m s^{-1} .

- Find an expression for the velocity of the particle at time t seconds.
- Find the maximum velocity of the particle.
- Find the time at which the particle comes to instantaneous rest, giving your answer to 3 significant figures.

(6 marks)

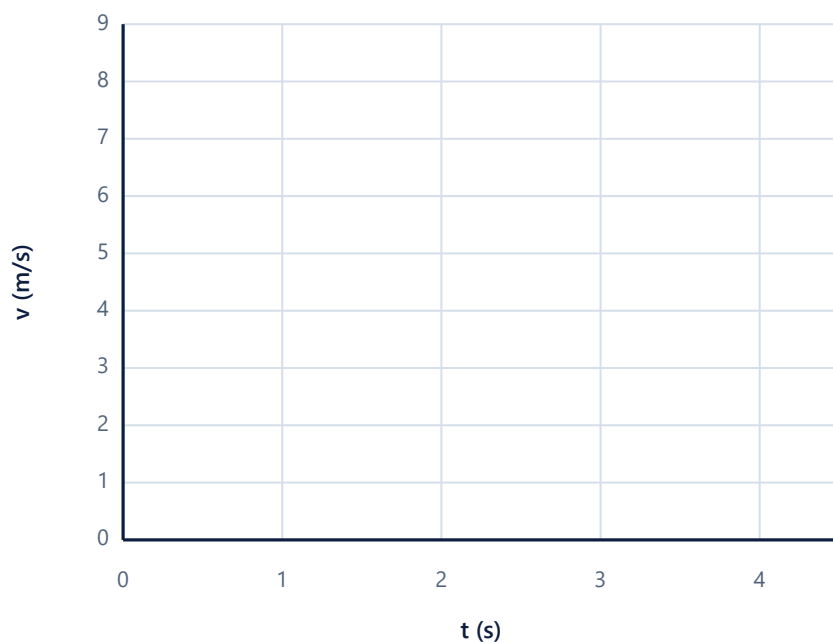
Answer _____

4

A cyclist rides along a straight road between two sets of traffic lights. She starts from rest at the first set and stops at the second set. Her velocity t seconds after leaving the first set is $v \text{ m s}^{-1}$, where

$$v = 8t - 2t^2, \quad 0 \leq t \leq 4$$

- Sketch a velocity-time graph for the motion of the cyclist on the axes below.
- Find the maximum speed of the cyclist.
- Find the distance between the two sets of traffic lights.



(7 marks)

Answer _____

- 5 A particle P moves along a straight line. At time t seconds the velocity of P is $v \text{ m s}^{-1}$, where

$$v = t^2 - 5t + 4, \quad t \geq 0$$

When $t = 0$, P is at the point O .

- Find the values of t at which P is instantaneously at rest.
- Find the displacement of P from O when $t = 5$
- Find the total distance travelled by P in the interval $0 \leq t \leq 5$

(7 marks)

Answer _____

- 6 A car moves along a straight road. It starts from rest at time $t = 0$. For $0 \leq t \leq 4$ its velocity is $v \text{ m s}^{-1}$, where

$$v = 6t - \frac{3}{4}t^2$$

For $t > 4$ the car moves at a constant speed equal to its speed when $t = 4$

- Show that the acceleration of the car is zero when $t = 4$
- Find the constant speed of the car for $t > 4$
- Find the distance travelled by the car in the first 10 seconds.

(7 marks)

Answer _____

- 7 A particle P moves along a straight line through the fixed point O . At time t seconds the displacement of P from O is x metres, where

$$x = 12t - t^3, \quad t \geq 0$$

- Find the greatest positive displacement of P from O .
- Find the exact value of t when P returns to O .
- Find the speed of P as it passes through O at this time.
- Find the total distance travelled by P in the first 4 seconds.

(8 marks)

Answer _____

- 8 A particle P moves along a straight line. At time t seconds the acceleration of P is $(6t - 8)$ m s^{-2} . When $t = 0$, P passes through the fixed point O with velocity 4 m s^{-1} .

- Find an expression for the displacement of P from O at time t seconds.
- Show that when P first returns to O it is instantaneously at rest.
- Find the greatest distance of P from O in the interval $0 \leq t \leq 2$

(8 marks)

Answer _____

9

A lift moves vertically upwards from rest at ground level. It comes to rest again at the top floor 6 seconds later. While moving, the velocity of the lift t seconds after it starts is v m s^{-1} , where

$$v = kt(6 - t), \quad 0 \leq t \leq 6$$

and k is a positive constant. The top floor is 24 m above ground level.

- Find the value of k .
- Find the maximum speed of the lift.
- Find the magnitude of the acceleration of the lift when $t = 5$

(7 marks)

Answer _____

10

Two cyclists, Priya and Tom, ride along a straight cycle track. At time $t = 0$ Priya passes a marker post O with speed 2 m s^{-1} , and she moves with constant acceleration 2 m s^{-2} . At the same moment Tom starts from rest at O and rides in the same direction. Tom's velocity at time t seconds is $3t^2 \text{ m s}^{-1}$. The model is valid for $0 \leq t \leq 3$

- Find, in terms of t , the distance of each cyclist from O .
- Find the time at which Tom catches up with Priya, and how far they are from O at that moment.
- Find the time at which the two cyclists have the same speed, giving your answer to 3 significant figures.

(8 marks)

Answer _____

11

A train leaves a station from rest at time $t = 0$. For the first 30 seconds its acceleration is a m s^{-2} , where

$$a = 0.6 - 0.02t, \quad 0 \leq t \leq 30$$

- Find the speed of the train when $t = 30$
- Find the distance travelled by the train in the first 30 seconds.

The train then travels at this speed for 2 minutes. It then decelerates uniformly at 0.25 m s^{-2} until it comes to rest at the next station.

- Find the distance between the two stations.
- Find the average speed of the train between the two stations.

(9 marks)

Answer

12

A particle P moves along the x -axis. At time t seconds the velocity of P is $v \text{ m s}^{-1}$ in the positive x direction, where

$$v = t^2 - 6t + 8, \quad t \geq 0$$

- Find the interval of time during which P is moving in the negative x direction.
- Find the values of t at which the speed of P is 3 m s^{-1} , and explain why there are only two such values.
- Find the total distance travelled by P in the interval $0 \leq t \leq 5$

(9 marks)

Answer

End of questions | Total 88 marks