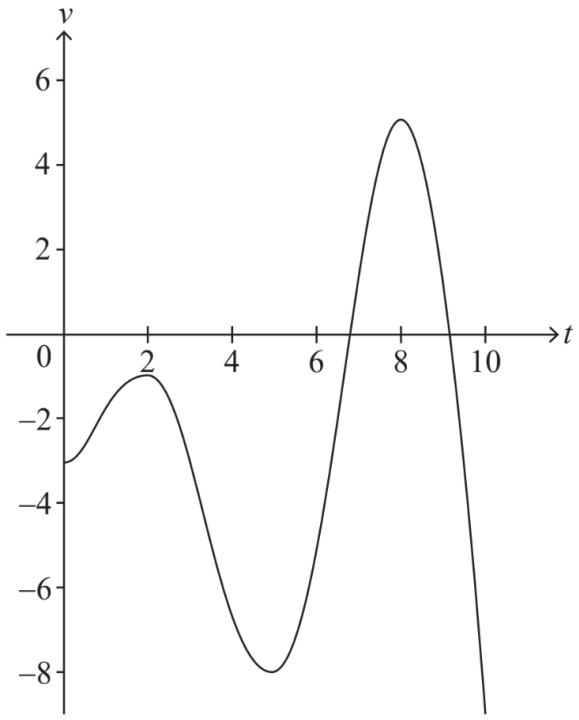
4. [Maximum mark: 6]

A particle moves in a straight line. The velocity, $v\,\text{ms}^{-1}$, of the particle at time t seconds is given by $v(t) = t\sin t - 3$, for $0 \le t \le 10$.

The following diagram shows the graph of v.



(a) Find the smallest value of t for which the particle is at rest. [2]

(b) Find the total distance travelled by the particle. [2]

(c) Find the acceleration of the particle when $t = 7$. [2]

6. [Maximum mark: 6]

A particle moves along a horizontal line such that at time t seconds, $t \ge 0$, its acceleration a is given by $a = 2t - 1$. When $t = 6$, its displacement s from a fixed origin O is $18.25\,\text{m}$. When $t = 15$, its displacement from O is $922.75\,\text{m}$. Find an expression for s in terms of t.

7. [Maximum mark: 5]

A point P moves in a straight line with velocity $v\,\text{ms}^{-1}$ given by $v(t) = \text{e}^{-t} - 8t^2\text{e}^{-2t}$ at time t seconds, where $t \ge 0$.

(a) Determine the first time t_1 at which P has zero velocity. [2]

(b) (i) Find an expression for the acceleration of P at time t.

(ii) Find the value of the acceleration of P at time t_1. [3]

4. [Maximum mark: 7]

A particle moves along a straight line. Its displacement, s metres, at time t seconds is given by $s = t + \cos 2t$, $t \geq 0$. The first two times when the particle is at rest are denoted by t_1 and t_2, where $t_1 < t_2$.

(a) Find t_1 and t_2. [5]

(b) Find the displacement of the particle when $t = t_1$. [2]

5. [Maximum mark: 5]

A particle moves in a straight line such that at time t seconds $(t \geq 0)$, its velocity v, in ms^{-1}, is given by $v = 10te^{-2t}$. Find the exact distance travelled by the particle in the first half-second.

10. [Maximum mark: 16]

A particle P moves along the x-axis. The velocity of P is $v\,\text{ms}^{-1}$ at time t seconds, where $v(t) = 4 + 4t - 3t^2$ for $0 \leq t \leq 3$. When $t = 0$, P is at the origin O.

(a) (i) Find the value of t when P reaches its maximum velocity.

(ii) Show that the distance of P from O at this time is $\frac{88}{27}$ metres. [7]

(b) Sketch a graph of v against t, clearly showing any points of intersection with the axes. [4]

(c) Find the total distance travelled by P. [5]