

11.4) Using integration

Worked example

A particle is moving on the x -axis.

At time $t = 0$, the particle is at the point where $x = 7$.

The velocity of the particle at time t seconds (where $t \geq 0$) is $(8t - 3t^2)$ ms^{-1} . Find:

- An expression for the displacement of the particle from O at time t seconds.
- The distance of the particle from its starting point when $t = 4$.

Your turn

A particle is moving on the x -axis.

At time $t = 0$, the particle is at the point where $x = 5$.

The velocity of the particle at time t seconds (where $t \geq 0$) is $(6t - t^2)$ ms^{-1} . Find:

- An expression for the displacement of the particle from O at time t seconds.
- The distance of the particle from its starting point when $t = 6$.

a) $x = 3t^2 - \frac{1}{3}t^3 + 5$

b) 36 m

Worked example

A particle travels in a straight line.

After t seconds its velocity, $v \text{ ms}^{-1}$, is given by $v = 7 - 6t^2$,
 $t \geq 0$.

Find the distance travelled by the particle in the fifth
second of its motion.

Your turn

A particle travels in a straight line.

After t seconds its velocity, $v \text{ ms}^{-1}$, is given by $v = 5 - 3t^2$,
 $t \geq 0$.

Find the distance travelled by the particle in the third
second of its motion.

14 m

Worked example

A particle P moves on the positive x -axis.

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

When $t = 0$, P is 5 m from the origin O . Find:

- The values of t when P is instantaneously at rest
- The acceleration of P when $t = 10$
- The total distance travelled by P in the interval $0 \leq t \leq 3$

Your turn

A particle P moves on the positive x -axis.

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

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

- The values of t when P is instantaneously at rest
- The acceleration of P when $t = 5$
- The total distance travelled by P in the interval $0 \leq t \leq 5$

a) $t = \frac{1}{2}, t = 4$

b) 11 ms^{-2}

c) 19.4 m (3 sf)

Worked example

A particle travels in a straight line such that its acceleration, $a \text{ ms}^{-2}$, at time t seconds, is given by $a = 18t + 6$.

When $t = 2$ seconds, the displacement, s , is 40 metres.

When $t = 3$ seconds, the displacement is 117 metres.

Find:

- The displacement when $t = 4$ seconds.
- The velocity when $t = 4$ seconds.

Your turn

A particle travels in a straight line such that its acceleration, $a \text{ ms}^{-2}$, at time t seconds, is given by $a = 12t + 4$.

When $t = 1$ seconds, the displacement, s , is 6 metres.

When $t = 2$ seconds, the displacement is 196 metres.

Find:

- The displacement when $t = 3$ seconds.
- The velocity when $t = 3$ seconds.

a) 98 m

b) 76 ms^{-1}