

8.3) Variable acceleration in one dimension

Worked example

A particle is moving in a straight line with acceleration at time t seconds given by

$$a = \cos 5\pi t \text{ ms}^{-2}, \quad t \geq 0$$

The velocity of the particle at time $t = 0$ is $\frac{1}{5\pi} \text{ ms}^{-1}$. Find:

- (a) an expression for the velocity at time t seconds
- (b) the maximum speed
- (c) the distance travelled in the first 6 seconds.

Your turn

A particle is moving in a straight line with acceleration at time t seconds given by

$$a = \cos 2\pi t \text{ ms}^{-2}, \quad t \geq 0$$

The velocity of the particle at time $t = 0$ is $\frac{1}{2\pi} \text{ ms}^{-1}$. Find:

- (a) an expression for the velocity at time t seconds
- (b) the maximum speed
- (c) the distance travelled in the first 3 seconds.

a) $v = \frac{1}{2\pi} \sin 2\pi t + \frac{1}{2\pi} \text{ ms}^{-1}$

b) $\frac{1}{\pi} = 0.32 \text{ ms}^{-1}$ (2 sf)

c) 0.48 m (2 sf)

Worked example

A particle of mass 12kg is moving on the positive x -axis. At time t seconds the displacement, s , of the particle from the origin is given by

$$s = 3t^{\frac{5}{2}} + \frac{e^{-3t}}{4} \text{ m}, \quad t \geq 0$$

(a) Find the velocity of the particle when $t = 2.5$.

Given that the particle is acted on by a single force of variable magnitude F N which acts in the direction of the positive x -axis,

(b) Find the value of F when $t = 4$

Your turn

A particle of mass 6kg is moving on the positive x -axis. At time t seconds the displacement, s , of the particle from the origin is given by

$$s = 2t^{\frac{3}{2}} + \frac{e^{-2t}}{3} \text{ m}, \quad t \geq 0$$

(a) Find the velocity of the particle when $t = 1.5$.

Given that the particle is acted on by a single force of variable magnitude F N which acts in the direction of the positive x -axis,

(b) Find the value of F when $t = 2$

a) 3.6 ms^{-1} (2 sf)

b) 6.5 N (2 sf)