

3. [In this question, position vectors are given relative to a fixed origin.]

At time t seconds, where $t \geq 1$, the velocity vector of a particle P is modelled as $\mathbf{v} \text{ m s}^{-1}$ where

$$\mathbf{v} = 2t\mathbf{i} - 6t^{\frac{1}{2}}\mathbf{j}$$

(a) Find the velocity of P at $t = 9$, giving your answer in terms of \mathbf{i} and \mathbf{j} . (1)

(b) Find an expression for the acceleration of P at time t seconds, where $t \geq 1$

Give your answer in terms of t , \mathbf{i} and \mathbf{j} . (2)

When $t = 1$, P is at the point with position vector $(\mathbf{i} - 2\mathbf{j}) \text{ m}$.

(c) Find an expression for the position vector of P at time t seconds, where $t \geq 1$

Give your answer in terms of t , \mathbf{i} and \mathbf{j} . (4)

When $t = T$, P is moving in the direction of $(4\mathbf{i} - \mathbf{j})$.

(d) Find the value of T . (4)