

SUVAT Equations (with vectors)

Question Paper

4. [In this question \mathbf{i} and \mathbf{j} are horizontal unit vectors due east and due north respectively and position vectors are given relative to the fixed point O .]

A particle P moves with constant acceleration.

At time $t = 0$, the particle is at O and is moving with velocity $(2\mathbf{i} - 3\mathbf{j})\text{ m s}^{-1}$

At time $t = 2$ seconds, P is at the point A with position vector $(7\mathbf{i} - 10\mathbf{j})\text{ m}$.

- (a) Show that the magnitude of the acceleration of P is 2.5 m s^{-2} (4)

At the instant when P leaves the point A , the acceleration of P changes so that P now moves with constant acceleration $(4\mathbf{i} + 8.8\mathbf{j})\text{ m s}^{-2}$

At the instant when P reaches the point B , the direction of motion of P is north east.

- (b) Find the time it takes for P to travel from A to B . (4)

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5. [In this question, \mathbf{i} and \mathbf{j} are horizontal unit vectors and position vectors are given relative to a fixed origin O]

A particle P is moving on a smooth horizontal plane.

The particle has constant acceleration $(2.4\mathbf{i} + \mathbf{j})\text{ms}^{-2}$

At time $t = 0$, P passes through the point A .

At time $t = 5$ s, P passes through the point B .

The velocity of P as it passes through A is $(-16\mathbf{i} - 3\mathbf{j})\text{ms}^{-1}$

(a) Find the speed of P as it passes through B . (4)

The position vector of A is $(44\mathbf{i} - 10\mathbf{j})\text{m}$.

At time $t = T$ seconds, where $T > 5$, P passes through the point C .

The position vector of C is $(4\mathbf{i} + c\mathbf{j})\text{m}$.

(b) Find the value of T . (3)

(c) Find the value of c . (3)

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[In this question \mathbf{i} and \mathbf{j} are horizontal perpendicular unit vectors.]

10. A particle P rests in equilibrium on a smooth horizontal plane.

A system of **three** forces, \mathbf{F}_1 N, \mathbf{F}_2 N and \mathbf{F}_3 N where

$$\mathbf{F}_1 = (3c\mathbf{i} + 4c\mathbf{j})$$

$$\mathbf{F}_2 = (-14\mathbf{i} + 7\mathbf{j})$$

is applied to P .

Given that P remains in equilibrium,

- (a) find \mathbf{F}_3 in terms of c , \mathbf{i} and \mathbf{j} . (2)

The force \mathbf{F}_3 is **removed** from the system.

Given that $c = 2$

- (b) find the size of the angle between the direction of \mathbf{i} and the direction of the resultant force acting on P . (4)

The mass of P is m kg.

Given that the magnitude of the acceleration of P is 8.5 m s^{-2}

- (c) find the value of m . (4)

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