

QQQ – Mechanics Year 2 – Chapter 8 – Vectors (Version 1)

Total Marks: 24

(24 = Platinum, 22 = Gold, 19 = Silver, 16 = Bronze)

1. A particle P moves with constant acceleration $(3\mathbf{i} - 2\mathbf{j}) \text{ m s}^{-2}$. At time $t = 4$ seconds, P has velocity $6\mathbf{i} \text{ m s}^{-1}$.

Determine the speed of P at time $t = 0$ seconds.

[4]

(Total 4 marks)

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2. The velocity $v \text{ m s}^{-1}$ of a particle at time $t \text{ s}$ is given by

$$v = 0.5t(7 - t).$$

Determine whether the **speed** of the particle is increasing or decreasing when $t = 8$.

[4]

(Total 4 marks)

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3. The position vector $\mathbf{r}$ metres of a particle at time t seconds is given by

$$\mathbf{r} = (1 + 12t - 2t^2) \mathbf{i} + (t^2 - 6t) \mathbf{j}.$$

- (i) Find an expression for the velocity of the particle at time t .

[2]

- (ii) Determine whether the particle is ever stationary.

[2]

(Total 4 marks)

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4. In this question the x - and y -directions are horizontal and vertically upwards respectively and the origin is on horizontal ground.

A ball is thrown from a point 5 m above the origin with an initial velocity $\begin{pmatrix} 14 \\ 7 \end{pmatrix} \text{ m s}^{-1}$.

- (a) Find the position vector of the ball at time $t \text{ s}$ after it is thrown.

[3]

- (b) Find the distance between the origin and the point at which the ball lands on the ground.

[3]

(Total 6 marks)

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5. [In this question position vectors are given relative to a fixed origin O]

At time t seconds, where $t \geq 0$, a particle, P , moves so that its velocity $\mathbf{v}$ m s⁻¹ is given by

$$\mathbf{v} = 6t\mathbf{i} - 5t^{\frac{3}{2}}\mathbf{j}$$

When $t = 0$, the position vector of P is $(-20\mathbf{i} + 20\mathbf{j})$ m.

(a) Find the acceleration of P when $t = 4$ **(3)**

(b) Find the position vector of P when $t = 4$ **(3)**

(Total 6 marks)