

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

**Total Marks: 25**

(25 = Platinum, 23 = Gold, 20 = Silver, 17 = Bronze)

1. A particle  $P$  moves with constant acceleration  $(2\mathbf{i} - 3\mathbf{j}) \text{ m s}^{-2}$

At time  $t = 0$ ,  $P$  is moving with velocity  $4\mathbf{i} \text{ m s}^{-1}$

(a) Find the velocity of  $P$  at time  $t = 2$  seconds. (2)

At time  $t = 0$ , the position vector of  $P$  relative to a fixed origin  $O$  is  $(\mathbf{i} + \mathbf{j}) \text{ m}$ .

(b) Find the position vector of  $P$  relative to  $O$  at time  $t = 3$  seconds. (2)

**(Total 4 marks)**

Edexcel October 2021 Paper 3 Mechanics Q1

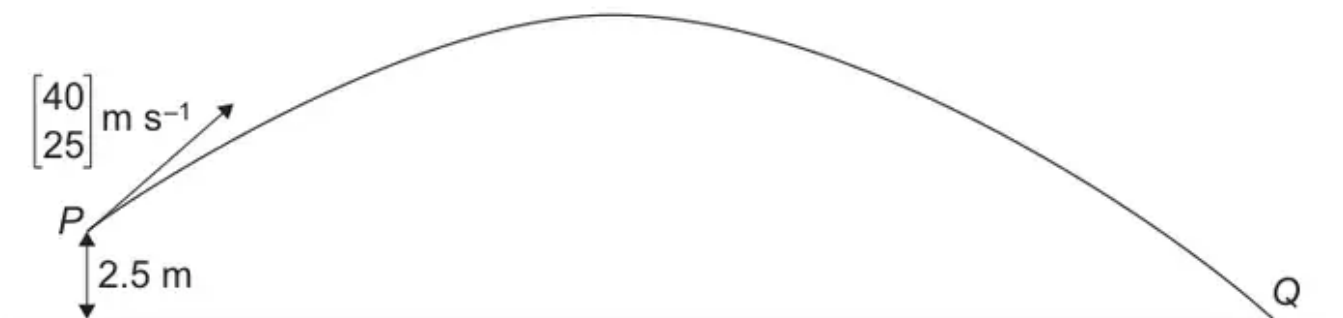
2. In this question use  $g = 9.8 \text{ m s}^{-2}$

An arrow is projected from a point  $P$  which is at a height of 2.5 metres above the horizontal ground.

The arrow has an initial velocity of  $\begin{bmatrix} 40 \\ 25 \end{bmatrix} \text{ m s}^{-1}$

The arrow lands on the horizontal ground at a point  $Q$

The path of the arrow is shown in the diagram.



Find the **speed** of the arrow at point  $Q$  **[4 marks]**

**(Total 4 marks)**

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**3.** A car has an initial velocity of  $1 \text{ m s}^{-1}$

The car is moving in a straight line.

The acceleration  $a \text{ m s}^{-2}$  of the car at time  $t$  seconds is given by

$$a = 3kt^2 - 2kt + 1$$

where  $k$  is a constant.

When  $t = 3$  the car has a velocity of  $10 \text{ m s}^{-1}$

Show that  $k = \frac{1}{3}$

**[4 marks]**

**(Total 4 marks)**

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**4.** In this question the unit vectors  $\mathbf{i}$  and  $\mathbf{j}$  are in the  $x$ - and  $y$ -directions respectively.

The velocity  $\mathbf{v} \text{ m s}^{-1}$  of a particle is given by  $\mathbf{v} = 3\mathbf{i} + (6t^2 - 5)\mathbf{j}$ . The initial position of the particle is  $7\mathbf{j} \text{ m}$ .

**(a)** Find an expression for the position vector of the particle at time  $t$  s.

**[4]**

**(b)** Find the Cartesian equation of the path of the particle.

**[2]**

**(Total 6 marks)**

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**5.** At time  $t$  seconds a particle,  $P$ , has position vector  $\mathbf{r}$  metres, with respect to a fixed origin, such that

$$\mathbf{r} = (t^3 - 5t^2)\mathbf{i} + (8t - t^2)\mathbf{j}$$

**(a)** Find the exact speed of  $P$  when  $t = 2$

**[4 marks]**

**(b)** Bella claims that the magnitude of acceleration of  $P$  will never be zero.

Determine whether Bella's claim is correct.

Fully justify your answer.

**[3 marks]**

**(Total 7 marks)**

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