

QQQ – Pure Year 2 – Chapter 12 – Vectors (Version 1)

Total Marks: 25

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

1. Relative to a fixed origin O

- the point A has position vector $5\mathbf{i} + 3\mathbf{j} + 2\mathbf{k}$
- the point B has position vector $2\mathbf{i} + 4\mathbf{j} + a\mathbf{k}$

where a is a positive integer.

(a) Show that $|\overrightarrow{OA}| = \sqrt{38}$ (1)

(b) Find the smallest value of a for which

$$|\overrightarrow{OB}| > |\overrightarrow{OA}|$$

(2)

(Total 3 marks)

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2. A particle P of mass 2.5 kg is in equilibrium under the action of three horizontal forces

$$\mathbf{F}_1 = \begin{pmatrix} 3 \\ -7 \end{pmatrix} \text{ N}, \mathbf{F}_2 = \begin{pmatrix} -5 \\ 10 \end{pmatrix} \text{ N and } \mathbf{F}_3.$$

(a) Find the force $\mathbf{F}_3$. [2]

The force $\mathbf{F}_3$ is changed to $\begin{pmatrix} 8 \\ 1 \end{pmatrix}$ N.

(b) Find the acceleration of P , giving your answer in column vector form. [2]

(Total 4 marks)

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3. Given that

- $\overrightarrow{PQ} = 2\mathbf{i} + 8\mathbf{j} - 2\mathbf{k}$
- $\overrightarrow{QR} = 6\mathbf{i} + 6\mathbf{k}$

(a) find $\overrightarrow{PR}$. (2)

(b) Hence show that triangle PQR is both right-angled and isosceles. (4)

(Total 6 marks)

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4. Relative to a fixed origin O

- the point A has position vector $4\mathbf{i} - 3\mathbf{j} + 5\mathbf{k}$
- the point B has position vector $4\mathbf{j} + 6\mathbf{k}$
- the point C has position vector $-16\mathbf{i} + p\mathbf{j} + 10\mathbf{k}$

where p is a constant.

Given that A , B and C lie on a straight line,

(a) find the value of p . (3)

The line segment OB is extended to a point D so that $\overrightarrow{CD}$ is parallel to $\overrightarrow{OA}$

(b) Find $|\overrightarrow{OD}|$, writing your answer as a fully simplified surd. (3)

(Total 6 marks)

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5. Relative to a fixed origin O ,

- A is the point with position vector $12\mathbf{i}$
- B is the point with position vector $16\mathbf{j}$
- C is the point with position vector $(50\mathbf{i} + 136\mathbf{j})$
- D is the point with position vector $(22\mathbf{i} + 24\mathbf{j})$

(a) Show that AD is parallel to BC . (2)

Points A, B, C and D are used to model the vertices of a running track in the shape of a quadrilateral.

Runners complete one lap by running along all four sides of the track.

The lengths of the sides are measured in metres.

Given that a particular runner takes exactly 5 minutes to complete 2 laps,

(b) calculate the average speed of this runner, giving the answer in kilometres per hour. (4)

(Total 6 marks)