

QQQ – Core Pure 1 – Chapter 9 – Vectors (Version 1)

Total Marks: 25

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

1. The line L has vector equation

$$\mathbf{r} = \begin{bmatrix} 4 \\ -7 \\ 0 \end{bmatrix} + \lambda \begin{bmatrix} -9 \\ 1 \\ 3 \end{bmatrix}$$

Give the equation of L in Cartesian form.

Tick (✓) **one** box.

[1 mark]

- $\frac{x+4}{-9} = \frac{y-7}{1} = \frac{z}{3}$
- $\frac{x-4}{-9} = \frac{y+7}{1} = \frac{z}{3}$
- $\frac{x+9}{4} = \frac{y-1}{-7}, z = 3$
- $\frac{x-9}{4} = \frac{y+1}{-7}, z = 3$

(Total 1 marks)

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2. A plane has equation $\mathbf{r} \cdot \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = 7$

A line has equation $\mathbf{r} = \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix} + \mu \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$

Calculate the acute angle between the line and the plane.

Give your answer to the nearest 0.1°

[3 marks]

(Total 3 marks)

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3. The plane $x + 2y + cz = 4$ is perpendicular to the plane $2x - cy + 6z = 9$, where c is a constant. Find the value of c .

[3]

(Total 3 marks)

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4. Two submarines are travelling on different straight lines.

The two lines are described by the equations

$$\mathbf{r} = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix} + \lambda \begin{bmatrix} 5 \\ 3 \\ -2 \end{bmatrix} \quad \text{and} \quad \frac{x-5}{4} = \frac{y}{2} = 4-z$$

(a) (i) Show that the two lines intersect. [3 marks]

(ii) Find the position vector of the point of intersection. [1 mark]

(b) Tracey says that the submarines will collide because there is a common point on the two lines.

Explain why Tracey is not necessarily correct. [1 mark]

(c) Calculate the acute angle between the lines

$$\mathbf{r} = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix} + \lambda \begin{bmatrix} 5 \\ 3 \\ -2 \end{bmatrix} \quad \text{and} \quad \frac{x-5}{4} = \frac{y}{2} = 4-z$$

Give your angle to the nearest 0.1° [3 marks]

(Total 8 marks)

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5. The line through points $A(8, -7, -2)$ and $B(11, -9, 0)$ is denoted by L_1 .

(a) Find a vector equation for L_1 . [2]

(b) Determine whether the point $(26, -19, -14)$ lies on L_1 . [2]

The line L_2 passes through the origin, O , and intersects L_1 at the point C . The lines L_1 and L_2 are perpendicular.

(c) By using the fact that C lies on L_1 , find a vector equation for L_2 . [4]

(d) Hence find the shortest distance from O to L_1 . [2]

(Total 10 marks)

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