

QQQ – Core Pure 1 – Chapter 9 – Vectors (Version 2)

Total Marks: 23

(23 = Platinum, 21 = Gold, 18 = Silver, 16 = Bronze)

1. Find, to the nearest degree, the angle between the vectors $\begin{pmatrix} 1 \\ 0 \\ -2 \end{pmatrix}$ and $\begin{pmatrix} -2 \\ 3 \\ -3 \end{pmatrix}$. **[3]**

(Total 3 marks)

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2. The line l has equation

$$\frac{x+2}{1} = \frac{y-5}{-1} = \frac{z-4}{-3}$$

The plane Π has equation

$$\mathbf{r} \cdot (\mathbf{i} - 2\mathbf{j} + \mathbf{k}) = -7$$

Determine whether the line l intersects Π at a single point, or lies in Π , or is parallel to Π without intersecting it. **(5)**

(Total 5 marks)

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3. An engineer detects a source of water below the surface of the ground. The engineer models the situation relative to a fixed origin O .

In the model

- the surface of the ground is a plane Π with equation $x - 2y + 8z = 1$
- the source of water is at a point W with coordinates $(6, -2, -4)$

where the units are metres.

- (a) Use the model to determine the shortest distance from W to the surface of the ground. (2)
- (b) By considering the model, comment on whether the answer to part (a) is reliable, giving a reason for your answer. (1)

To access the water, a hole is drilled, in a straight line, from a point P on the surface of the ground to W .

Given that the length of the hole needs to be as short as possible,

- (c) determine the coordinates of P , according to the model. (3)

Given that the actual length of the hole drilled is 2.52 metres,

- (d) use the answer to part (a) to evaluate the model, giving a reason for your answer. (1)

(Total 7 marks)

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4. The points $A(5, -4, 6)$ and $B(6, -6, 8)$ lie on the line L . The point C is $(15, -5, 9)$.

- (a) D is the point on L that is closest to C .

Find the coordinates of D . **[6 marks]**

- (b) Hence find, in exact form, the shortest distance from C to L . **[2 marks]**

(Total 8 marks)

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