| Question | Scheme | Marks | AOs |
|---|---|---|---|
| 7(a) | $\mathbf{r} = 8\mathbf{i} + 2\mathbf{j} + 10\mathbf{k} + k(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k})$ or<br>$(8\mathbf{i} + 2\mathbf{j} + 10\mathbf{k}).(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}) = 16 - 6 + 40$ | M1 | 1.1b |
| | $(8\mathbf{i} + 2\mathbf{j} + 10\mathbf{k} + k(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k})).(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}) = -8 \Rightarrow k = -2$<br>$\Rightarrow d = \lvert 2(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}) \rvert = \sqrt{116}$ or $2\sqrt{29}$<br>Or<br>$d = \dfrac{(8\mathbf{i} + 2\mathbf{j} + 10\mathbf{k}).(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}) + 8}{\sqrt{2^2 + 3^2 + 4^2}} = \dfrac{58}{\sqrt{29}}$ | M1<br>A1 | 3.1a<br>1.1b |
| | | **(3)** | |
| (b) | $(4\mathbf{i} + \mathbf{j} - 7\mathbf{k}).(\mathbf{i} + 3\mathbf{j} + \mathbf{k}) = 4 + 3 - 7 = 0$<br>$(4\mathbf{i} + \mathbf{j} - 7\mathbf{k}).(2\mathbf{i} - \mathbf{j} + \mathbf{k}) = 8 - 1 - 7 = 0$ | M1 | 1.1b |
| | As $4\mathbf{i} + \mathbf{j} - 7\mathbf{k}$ is perpendicular to both direction vectors of $\Pi_2$ then it must be perpendicular to $\Pi_2$ | A1 | 2.2a |
| | | **(2)** | |
| (c) | $(4\mathbf{i} + \mathbf{j} - 7\mathbf{k}).(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}) = 8 - 3 - 28 = -23$ | M1 | 1.1b |
| | $\sqrt{4^2 + 1^2 + 7^2}\sqrt{2^2 + 3^2 + 4^2}\cos\theta = -23$<br>$\Rightarrow \cos\theta = \dfrac{-23}{\sqrt{66}\sqrt{29}}$ | M1 | 2.1 |
| | $\theta = 58°$ | A1 | 1.1b |
| | | **(3)** | |
| (d) | $4x + y - 7z = 0$ and $2x - 3y + 4z = -8$ | | |
| | $x = 0 \rightarrow \left(0, \frac{56}{17}, \frac{8}{17}\right)$, $y = 0 \rightarrow \left(-\frac{28}{15}, 0, -\frac{16}{15}\right)$, $z = 0 \rightarrow \left(-\frac{4}{7}, \frac{16}{7}, 0\right)$<br>$\Rightarrow dir = 17\mathbf{i} + 30\mathbf{j} + 14\mathbf{k}$ | M1<br>A1 | 3.1a<br>1.1b |
| | $\mathbf{r} = \dfrac{56}{17}\mathbf{j} + \dfrac{8}{17}\mathbf{k} + \lambda(17\mathbf{i} + 30\mathbf{j} + 14\mathbf{k})$ | M1<br>A1 | 1.1b<br>2.5 |
| | | **(4)** | |
| | | | **(12 marks)** |

**Notes**

(a)
M1: Starts by attempting to find an appropriate scalar product or finding the parametric equation of the perpendicular line
M1: A complete strategy to establish the required distance
A1: Correct exact answer (allow any exact form)
(b)
M1: Attempts both scalar products
A1: Makes a correct deduction
(c)
M1: Calculates the scalar product between the normal vectors
M1: Applies the scalar product formula with their – 23 to find a value for $\cos\theta$
A1: Correct answer
(d)

M1: Attempts to find the direction e.g. by finding 2 points on the line or uses vector product
A1: Correct direction of required line
M1: Uses their direction and a point on the line to form a vector equation for the line
A1: Correct equation using correct notation