Question	Scheme	Marks	AOs
4(a)	Attempts normal vector: E.g. let $\mathbf{n} = a\mathbf{i} + b\mathbf{j} + \mathbf{k}$ then $a + 2b - 3 = 0, -a + 2b + 1 = 0$ $\Rightarrow a = ..., b = ...$ or $\mathbf{n} = (\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}) \times (-\mathbf{i} + 2\mathbf{j} + \mathbf{k})$	M1	3.1a
	$\mathbf{n} = k(4\mathbf{i} + \mathbf{j} + 2\mathbf{k})$	A1	1.1b
	$(4\mathbf{i} + \mathbf{j} + 2\mathbf{k}).(2\mathbf{i} + 4\mathbf{j} - \mathbf{k}) = ...$	M1	1.1b
	$4x + y + 2z = 10$	A1	2.5
		(4)	
	Alternative:		
	$x = 2 + \lambda - \mu$ $y = 4 + 2\lambda + 2\mu \Rightarrow$ $2x + y = 8 + 4\lambda$, $y - 2z = 6 + 8\lambda$ $z = -1 - 3\lambda + \mu$	M1 A1	3.1a 1.1b
	$2(2x + y - 8) = y - 2z - 6$ $(4x + y + 2z = 10)$	M1 A1	1.1b 2.5
		(4)	
(b)	$\frac{x-1}{5} = \frac{y-3}{-3} = \frac{z+2}{4} \Rightarrow \mathbf{r} = \mathbf{i} + 3\mathbf{j} - 2\mathbf{k} + \lambda(5\mathbf{i} - 3\mathbf{j} + 4\mathbf{k})$ $4(1 + 5\lambda) + 3 - 3\lambda + 2(4\lambda - 2) = 10 \Rightarrow \lambda = ...$	M1	3.1a
	$\lambda = \frac{7}{25} \Rightarrow \mathbf{r} = \mathbf{i} + 3\mathbf{j} - 2\mathbf{k} + \frac{7}{25}(5\mathbf{i} - 3\mathbf{j} + 4\mathbf{k})$	dM1	1.1b
	$\left(\frac{12}{5}, \frac{54}{25}, -\frac{22}{25}\right)$	A1	1.1b
		(3)	
	Alternative: $4x + \left(-\frac{3}{5}(x-1) + 3\right) + 2\left(\frac{4}{5}(x-1) - 2\right) = 10 \Rightarrow x = ...$	M1	3.1a
	$\Rightarrow y = ..., z = ...$	M1	1.1b
	$\left(\frac{12}{5}, \frac{54}{25}, -\frac{22}{25}\right)$	A1	1.1b
		(3)	
(c)	$(4\mathbf{i} + \mathbf{j} + 2\mathbf{k}).(2\mathbf{i} - \mathbf{j} + 3\mathbf{k}) = 8 - 1 + 6 = 13$ $13 = \sqrt{14}\sqrt{21}\cos\theta \Rightarrow \theta = ...$	M1	1.1b
	$\theta = 41°$	A1	1.1b
		(2)	
			(9 marks)

Notes
Accept equivalent vector notation throughout. (a) M1: Starts by attempting to find a normal vector using a correct method. Allow if there are sign errors in attempts at the cross product. A1: Obtains a correct normal vector M1: Attempts scalar product between their normal and a point in the plane A1: Correct Cartesian form (accept any equivalent Cartesian equation) Alternative M1: Uses the component form to eliminate one of the scalar parameters A1: Two correct equations with one parameter eliminated OR a correct equation for each parameter in terms of x, y and z M1: Forms a Cartesian equation A1: Correct Cartesian equation (accept any equivalent form) (b) M1: Interprets the Cartesian form to give a parametric form (allow sign slips) and substitutes this into their Cartesian equation and proceeds to find a value for their parameter. NB: Attempts at $\begin{pmatrix} 2+\lambda-\mu \\ 4+2\lambda+2\mu \\ -1-3\lambda+\mu \end{pmatrix} = \begin{pmatrix} 1+5\lambda \\ 3-3\lambda \\ -2+4\lambda \end{pmatrix}$ will score M0 as there are only two parameters, but $\begin{pmatrix} 2+\lambda-\mu \\ 4+2\lambda+2\mu \\ -1-3\lambda+\mu \end{pmatrix} = \begin{pmatrix} 1+5\gamma \\ 3-3\gamma \\ -2+4\gamma \end{pmatrix}$ leading to a value for γ from solving three equations in three unknowns in M1. dM1: Substitutes their parameter value back into the parametric form of the line. The parameter must have come from a correct attempt to find the value at intersection. A1: Correct coordinates. Accept as $x = \ldots$, $y=$, … $z = \ldots$ or as a vector. Alternative: M1: Eliminates two of the variables from the equation of plane using the Cartesian equation of the line and solves the linear equation. dM1: Finds the other two coordinates. A1: Correct coordinates, as above. (c) M1: Complete and correct scalar product method leading to a value for θ. Note that if $\sin\theta$ is used instead of $\cos\theta$ then they must also apply $90 - \theta$ to access the method. A1: Correct angle, accept awrt 41. as their final answer (do not isw if they go on to give e.g. $(180-41)°$)