Question Number	Scheme	Notes	Marks
7(a)	$\begin{pmatrix}0\\3\\-2\end{pmatrix}\times\begin{pmatrix}1\\1\\2\end{pmatrix}=8\mathbf{i}-2\mathbf{j}-3\mathbf{k}$	M1: Attempts vector product of two vectors in the plane. Unless there is a full clear method they must achieve two correct components A1: $\pm(8\mathbf{i}-2\mathbf{j}-3\mathbf{k})$ or multiple	M1 A1
	Allow any vector notation throughout this question		**(2)**
(b)	l has direction vector $\pm(2\mathbf{j}+2\mathbf{k})$	Correct direction for l	B1
	$(\cos\alpha \text{ or } \sin\theta=)$ $\left\|\frac{"(8\mathbf{i}-2\mathbf{j}-3\mathbf{k})"."(2\mathbf{j}+2\mathbf{k})"}{"\sqrt{8^2+2^2+3^2}"\times"\sqrt{2^2+2^2}"}\right\|=\left\|\frac{"(8)(0)+(-2)(2)+(-3)(2)"}{"\sqrt{8^2+2^2+3^2}"\times"\sqrt{0^2+2^2+2^2}"}\right\|\left(=\left\|\frac{-10}{\sqrt{77}\times\sqrt{8}}\right\| \text{ or } \left\|\frac{-5\sqrt{154}}{154}\right\|\right)$ M1: For the scalar product of their normal and direction vector divided by the product of the magnitudes of their vectors. The first expression above oe is sufficient. There must have been a valid attempt at both vectors. Allow copying errors/slips if intention is clear. Modulus not required. A1ft: A correct ft numerical expression with scalar product calculated as shown by second expression or better. Allow a decimal correct to 2sf. Modulus not required. Ignore labelling. Actual decimal is 0.40291148... Implied by awrt 24 or 66 or 114 provided some work and nothing incorrect seen. Allow awrt 0.41, 1.16 or 1.99 if working in radians.	M1 A1ft
	Acute angle between l and P $=90-\alpha=90-66.23968409...$ or $\theta=23.76031591...\Rightarrow 24°$ to the nearest degree	awrt 24 from correct work which could be minimal. Degrees symbol not required. **Mark final answer.**	A1
			(4)
	Note that a vector product could be used: M1: $\left\|\frac{"(8\mathbf{i}-2\mathbf{j}-3\mathbf{k})"\times"(2\mathbf{j}+2\mathbf{k})"}{"\sqrt{8^2+2^2+3^2}"\times"\sqrt{2^2+2^2}"}\right\|$ A1: $\left\|\frac{"\sqrt{2^2+16^2+16^2}"}{"\sqrt{8^2+2^2+3^2}"\times"\sqrt{2^2+2^2}"}\right\|$ $\left(=\frac{2\sqrt{129}}{\sqrt{77}\sqrt{8}}=0.9152389511...\right)$ The modulus of the numerator is required for any marks		
(c) **Way 1** **Parallel planes**	$(\mathbf{i}+2\mathbf{j}+3\mathbf{k}).("8\mathbf{i}-2\mathbf{j}-3\mathbf{k}")=-5$ or $(6\mathbf{i}-3\mathbf{j}-6\mathbf{k}).("8\mathbf{i}-2\mathbf{j}-3\mathbf{k}")=72$	M1: Finds a value for the scalar product of a position vector of a point in the plane or the given point and their normal. A1: –5 or 72 (or 5 or -72 if normal is in the opposite direction). May be seen as a distance e.g., $\frac{-5}{\sqrt{"77"}}$	M1 A1
	Shortest distance is $\left\|\frac{-5-72}{\sqrt{77}}\right\|=\frac{77}{\sqrt{77}}$ or $\sqrt{77}$	**d**M1: Having attempted both scalar products, obtains a numerical expression for the distance. Award for $\frac{\pm"5"\pm"72"}{\sqrt{"8"^2+"2"^2+"3"^2}}$ **Dependent on previous M mark.** A1: Correct exact distance. Isw	**d**M1 A1
			(4)

Question Number	Scheme	Notes	Marks
7(c) **Way 2** **Perp. distance formula**	$(\mathbf{i}+2\mathbf{j}+3\mathbf{k}).("8\mathbf{i}-2\mathbf{j}-3\mathbf{k}")=-5$	M1: Finds a value for the scalar product of a position vector to a point the plane and their normal. A1: -5 (or 5 if normal is in the opposite direction)	M1 A1
	"$8x-2y-3z+5=0$" Shortest distance is $\dfrac{\lvert("8")(6)+("-2")(-3)+("-3")(-6)+"5"\rvert}{\sqrt{"8"^2+"2"^2+"3"^2}}$ $=\dfrac{77}{\sqrt{77}}$ or $\sqrt{77}$	**d**M1: Uses distance formula with their normal and plane equation to reach a numerical expression for the distance. Condone sign slip on their -5 and their d must not be zero. **Dependent on previous M mark.** A1: Correct exact distance. Isw	**d**M1 A1
			(4)
Way 3 **Projection /resolving formula**	Let Q be the point on the plane (1, 2, 3) then $\overrightarrow{PQ}=(\mathbf{i}+2\mathbf{j}+3\mathbf{k})-(6\mathbf{i}-3\mathbf{j}-6\mathbf{k})$ $=-5\mathbf{i}+5\mathbf{j}+9\mathbf{k}$	M1: Attempts vector from given point to a point on the plane A1: Correct vector $(\pm)$	M1 A1
	Shortest distance is $\lvert\overrightarrow{PQ}.\mathbf{n}\rvert=$ $\dfrac{\lvert("-5\mathbf{i}+5\mathbf{j}+9\mathbf{k}").("8\mathbf{i}+-2\mathbf{j}+-3\mathbf{k}")\rvert}{\sqrt{"8"^2+"2"^2+"3"^2}}=...$ $=\dfrac{77}{\sqrt{77}}$ *or* $\sqrt{77}$	**d**M1: Uses formula with their vectors to reach a numerical expression for the distance **Dependent on previous M mark.** A1: Correct exact distance. Isw	**d**M1 A1
			(4)
Way 4 **Example of method involving the point where the line meets plane**	Line through given point in direction of normal is $r=(6\mathbf{i}-3\mathbf{j}-6\mathbf{k})+\lambda(8\mathbf{i}-2\mathbf{j}-3\mathbf{k})$ & meets plane "$8x-2y-3z+5=0$" when $8(6+8\lambda)-2(-3-2\lambda)-3(-6-3\lambda)+5=0$ $\Rightarrow\lambda=-1$	M1: Uses line through given point in the direction of their normal and substitutes into their plane to find a value for λ. The d in their plane equation must not be zero A1: Correct value	M1 A1
	$\lvert-1("8\mathbf{i}+-2\mathbf{j}+-3\mathbf{k}")\rvert=\sqrt{"8"^2+"2"^2+"3"^2}$ Or point of intersection is (6 –"8", –3 –"–2", –6 –"–3") = (–2, –1, –3) and distance is $\sqrt{(6-"-2")^2+(-3-"-1")^2+(-6-"-3")^2}$ $\Rightarrow\sqrt{77}$	**d**M1: Attempts $\lvert\lambda\mathbf{n}\rvert$ or finds point on the plane and obtains numerical expression for distance between this point and the given point **Dependent on previous M mark.** A1: Correct exact distance. Isw	**d**M1 A1
			(4)
	Marks are scored through the ay which is the best overall match for the attempt. Credit for work done in (b) is only available for part (c) if it is used in part (c).		
			Total 10