Question	Scheme	Marks	AOs
6(a)	$\begin{pmatrix}2\\3\\-4\end{pmatrix}\cdot\begin{pmatrix}8\\12\\15\end{pmatrix}=16+36-60$	M1	1.1b
	$\cos\theta=\frac{-8}{\sqrt{2^2+3^2+(-4)^2}\sqrt{8^2+12^2+15^2}}$	M1	3.1b
	Acute angle between the sides of the tent is 86°	A1	3.2a
		(3)	
(b)	$2(6)+3(7)-4(8)=1$ and $8(6)+12(7)+15(8)=252$	M1	3.4
	Point P lies on both planes therefore lies on the straight line	A1	2.4
		(2)	
(c)	Attempts the scalar product between the direction of the rope and the normal to side *ABCD* of the tent and uses trigonometry to find an angle	M1	3.1b
	$\left(\begin{pmatrix}6\\7\\8\end{pmatrix}-\begin{pmatrix}-4\\-3\\0\end{pmatrix}\right)\cdot\begin{pmatrix}2\\3\\-4\end{pmatrix}=18$ or $\left(\begin{pmatrix}-4\\-3\\0\end{pmatrix}-\begin{pmatrix}6\\7\\8\end{pmatrix}\right)\cdot\begin{pmatrix}2\\3\\-4\end{pmatrix}=-18$	M1 A1	1.1b 1.1b
	$\cos\alpha=\frac{18}{\sqrt{2^2+3^2+(-4)^2}\sqrt{10^2+10^2+8^2}}$ $\therefore\ \theta=90-\arccos\left(\frac{18}{\sqrt{29}\sqrt{264}}\right)$ or $\theta=\arcsin\left(\frac{18}{\sqrt{29}\sqrt{264}}\right)$	M1	1.1b
	Acute angle between tent side and rope is 12	A1	3.2a
		(5)	
		(10 marks)	

Notes:

(a)

M1: Calculates the scalar product between the two normal vectors

M1: Applies the scalar product formula between the two normal vectors to find a value for cos θ

A1: Identifies the correct angle by linking the angle between the normals and the angle between the planes.

(b)

M1: Substitutes point P into each equation of the plane and shows that that each plane is satisfied

A1: Comments that therefore point P lies on the straight line.

(c)

M1: Realises the scalar product between the line and the normal to the plane is needed and uses trigonometry to find an angle

M1: Calculates the scalar product between $\pm\left(\begin{pmatrix}6\\7\\8\end{pmatrix}-\begin{pmatrix}-4\\-3\\0\end{pmatrix}\right)$ and $\pm\begin{pmatrix}2\\3\\-4\end{pmatrix}$

A1: $\begin{pmatrix}10\\10\\8\end{pmatrix}.\begin{pmatrix}2\\3\\-4\end{pmatrix}=18$ or $\begin{pmatrix}10\\10\\8\end{pmatrix}.\begin{pmatrix}-2\\-3\\4\end{pmatrix}=-18$ or $\begin{pmatrix}-10\\-10\\-8\end{pmatrix}.\begin{pmatrix}-2\\-3\\4\end{pmatrix}=18$ or $\begin{pmatrix}-10\\-10\\-8\end{pmatrix}.\begin{pmatrix}2\\3\\-4\end{pmatrix}=-18$

M1: A fully complete and correct method for obtaining the acute angle

A1: Awrt 12° . Do not isw. Withhold this mark if extra answers are given.