Question Number	Scheme	Notes	Marks
7.	$A(-1, 5, 1),\ B(1, 0, 3),\ C(2, -1, 2),\ D(3, 6, -1)$		
(a)	e.g., $\mathbf{AB} = \begin{pmatrix}1\\0\\3\end{pmatrix} - \begin{pmatrix}-1\\5\\1\end{pmatrix} = \begin{pmatrix}2\\-5\\2\end{pmatrix}$, $\mathbf{AC} = \begin{pmatrix}3\\-6\\1\end{pmatrix}$, $\mathbf{AD} = \begin{pmatrix}4\\1\\-2\end{pmatrix}$ $\mathbf{BC} = \begin{pmatrix}1\\-1\\-1\end{pmatrix}$, $\mathbf{BD} = \begin{pmatrix}2\\6\\-4\end{pmatrix}$, $\mathbf{CD} = \begin{pmatrix}-1\\-7\\3\end{pmatrix}$ Attempts any 3 edges (must attempt to subtract) which have a common vertex. Using position vectors **OA** etc is M0		**M1**
	e.g., $\begin{vmatrix}2 & -5 & 2\\3 & -6 & 1\\4 & 1 & -2\end{vmatrix}$ or $\begin{pmatrix}2\\-5\\2\end{pmatrix}.\begin{vmatrix}\mathbf{i} & \mathbf{j} & \mathbf{k}\\3 & -6 & 1\\4 & 1 & -2\end{vmatrix}$ or $\begin{pmatrix}2\\-5\\2\end{pmatrix}.\left(\begin{pmatrix}3\\-6\\1\end{pmatrix}\times\begin{pmatrix}4\\1\\-2\end{pmatrix}\right)$ Completes an attempt to form an appropriate scalar triple product with their edges with a common vertex. Condone incorrect $\frac{1}{6}$ e.g., $\frac{1}{3}$ or $\frac{1}{2}$ but M0 if triple product is part of a calculation e.g., all square rooted		**dM1**
	$= \frac{1}{6}\lvert 2\times 11 - 5\times 10 + 2\times 27\rvert = \ldots \quad \left\{\frac{1}{6}\times 26 = \right\}\ \frac{13}{3}$ ddM1: Finds value appropriately (may be negative if omission of modulus). Must include the $\frac{1}{6}$. M0 if a clear systematic error in processing and must have 2 consistent products (or values) in a sum of 3 if method unclear. If just a value is given it must be consistent, but accept a determinant form followed by a value unless clear evidence of an invalid method (e.g., determinant interpreted as a "modulus") A1: Correct (positive) volume (allow exact equivalents)		**ddM1** **A1**
	Protracted methods may score the 1st mark as above but need to be complete attempts that find a value for the volume to receive credit.		**(4)**
(b)	$\mathbf{AB}\times\mathbf{AC} = \begin{vmatrix}\mathbf{i} & \mathbf{j} & \mathbf{k}\\2 & -5 & 2\\3 & -6 & 1\end{vmatrix} = \begin{pmatrix}7\\4\\3\end{pmatrix}$ Result must be seen/used in (b) if done in (a). M1: Completes cross product using attempts at two sides of ABC (Must have subtracted for the vectors & obtain 2 correct components for their product if method unclear). Allow determinant $\rightarrow$ vector unless clear evidence of invalid method. No position vectors A1: Correct normal vector (any multiple).		**M1** **A1**
	OR $-a+5b+c=d,\ a+3c=d,\ 2a-b+2c=d \Rightarrow a=\ldots\{7\},\ b=\ldots\{4\},\ c=\ldots\{3\}$ M1: Uses A, B & C to form 3 equations & solves to find all values A1: Correct. **OR** e.g., $(x, y, z) = (1, 5, 1) + s(2, -5, 2) + t(3, -6, 1) \rightarrow x = -1 + 2s + 3t,\ y = 5 - 5s - 6t, z = 1 + 2s + t$ (M1A1) and then eliminates parameters to an unsimplified plane equation of correct form dM1A1		
	$\begin{pmatrix}7\\4\\3\end{pmatrix}.\begin{pmatrix}-1\\5\\1\end{pmatrix} = \ldots\{16\}$	Finds value for scalar product with appropriate vectors (normal & a point). Allow slips if valid method indicated but if value only given it must be consistent. Could sub. point into $7x+4y+3z+d=0 \Rightarrow d=\ldots$	**dM1**
	$7x+4y+3z=16$	Correct 4 term equation (any multiple)	**A1**
			(4)
(c)	$\{\mathbf{OT} =\}\begin{pmatrix}3\\6\\-1\end{pmatrix} + \lambda\begin{pmatrix}7\\4\\3\end{pmatrix}$ oe	Attempts consistent parametric form of **OT** May see e.g., $\frac{x-3}{7} = \frac{y-6}{4} = \frac{z+1}{3}$ (I)	**M1**
	$7(3+7\lambda)+4(6+4\lambda)+3(-1+3\lambda)=16 \Rightarrow \lambda = \ldots$ Substitutes parametric form of **OT** into their plane equation (at least 3 terms, allow slips e.g., $16 \rightarrow 0$) and solves for λ. Could solve (I) with their plane eqn. and score dM1ddM1 together		**dM1**
	$\lambda = -\frac{13}{37} \Rightarrow T$ is $\left(\frac{20}{37}, \frac{170}{37}, -\frac{76}{37}\right)$ Allow $x=\ldots, y=\ldots, z=\ldots$	ddM1: Uses their value of λ in their **OT** equation to obtain coordinates/vector. Give BOD if no working unless a clearly trivial/invented answer is seen A1: Correct exact coordinates (or vector)	**ddM1** **A1**
	Alternative methods need to reach a point/vector via a valid strategy for any marks.		**(4)**
			Total 12