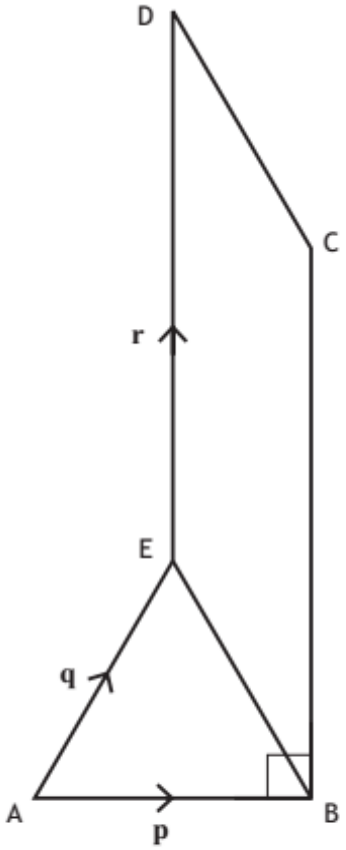
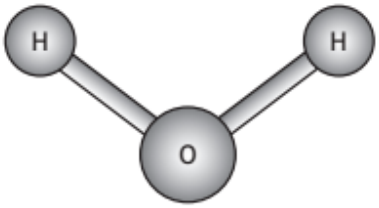
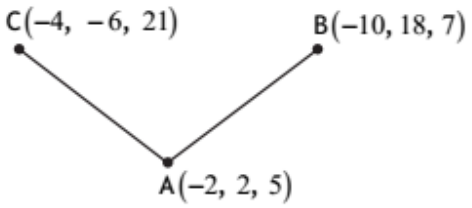
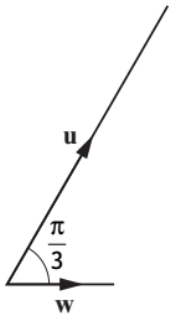
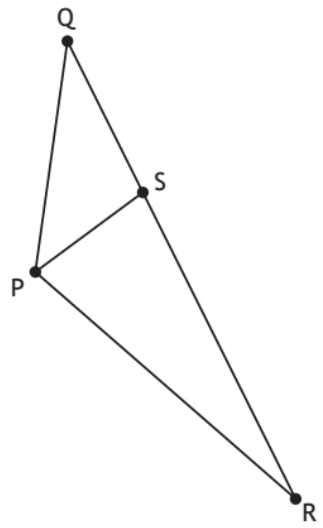
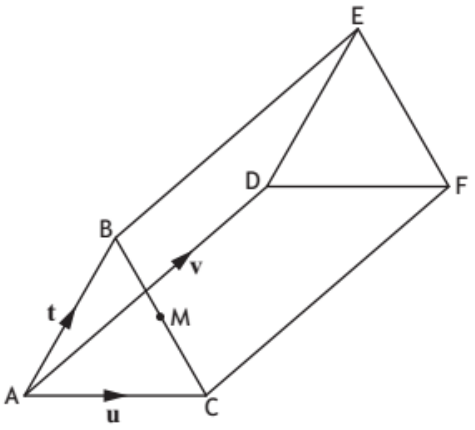
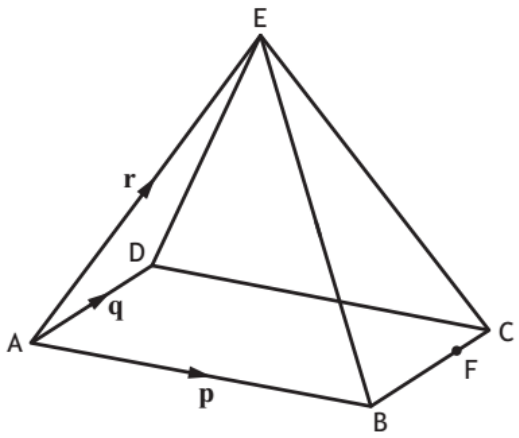
Y	Q	P	Vectors
15	1	1	Vectors $\mathbf{u} = 8\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $\mathbf{v} = -3\mathbf{i} + t\mathbf{j} - 6\mathbf{k}$ are perpendicular. Determine the value of t. **2**
15	6	2	Vectors $\mathbf{p}$, $\mathbf{q}$ and $\mathbf{r}$ are represented on the diagram as shown. • BCDE is a parallelogram • ABE is an equilateral triangle • $\lvert\mathbf{p}\rvert = 3$ • Angle ABC = $90°$  (a) Evaluate $\mathbf{p}.(\mathbf{q}+\mathbf{r})$. **3** (b) Express $\overrightarrow{EC}$ in terms of $\mathbf{p}$, $\mathbf{q}$ and $\mathbf{r}$. **1** (c) Given that $\overrightarrow{AE}.\overrightarrow{EC} = 9\sqrt{3} - \frac{9}{2}$, find $\lvert\mathbf{r}\rvert$. **3**
16	7	1	Three vectors can be expressed as follows: $\overrightarrow{FG} = -2\mathbf{i} - 6\mathbf{j} + 3\mathbf{k}$ $\overrightarrow{GH} = 3\mathbf{i} + 9\mathbf{j} - 7\mathbf{k}$ $\overrightarrow{EH} = 2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$ (a) Find $\overrightarrow{FH}$. **2** (b) Hence, or otherwise, find $\overrightarrow{FE}$. **2**

16	11	1	(a) A and C are the points $(1,\ 3,-2)$ and $(4,-3,\ 4)$ respectively. Point B divides AC in the ratio $1:2$. Find the coordinates of B. **2** (b) $k\overrightarrow{AC}$ is a vector of magnitude 1, where $k>0$. Determine the value of k. **3**
16	5	2	The picture shows a model of a water molecule.  Relative to suitable coordinate axes, the oxygen atom is positioned at point $A(-2,\ 2,\ 5)$. The two hydrogen atoms are positioned at points $B(-10,\ 18,\ 7)$ and $C(-4,\ -6,\ 21)$ as shown in the diagram below.  (a) Express $\overrightarrow{AB}$ and $\overrightarrow{AC}$ in component form. **2** (b) Hence, or otherwise, find the size of angle BAC. **4**
17	5	1	Vectors **u** and **v** are $\begin{pmatrix}5\\1\\-1\end{pmatrix}$ and $\begin{pmatrix}3\\-8\\6\end{pmatrix}$ respectively. (a) Evaluate **u**.**v**. **1** (b)  Vector **w** makes an angle of $\frac{\pi}{3}$ with **u** and $\lvert\mathbf{w}\rvert=\sqrt{3}$. Calculate **u**.**w**. **3**

17	5	2	In the diagram, $\overrightarrow{PR} = 9\mathbf{i} + 5\mathbf{j} + 2\mathbf{k}$ and $\overrightarrow{RQ} = -12\mathbf{i} - 9\mathbf{j} + 3\mathbf{k}$.  (a) Express $\overrightarrow{PQ}$ in terms of $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$. **2** The point S divides QR in the ratio 1:2. (b) Show that $\overrightarrow{PS} = \mathbf{i} - \mathbf{j} + 4\mathbf{k}$. **2** (c) Hence, find the size of angle QPS. **5**
18	5	1	A (−3, 4, −7), B (5, t, 5) and C (7, 9, 8) are collinear. (a) State the ratio in which B divides AC. **1** (b) State the value of t. **1**
18	9	1	The diagram shows a triangular prism ABC,DEF. $\overrightarrow{AB} = \mathbf{t}$, $\overrightarrow{AC} = \mathbf{u}$ and $\overrightarrow{AD} = \mathbf{v}$.  (a) Express $\overrightarrow{BC}$ in terms of $\mathbf{u}$ and $\mathbf{t}$. **1** M is the midpoint of BC. (b) Express $\overrightarrow{MD}$ in terms of $\mathbf{t}$, $\mathbf{u}$ and $\mathbf{v}$. **2**

18	12	1	Vectors $\mathbf{a}$ and $\mathbf{b}$ are such that $\mathbf{a} = 4\mathbf{i} - 2\mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = -2\mathbf{i} + \mathbf{j} + p\mathbf{k}$. (a) Express $2\mathbf{a} + \mathbf{b}$ in component form. **1** (b) Hence find the values of p for which $\lvert 2\mathbf{a} + \mathbf{b} \rvert = 7$. **3**
18	2	2	Vectors $\mathbf{u}$ and $\mathbf{v}$ are defined by $\mathbf{u} = \begin{pmatrix} -1 \\ 4 \\ -3 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} -7 \\ 8 \\ 5 \end{pmatrix}$. (a) Find $\mathbf{u}.\mathbf{v}$. **1** (b) Calculate the acute angle between $\mathbf{u}$ and $\mathbf{v}$. **4**
19	5	1	(a) Show that the points A(1,5,–3), B(4,–1,0) and C(8,–9,4) are collinear. **3** (b) State the ratio in which B divides AC. **1**
19	9	1	Vectors $\mathbf{u}$ and $\mathbf{v}$ have components $\begin{pmatrix} p \\ -2 \\ 4 \end{pmatrix}$ and $\begin{pmatrix} 2p+16 \\ -3 \\ 6 \end{pmatrix}$, $p \in \mathbb{R}$. (a) (i) Find an expression for $\mathbf{u}.\mathbf{v}$. **1** (ii) Determine the values of p for which $\mathbf{u}$ and $\mathbf{v}$ are perpendicular. **3** (b) Determine the value of p for which $\mathbf{u}$ and $\mathbf{v}$ are parallel. **2**
19	3	2	E,ABCD is a rectangular based pyramid. $\overrightarrow{AB} = \mathbf{p}$, $\overrightarrow{AD} = \mathbf{q}$ and $\overrightarrow{AE} = \mathbf{r}$.  (a) Express $\overrightarrow{BE}$ in terms of $\mathbf{p}$ and $\mathbf{r}$. **1** Point F divides BC in the ratio 3:1. (b) Express vector $\overrightarrow{EF}$ in terms of $\mathbf{p}$, $\mathbf{q}$ and $\mathbf{r}$. **2**

19	14	2	The vectors $\mathbf{u}$ and $\mathbf{v}$ are such that • $\lvert\mathbf{u}\rvert = 4$ • $\lvert\mathbf{v}\rvert = 5$ • $\mathbf{u}.(\mathbf{u}+\mathbf{v}) = 21$ Determine the size of the angle between the vectors $\mathbf{u}$ and $\mathbf{v}$. **4**