SQA Past paper questions

2019 – Paper 2 – Question 14

The vectors $\mathbf{u}$ and $\mathbf{v}$ are such that

- $|\mathbf{u}| = 4$
- $|\mathbf{v}| = 5$
- $\mathbf{u}.(\mathbf{u}+\mathbf{v}) = 21$

Determine the size of the angle between the vectors $\mathbf{u}$ and $\mathbf{v}$. **4**

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2018 – Paper 2 – Question 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**

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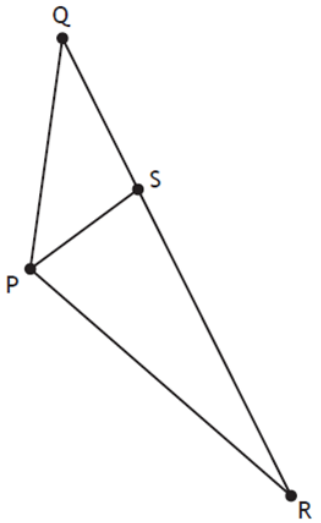
2017 – Paper 2 – Question 5

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**

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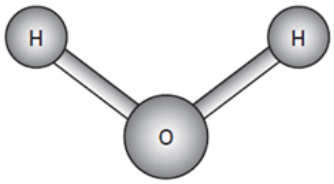
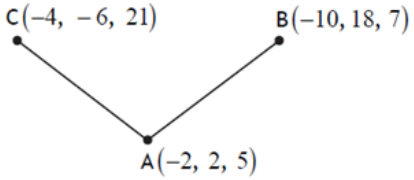
2016 – Paper 2 – Question 5

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

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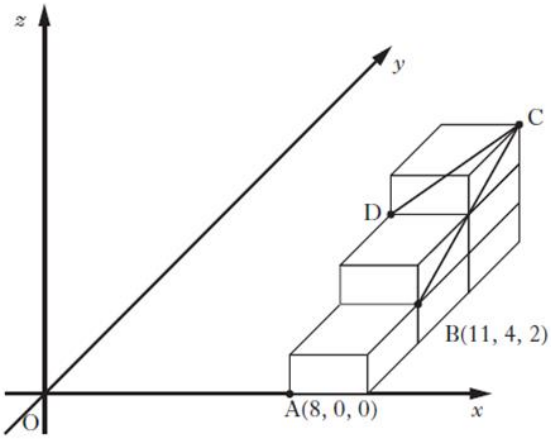
2014 – Paper 2 – Question 4

Six identical cuboids are placed with their edges parallel to the coordinate axes as shown in the diagram.



A and B are the points (8, 0, 0) and (11, 4, 2) respectively.

(a) State the coordinates of C and D. 2

(b) Determine the components of $\overrightarrow{CB}$ and $\overrightarrow{CD}$. 2

(c) Find the size of the angle BCD. 5

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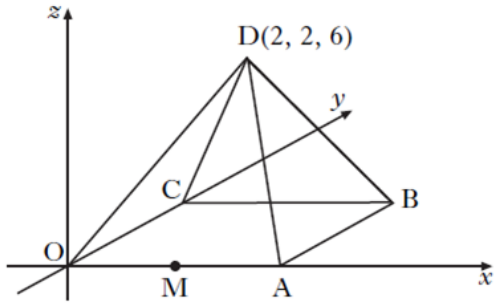
2011 – Paper 2 – Question 1

D,OABC is a square based pyramid as shown in the diagram below.



O is the origin, D is the point (2, 2, 6) and OA = 4 units.

M is the mid-point of OA.

(*a*) State the coordinates of B. **1**

(*b*) Express $\overrightarrow{DB}$ and $\overrightarrow{DM}$ in component form. **3**

(*c*) Find the size of angle BDM. **5**

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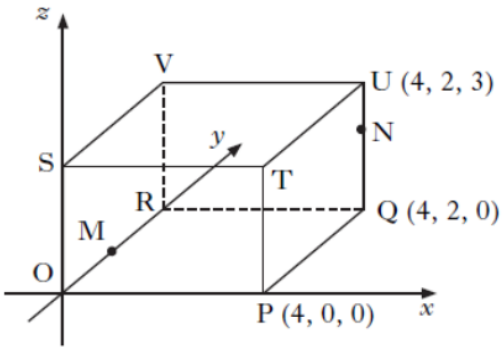
2010 – Paper 2 – Question 1

The diagram shows a cuboid OPQR,STUV relative to the coordinate axes.

P is the point (4, 0, 0),
Q is (4, 2, 0) and U is (4, 2, 3).

M is the midpoint of OR.

N is the point on UQ such that $UN = \frac{1}{3}UQ$.



(*a*) State the coordinates of M and N. **2**

(*b*) Express $\overrightarrow{VM}$ and $\overrightarrow{VN}$ in component form. **2**

(*c*) Calculate the size of angle MVN. **5**

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2008 – Paper 2 – Question 2

The diagram shows a cuboid OABC, DEFG.

F is the point (8, 4, 6).

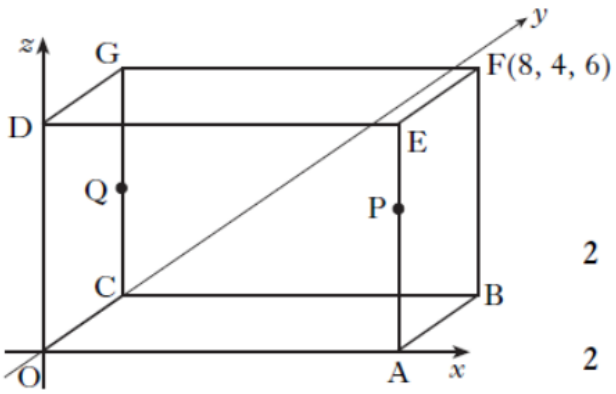
P divides AE in the ratio 2:1.

Q is the midpoint of CG.

(a) State the coordinates of P and Q. **2**

(b) Write down the components of $\overrightarrow{PQ}$ and $\overrightarrow{PA}$. **2**

(c) Find the size of angle QPA. **5**



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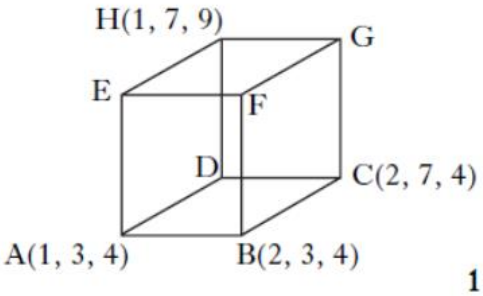
Specimen 1 – Paper 2 – Question 2

The diagram shows a wire framework in the shape of a cuboid with the edges parallel to the axes.

Relative to these axes, A, B, C and H have coordinates (1, 3, 4), (2, 3, 4), (2, 7, 4) and (1, 7, 9) respectively.

(a) State the lengths of AB, AD and AE. **1**

(b) Write down the components of $\overrightarrow{HB}$ and $\overrightarrow{HC}$ and hence or otherwise calculate the size of angle BHC. **7**



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Specimen 2 – Paper 2 – Question 1

Given that $\overrightarrow{QP} = \begin{pmatrix} -1 \\ 3 \\ -2 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} -5 \\ 1 \\ 1 \end{pmatrix}$, find the size of angle PQR. **5**

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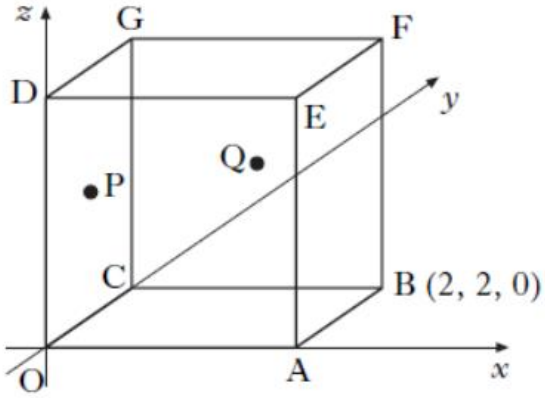
2007 – Paper 2 – Question 1

OABCDEFG is a cube with side 2 units, as shown in the diagram.

B has coordinates (2, 2, 0).

P is the centre of face OCGD and Q is the centre of face CBFG.



(a) Write down the coordinates of G. 1

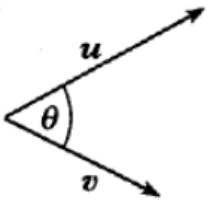
(b) Find $\boldsymbol{p}$ and $\boldsymbol{q}$, the position vectors of points P and Q. 2

(c) Find the size of angle POQ. 5

Click here for video solution.

2006 – Paper 1 – Question 9

$\boldsymbol{u}$ and $\boldsymbol{v}$ are vectors given by $\boldsymbol{u} = \begin{pmatrix} k^3 \\ 1 \\ k+2 \end{pmatrix}$ and $\boldsymbol{v} = \begin{pmatrix} 1 \\ 3k^2 \\ -1 \end{pmatrix}$, where $k > 0$.



(a) If $\boldsymbol{u}.\boldsymbol{v} = 1$, show that $k^3 + 3k^2 - k - 3 = 0$. 2

(b) Show that $(k + 3)$ is a factor of $k^3 + 3k^2 - k - 3$ and hence factorise $k^3 + 3k^2 - k - 3$ fully. 5

(c) Deduce the only possible value of k. 1

(d) The angle between $\boldsymbol{u}$ and $\boldsymbol{v}$ is θ. Find the exact value of $\cos\theta$. 3

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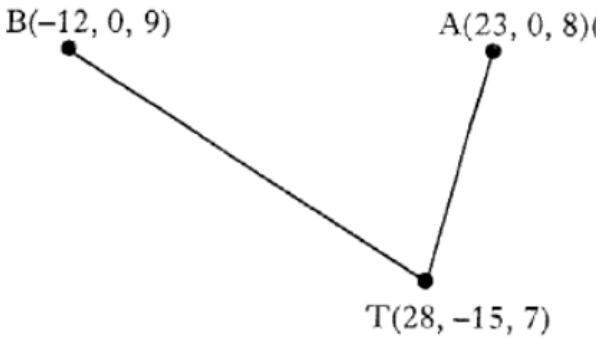
2005 – Paper 2 – Question 4



The sketch shows the positions of Andrew(A), Bob(B) and Tracy(T) on three hill-tops.

Relative to a suitable origin, the coordinates (in hundreds of metres) of the three people are A(23, 0, 8), B(–12, 0, 9) and T(28, –15, 7).

In the dark, Andrew and Bob locate Tracy using heat-seeking beams.

(*a*) Express the vectors $\overrightarrow{TA}$ and $\overrightarrow{TB}$ in component form. **2**

(*b*) Calculate the angle between these two beams. **5**

Click here for video solution.

2004 – Paper 2 – Question 2

P, Q and R have coordinates (1, 3, –1), (2, 0, 1) and (–3, 1, 2) respectively.

(*a*) Express the vectors $\overrightarrow{QP}$ and $\overrightarrow{QR}$ in component form. 2

(*b*) Hence or otherwise find the size of angle PQR. 5

Click here for video solution.

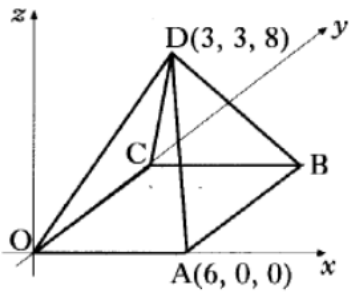
2002 – Paper 2 – Question 2

The diagram shows a square-based pyramid of height 8 units.

Square OABC has a side length of 6 units.

The coordinates of A and D are (6, 0, 0) and (3, 3, 8).

C lies on the *y*-axis.



(*a*) Write down the coordinates of B. **1**

(*b*) Determine the components of $\overrightarrow{DA}$ and $\overrightarrow{DB}$. **2**

(*c*) Calculate the size of angle ADB. **4**

Click here for video solution.