



Mathematics  
Department

# National 5: Vectors

## Cumnock Academy



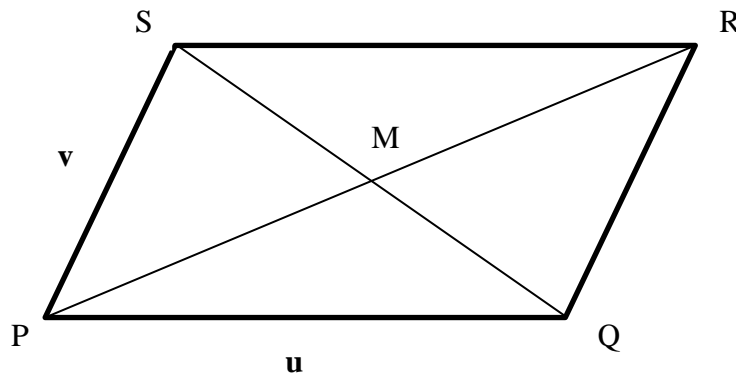
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1. The vectors  $\mathbf{u}$  and  $\mathbf{v}$  are as stated below:

$$\mathbf{u} = \begin{pmatrix} 1 \\ 4 \\ 6 \end{pmatrix} \quad \mathbf{v} = \begin{pmatrix} 3 \\ -2 \\ 4 \end{pmatrix}$$

Find the magnitude of  $|\mathbf{u} + \mathbf{v}|$  giving your answer as a surd in its simplest form.

2. Shown below is a parallelogram PQRS with vector  $\overrightarrow{PQ} = \mathbf{u}$  and vector  $\overrightarrow{PS} = \mathbf{v}$



Find the following vectors in terms of  $\mathbf{u}$  and  $\mathbf{v}$ :

- (a)  $\overrightarrow{QR}$                       (b)  $\overrightarrow{SR}$                       (c)  $\overrightarrow{PR}$   
(d)  $\overrightarrow{QS}$                       (e)  $\overrightarrow{PM}$                       (f)  $\overrightarrow{SM}$

3. P is the point (6, 4, 2), Q(8, 6, 4) and R(2, 2, 2).

(a) Show that  $\overrightarrow{OP} = \overrightarrow{RQ}$ , where O is the origin.

(b) What type of quadrilateral is ABCD?

4. A is the point (2, 4, 6), B(7, 5, 0), C(6, 10, -6) and D(1, 9, 0). Show that:

(a)  $\overrightarrow{AB} = \overrightarrow{DC}$

(b)  $|\overrightarrow{AB}| = |\overrightarrow{DC}|$

5. Solve the following vector equations for  $\mathbf{x}$ :

(a)  $\mathbf{x} + \begin{pmatrix} 1 \\ -2 \\ -1 \end{pmatrix} = \begin{pmatrix} 5 \\ 3 \\ -1 \end{pmatrix}$       (b)  $2\mathbf{x} - \begin{pmatrix} -3 \\ 7 \\ -5 \end{pmatrix} = \begin{pmatrix} 11 \\ -9 \\ 17 \end{pmatrix}$

6. P is the point (1, -1, 2), Q is (2, 0, -5) and R is (1, 1, 0).

(a) Write down the components of  $\mathbf{p}$ ,  $\mathbf{q}$  and  $\mathbf{r}$  the position vectors of P, Q and R.

(b) Find the vectors:

(i)  $\overrightarrow{QP}$

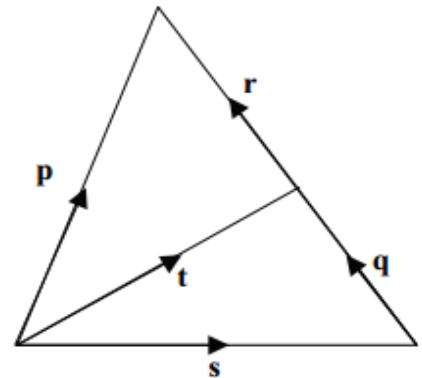
(ii)  $\overrightarrow{QR}$

(iii)  $\overrightarrow{PR}$

7. Use the diagram opposite to name the vector that represents:

(a)  $\mathbf{p} - \mathbf{r}$       (b)  $\mathbf{r} - \mathbf{p}$       (c)  $\mathbf{t} - \mathbf{q}$       (d)  $\mathbf{s} - \mathbf{t}$

(e)  $\mathbf{p} - \mathbf{r} - \mathbf{q}$       (f)  $\mathbf{t} + \mathbf{r} - \mathbf{p}$       (g)  $\mathbf{s} - \mathbf{p} + \mathbf{q}$



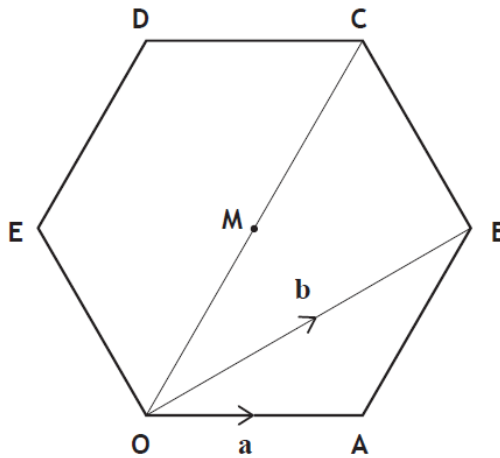
8. Two forces acting on a rocket are represented by vectors  $\mathbf{u}$  and  $\mathbf{v}$ .

$$\mathbf{u} = \begin{pmatrix} 2 \\ -5 \\ -3 \end{pmatrix} \quad \text{and} \quad \mathbf{v} = \begin{pmatrix} 7 \\ 4 \\ -1 \end{pmatrix} .$$

Calculate  $|\mathbf{u} + \mathbf{v}|$ , the magnitude of the resultant force.

Express your answer as a surd in its simplest form.

9. In the diagram, OABCDE is a regular hexagon with centre M. Vectors  $\mathbf{a}$  and  $\mathbf{b}$  are represented by  $\overrightarrow{OA}$  and  $\overrightarrow{OB}$  respectively.



- (a) Express  $\overrightarrow{AB}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .  
 (b) Express  $\overrightarrow{OC}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

10. ABCDEF is a regular hexagon with centre O.

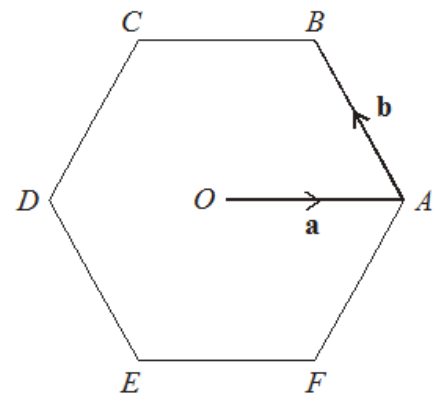
$$\overrightarrow{OA} = \mathbf{a} \text{ and } \overrightarrow{AB} = \mathbf{b}$$

- (a) Find expressions, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ , for  
 (i)  $\overrightarrow{OB}$     (ii)  $\overrightarrow{AC}$     (iii)  $\overrightarrow{EC}$
- (b) The positions of points P and Q are given by the vectors:

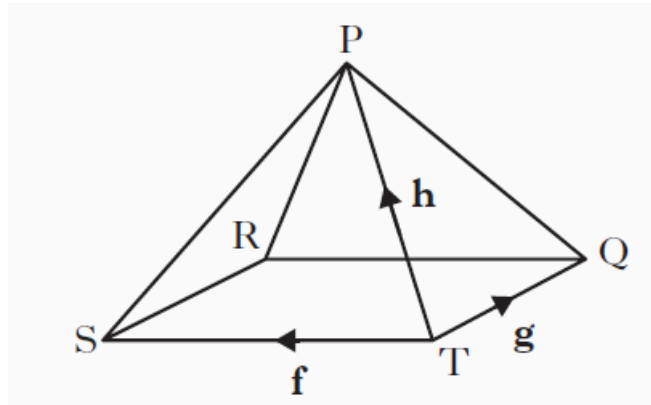
$$\overrightarrow{OP} = \mathbf{a} - \mathbf{b}$$

$$\overrightarrow{OQ} = \mathbf{a} + 2\mathbf{b}$$

- (i) Draw and label the positions of points P and Q on the diagram.  
 (ii) Hence, or otherwise, deduce an expression for  $\overrightarrow{PQ}$ .



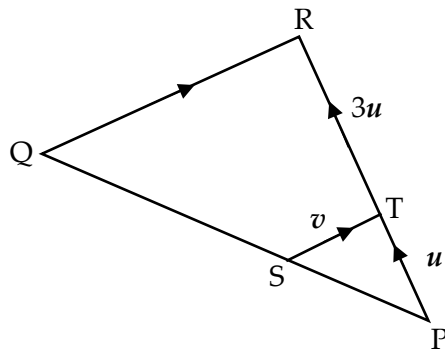
11. The diagram shows a square-based pyramid P, QRST.  $\overrightarrow{TS}$ ,  $\overrightarrow{TQ}$  and  $\overrightarrow{TP}$  represent  $\mathbf{f}$ ,  $\mathbf{g}$  and  $\mathbf{h}$  respectively.



Express  $\overrightarrow{RP}$  in terms of  $\mathbf{f}$ ,  $\mathbf{g}$  and  $\mathbf{h}$ .

12. A is the point with coordinates  $(1, -1, 2)$ , B $(3, 0, 3)$  and C $(-2, 3, 4)$ .  
Express  $\overrightarrow{AB}$  and  $\overrightarrow{AC}$  in component form.

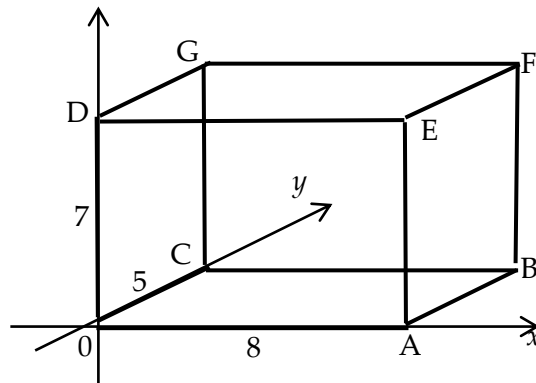
13. Vectors  $\mathbf{u}$  and  $\mathbf{v}$  are shown in the diagram below.



$$|QR| = 3|ST|$$

Find  $\overrightarrow{PQ}$  in terms of  $\mathbf{u}$  and  $\mathbf{v}$ .

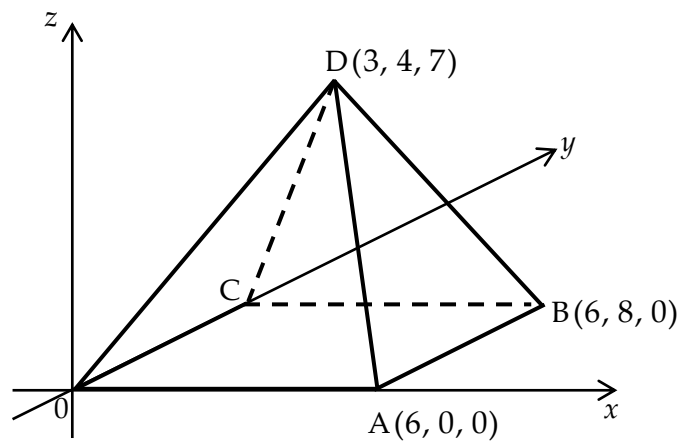
14. OABC,DEFG is a rectangular prism as show.



OA is 8 units long, OC is 5 units and OD is 7 units.

Write down the coordinates of B and G.

15. The rectangular based pyramid D, OABC has vertices A (6, 0, 0), B(6, 8, 0) and (3, 4, 7).



- (a) Write down the coordinates of C.
- (b) Express  $\overrightarrow{AC}$  and  $\overrightarrow{AD}$  in component form.