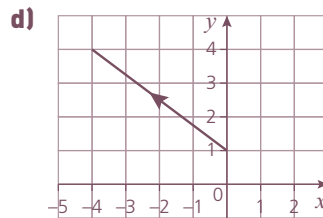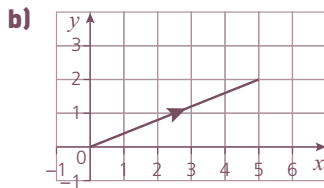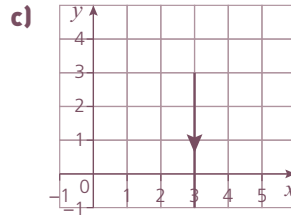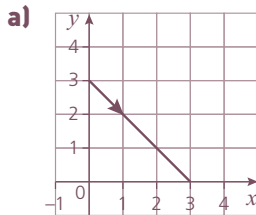# 13 Vectors in two dimensions

1 Express the following vectors **(i)** in component form and **(ii)** in column vector form.

a)

c)

b)

d)

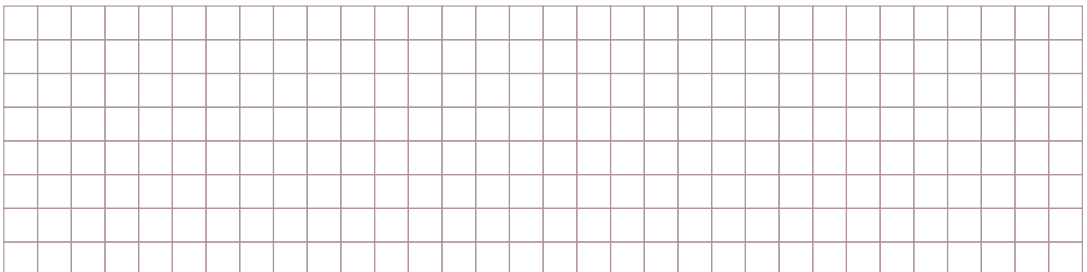|	**a)**	**b)**	**c)**	**d)**
(i) Components				
(ii) Column vectors				

2 (i) Draw the following vectors on the grid below:

a) $-3\mathbf{i}$ **b)** $2\mathbf{i} + 5\mathbf{j}$ **c)** $4\mathbf{i} + 2\mathbf{j}$ **d)** $-4\mathbf{i} + 2\mathbf{j}$

(ii) Find the modulus of each vector.

a) **b)** **c)** **d)**

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3 For each of the following vectors **(i)** draw a diagram and **(ii)** find its magnitude.

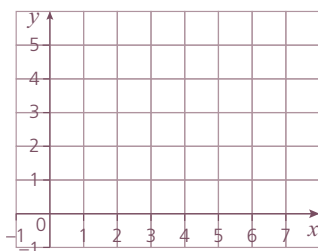**a)** $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$ **b)** $\begin{pmatrix} 0 \\ 3 \end{pmatrix}$ **c)** $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ **d)** $\begin{pmatrix} -1 \\ 1 \end{pmatrix}$

4 a) A, B, C and D have coordinates $(-1, 3)$, $(1, 5)$, $(4, 3)$ and $(1, 1)$. Draw quadrilateral ABCD on the grid.

b) Write down the position vectors of the points A, B, C and D.

A

B

C

D

c) Write down the vectors:

(i) $\overrightarrow{AB}$ **(ii)** $\overrightarrow{BC}$ **(iii)** $\overrightarrow{AD}$ **(iv)** $\overrightarrow{DC}$
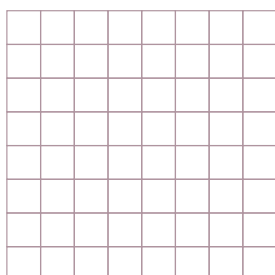
5 ABC is a triangle with $\overrightarrow{AB} = 2\mathbf{i}$ and $\overrightarrow{AC} = \mathbf{i} + 2\mathbf{j}$.

a) Write down the vector $\overrightarrow{BC}$.

c) Describe the triangle ABC.

b) Sketch the triangle ABC.

d) Find $\overrightarrow{AD}$ if ABDC is a parallelogram.

6 Simplify the following.

   a) $(3\mathbf{i} + \mathbf{j}) - (3\mathbf{i} - \mathbf{j})$ **b)** $3(\mathbf{i} + \mathbf{j}) - 2(\mathbf{i} - \mathbf{j})$ **c)** $2(2\mathbf{i} - 3\mathbf{j}) - 3(-2\mathbf{i} + 3\mathbf{j})$

7 $\mathbf{p} = 2\mathbf{i} - \mathbf{j}$, $\mathbf{q} = \mathbf{i} + 2\mathbf{j}$ and $\mathbf{r} = -\mathbf{i} + 3\mathbf{j}$
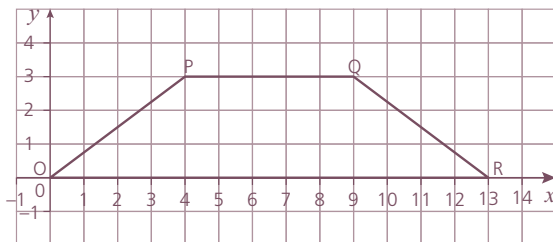
   Find the following vectors and work out their lengths:

   a) $\mathbf{p} + \mathbf{q} + \mathbf{r}$ **b)** $2\mathbf{p} - 3\mathbf{q} + 4\mathbf{r}$ **c)** $3(\mathbf{p} + 2\mathbf{q}) - 2(2\mathbf{p} - 3\mathbf{q})$

8 The diagram shows an isosceles trapezium OPQR where $\overrightarrow{OP} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ and $\overrightarrow{OQ} = \begin{pmatrix} 9 \\ 3 \end{pmatrix}$.

   a) Write down the vectors $\overrightarrow{PQ}$, $\overrightarrow{QR}$ and $\overrightarrow{OR}$ as column vectors.

     $\overrightarrow{PQ}$ $\overrightarrow{QR}$ $\overrightarrow{OR}$

   b) Write down the vector $\overrightarrow{RP}$ as a column vector.

   c) When produced, $\overrightarrow{OP}$ and $\overrightarrow{RQ}$ meet at the point B. Add B to the diagram,
       and use one word to describe the triangle OBR.

9 Find unit vectors parallel to each of the following:
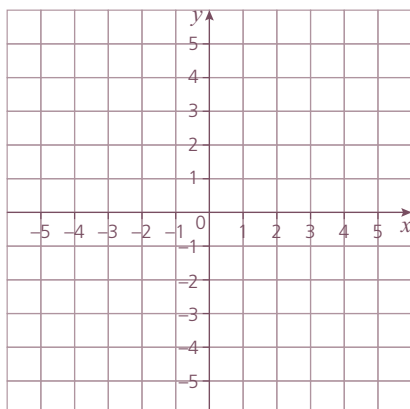
   a) $5\mathbf{i} + 12\mathbf{j}$ **b)** $\mathbf{i} + \mathbf{j}$ **c)** $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$ **d)** $\begin{pmatrix} -2 \\ -5 \end{pmatrix}$

10 $A(1, 2), B(4, 6), C(8, 9)$ and $D(5, 5)$ form the vertices of a quadrilateral.

a) Draw the quadrilateral.

b) Write the following sides of the quadrilateral as column vectors.

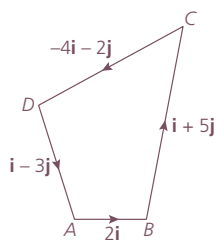**(i)** AB

(iii) AD

(ii) BC

(iv) DC

c) Find the lengths of the sides of the quadrilateral.

d) Describe the quadrilateral as fully as possible.

11

Onaka wants to measure the area and perimeter of a field that he is buying, so he asks a surveyor to measure it for him. The surveyor then presents him with this sketch.

Onaka doesn't understand how vectors work, so he starts by adding up the four pieces of information on the diagram.

a) What answer does this give him? Explain the result.

b) What answer should he get for the perimeter if each unit represents 100 m?

c) Taking A to be at the origin, write down the position vectors of the other three corners of the field.

d) Find the area of the field.

12 Jenny starts at O and travels north west for 2 hours at 6 km h^{-1}, and then east until she arrives at Q which is 20.1 km from O. Find the bearing of Q from O, giving your answer to the nearest degree.