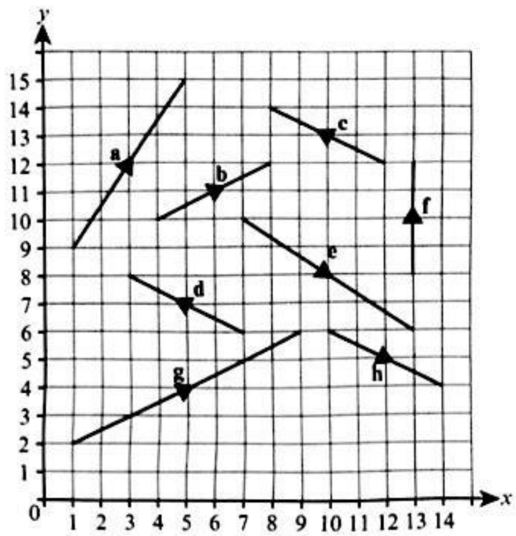
1 Write a column vector for each of the vectors shown on the diagram.



2 Represent these vectors on squared paper.

a $\overrightarrow{AB} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$ **b** $\overrightarrow{CD} = \begin{pmatrix} 2 \\ 2 \end{pmatrix}$ **c** $\overrightarrow{PQ} = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$ **d** $\overrightarrow{RS} = \begin{pmatrix} 0 \\ 3 \end{pmatrix}$

e $\overrightarrow{TU} = \begin{pmatrix} -2 \\ 0 \end{pmatrix}$ **f** $\overrightarrow{MN} = \begin{pmatrix} -2 \\ -4 \end{pmatrix}$ **g** $\overrightarrow{KL} = \begin{pmatrix} 0 \\ -5 \end{pmatrix}$ **h** $\overrightarrow{VW} = \begin{pmatrix} -3 \\ -3 \end{pmatrix}$

i $\overrightarrow{EF} = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$ **j** $\overrightarrow{JL} = \begin{pmatrix} -3 \\ -2 \end{pmatrix}$ **k** $\overrightarrow{MP} = \begin{pmatrix} -5 \\ 0 \end{pmatrix}$ **l** $\overrightarrow{QT} = \begin{pmatrix} -4 \\ 2 \end{pmatrix}$

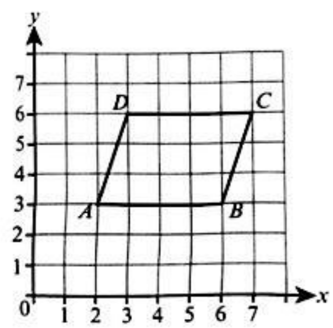
3 In the diagram, $ABCD$ is a parallelogram.

a Write column vectors for the following:

i $\overrightarrow{AB}$ and $\overrightarrow{DC}$

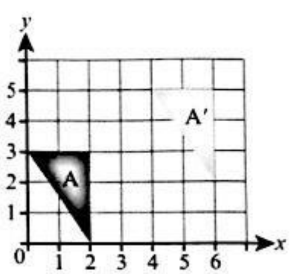
ii $\overrightarrow{BC}$ and $\overrightarrow{AD}$.

b What can you say about the two pairs of vectors?

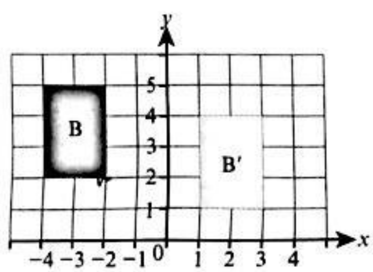


4 In the diagrams below, shapes A, B, C, D, E and F are mapped onto images A′, B′, C′, D′, E′ and F′ by translation. Find the column vector for the translation in each case.

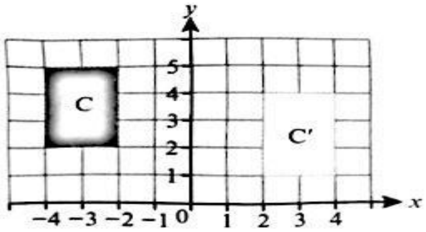
a



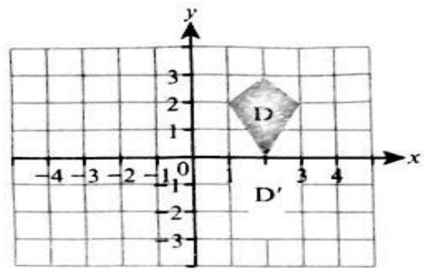
b



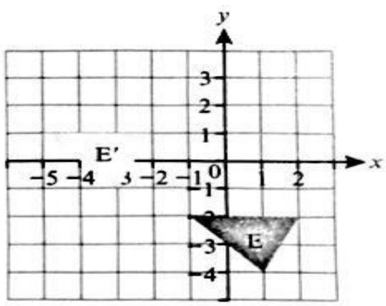
c

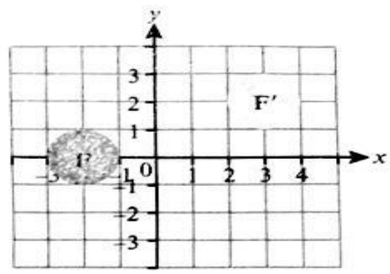


d



e

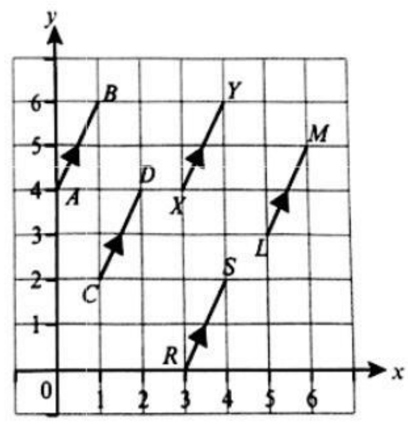




Equal vectors

Equal vectors have the same size (magnitude) and direction. As vectors are usually independent of position, they can start at any point. The same vector can be at many places in a diagram.

In the diagram, $\overrightarrow{AB}$, $\overrightarrow{CD}$, $\overrightarrow{XY}$, $\overrightarrow{LM}$ and $\overrightarrow{RS}$ are equal vectors.



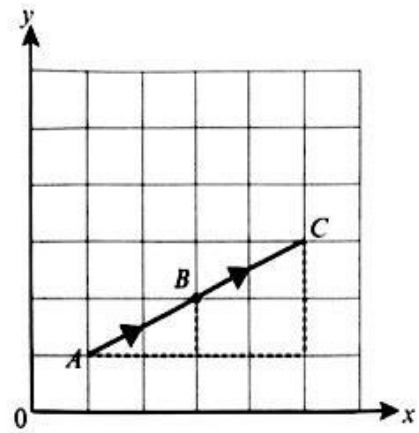
$$\overrightarrow{AB} = \overrightarrow{CD} = \overrightarrow{XY} = \overrightarrow{LM} = \overrightarrow{RS} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

When equal vectors share a common point, for example when $\overrightarrow{AB} = \overrightarrow{BC}$ you can deduce that that the points A, B and C all lie on a straight line. When points lie on a straight line, they are collinear.

Multiplying a vector by a scalar

Look at the diagram. Vector $\overrightarrow{AC}$ is twice as long as vector $\overrightarrow{AB}$.

You can say:
$\overrightarrow{AC} = 2\overrightarrow{AB} = 2\begin{pmatrix}2\\1\end{pmatrix} = \begin{pmatrix}4\\2\end{pmatrix}$.

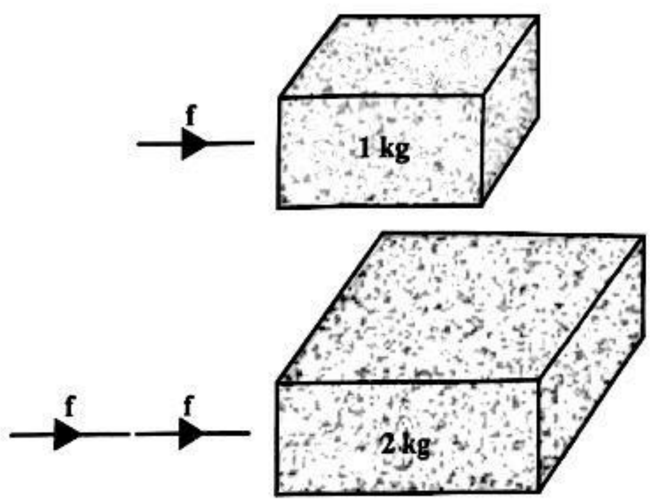


Here is another example.

A force, represented by vector **f**, is needed to move a 1 kg concrete block.

If you want to move a 2 kg concrete block, you need to apply twice the force. In other words, you would need to apply **f** + **f** or 2**f**.

A force of 2**f** has the same direction as **f**, but it has twice its magnitude.



If $\mathbf{a} = \begin{pmatrix} -1 \\ -4 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 3 \\ 7 \end{pmatrix}$ calculate:

a $-2\mathbf{a}$

b $3\mathbf{b}$

c $\frac{3}{2}\mathbf{b}$

d $-\frac{3}{4}\mathbf{a}$

e $-1.5\mathbf{a}$

f $-12\mathbf{b}$

g $-\frac{3}{2}\mathbf{a}$

h $-\frac{5}{9}\mathbf{b}$