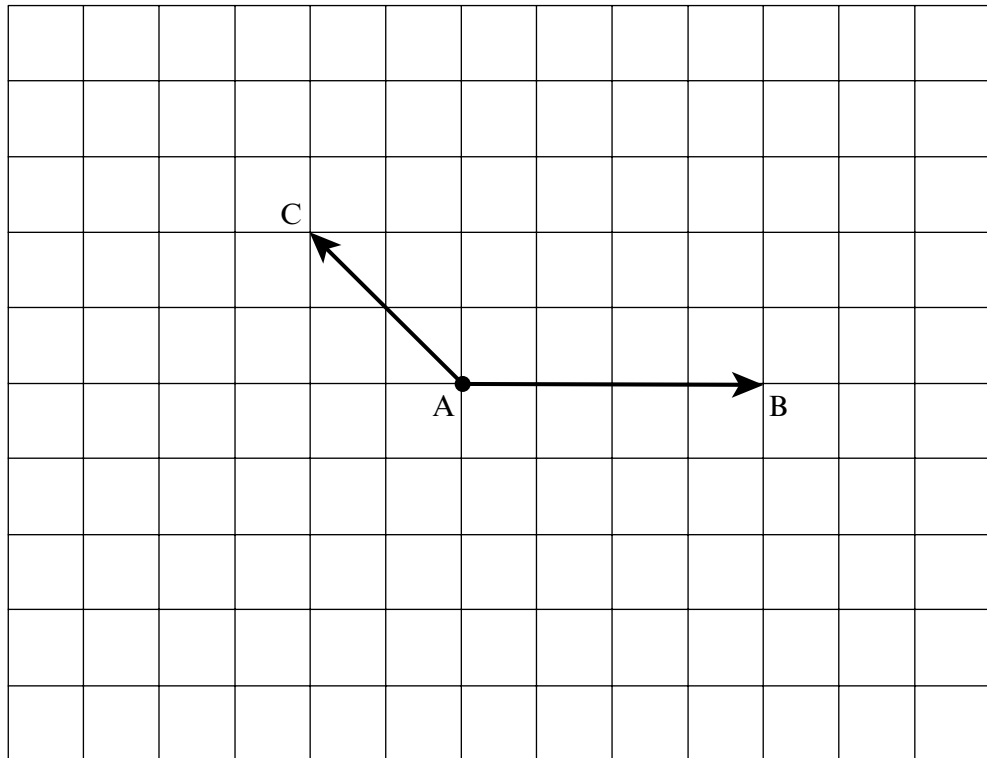# Vectors 1

1)   The diagram below shows the vectors $\vec{AB}$ and $\vec{AC}$.

On the diagram, mark the following points

(a)   the point D such that $\vec{AD} = 2\,\vec{AC}$;

(b)   the point P such that $\vec{AP} = \vec{AB} - \vec{AC}$;

(c)   the point Q such that $\vec{AQ}$ is the projection of the vector $\vec{AC}$ in the direction of $\vec{AB}$.

2)   The vector equations of two lines are given below.

$$r_1 = \begin{pmatrix} 5 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ -2 \end{pmatrix}, \quad r_2 = \begin{pmatrix} -2 \\ 2 \end{pmatrix} + t \begin{pmatrix} 4 \\ 1 \end{pmatrix}.$$

The lines intersect at the point P. Find the position vector of P.

3)   A vector equation for the line L is $r = \begin{pmatrix} 4 \\ 4 \end{pmatrix} + t\begin{pmatrix} 3 \\ 1 \end{pmatrix}$.

Which of the following are also vector equations for the same line L?

A. $r = \begin{pmatrix} 4 \\ 4 \end{pmatrix} + t\begin{pmatrix} 2 \\ 1 \end{pmatrix}$.

B. $r = \begin{pmatrix} 4 \\ 4 \end{pmatrix} + t\begin{pmatrix} 6 \\ 2 \end{pmatrix}$.

C. $r = \begin{pmatrix} 0 \\ 1 \end{pmatrix} + t\begin{pmatrix} 1 \\ 3 \end{pmatrix}$.

D. $r = \begin{pmatrix} 7 \\ 5 \end{pmatrix} + t\begin{pmatrix} 3 \\ 1 \end{pmatrix}$.

4)   Two lines L_1 and L_2 have these vector equations.
$$L_1 : r = 2i + 3j + t(i - 3j)$$
$$L_2 : r = i + 2j + s(i - j)$$
The angle between L_1 and L_2 is θ. Find the cosine of the angle θ.

Answers:

5)   Find the cosine of the angle between the two vectors $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$ and $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$.

6)   A boat B moves with constant velocity along a straight line. Its velocity vector is given by $v = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$.

At time $t = 0$ it is at the point (−2, 1).   *Answer:*
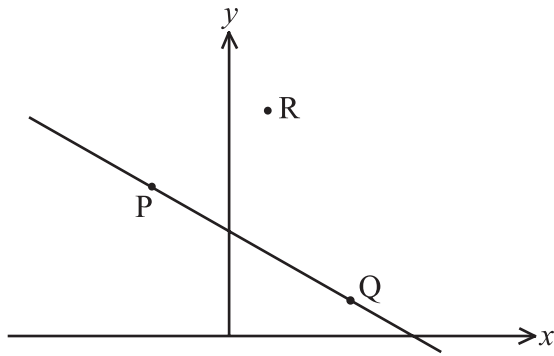
(a)   Find the magnitude of v.

(b)   Find the coordinates of B when $t = 2$.

(c)   Write down a vector equation representing the position of B, giving your answer in the form $r = a + tb$.

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7)   The points P $(-2, 4)$, Q $(3, 1)$ and R $(1, 6)$ are shown in the diagram below.

(a)   Find the vector $\vec{PQ}$.

(b)   Find a vector equation for the line through R parallel to the line (PQ).