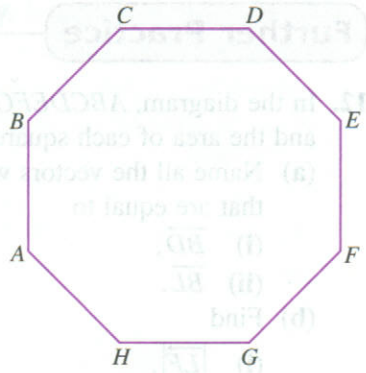
15. In the diagram, $ABCDEFGH$ is a regular octagon. Express each of the following as a single vector.

(a) $-\overrightarrow{DC} + \overrightarrow{BE} - \overrightarrow{AG}$

(b) $\overrightarrow{GF} - \overrightarrow{BA} - \overrightarrow{DC} + \overrightarrow{EA}$

(c) $\overrightarrow{BC} + \overrightarrow{BG} - \overrightarrow{BA} - \overrightarrow{AH} + \overrightarrow{DC}$



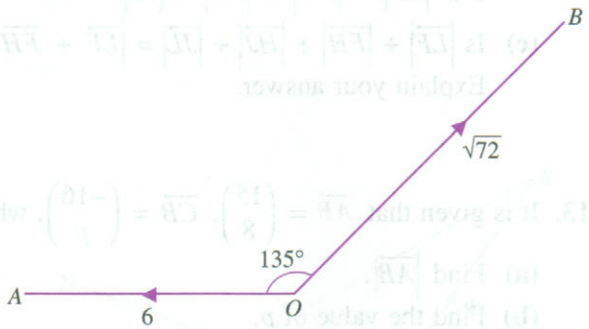
16. In the diagram, $|\overrightarrow{OA}| = 6$ units, $|\overrightarrow{OB}| = \sqrt{72}$ units and the angle between $\overrightarrow{OA}$ and $\overrightarrow{OB}$ is 135°.

(a) Find

(i) $|\overrightarrow{OA} - \overrightarrow{OB}|$,

(ii) $|\overrightarrow{OA} + \overrightarrow{OB}|$.

(b) Suppose that $\overrightarrow{OC} = \overrightarrow{OA} + \overrightarrow{OB}$. State two properties of $\triangle AOC$.



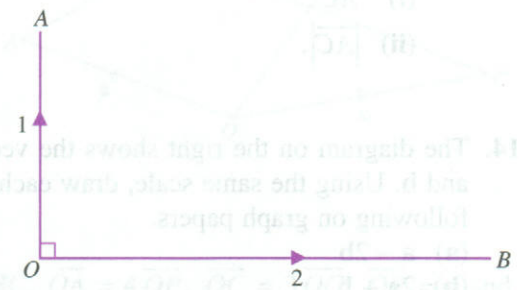
17. In the diagram, the vector $\overrightarrow{OA}$ is perpendicular to the vector $\overrightarrow{OB}$, $|\overrightarrow{OB}| = 2$ units and $|\overrightarrow{OA}| = 1$ unit.

(a) Find

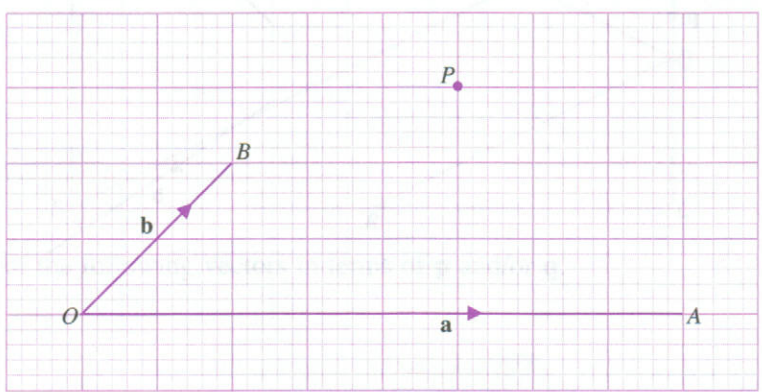
$|\overrightarrow{OP}|$ if $\overrightarrow{OP} = 2\overrightarrow{OA} + 3\overrightarrow{OB}$.

$|\overrightarrow{OQ}|$ if $\overrightarrow{OQ} = -\overrightarrow{OA} + 4\overrightarrow{OB}$.

(b) Calculate the size of $\angle POQ$.



18. The points O, A, B and P are shown in the diagram below. The position vectors of A and B with respect to the point O are **a** and **b** respectively.



(a) Locate and label clearly the point Q if $\overrightarrow{OQ} = t\mathbf{b}$ and $\overrightarrow{QP} = s\mathbf{a}$.

(b) Hence, find the values of s and t.

(c) The point R on OA is such that $|\overrightarrow{RQ}| = |\overrightarrow{RP}|$.

(i) Locate and label clearly the point R.

(ii) Hence, express $\overrightarrow{OR}$ and $\overrightarrow{BR}$ in terms of **a** and/or **b**.