In the diagram, A is the point $(10, 1)$ and $\vec{AB} = \begin{pmatrix} -8 \\ 15 \end{pmatrix}$.

(a) Find

    (i) $|\vec{AB}|$,   [2]

    (ii) the coordinates of B.   [1]

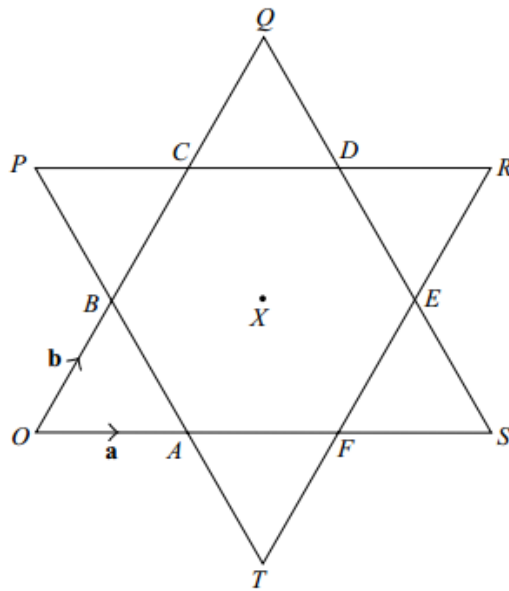The point C is $(42, 16)$ and $\vec{CD} = 3\vec{AB}$.

(b) Find

    (i) the coordinates of D,   [2]

    (ii) the vector $\vec{AD}$.   [1]

The point E is $(k, 16)$.

(c) **(i)** Find, in terms of k, the vector $\vec{AE}$.   [1]

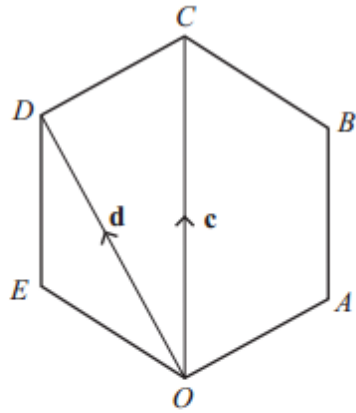   **(ii)** Given that AED is a straight line, find k.   [2]

(d) Find $\dfrac{\text{Area of triangle } ABE}{\text{Area of triangle } CDE}$.   [2]

A star is made up of a regular hexagon, centre X, surrounded by 6 equilateral triangles.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Write the following vectors in terms of $\mathbf{a}$ and/or $\mathbf{b}$, giving your answers in their simplest form.

    (i) $\overrightarrow{OS}$,   [1]

    (ii) $\overrightarrow{AB}$,   [1]

    (iii) $\overrightarrow{CD}$,   [1]

    (iv) $\overrightarrow{OR}$,   [2]

    (v) $\overrightarrow{CF}$.   [2]

OABCDE is a regular hexagon.

With *O* as origin the position vector of *C* is **c** and the position vector of *D* is **d**.

(a) Find, in terms of **c** and **d**,

    (i) $\overrightarrow{DC}$, [1]

    (ii) $\overrightarrow{OE}$, [2]

    (iii) the position vector of *B*. [2]