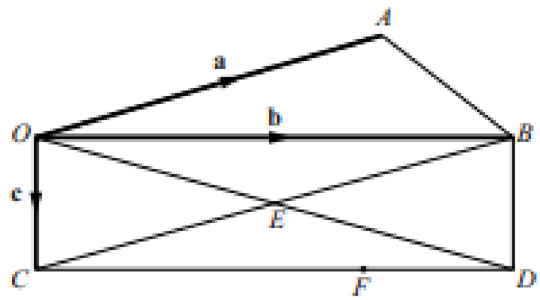
Question 1

OAB is a triangle and *OBDC* is a rectangle where *OD* and *BC* intersect at *E*.
F is the point on *CD* such that $CF = \frac{3}{4} CD$.
$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$.



(a) Express, as simply as possible, in terms of one or more of the vectors **a**, **b** and **c**,

(i) $\overrightarrow{AB}$,

Answer .... [1]

(ii) $\overrightarrow{OE}$,

Answer .... [1]

(iii) $\overrightarrow{EF}$.

Answer .... [2]

(b) *G* is the point on *AB* such that $\overrightarrow{OG} = \frac{3}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$.

(i) Express $\overrightarrow{AG}$ in terms of **a** and **b**.
Give your answer as simply as possible.

Answer .... [1]

(ii) Find $AG : GB$.

Answer .... : .... [1]

(iii) Express $\overrightarrow{FG}$ in terms of **a**, **b** and **c**.
Give your answer as simply as possible.

[2]

Question 2

$$\mathbf{m} = \begin{pmatrix} 3 \\ -2 \end{pmatrix} \quad \mathbf{n} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$$

(a) Calculate $\mathbf{m} - 2\mathbf{n}$.

Answer $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

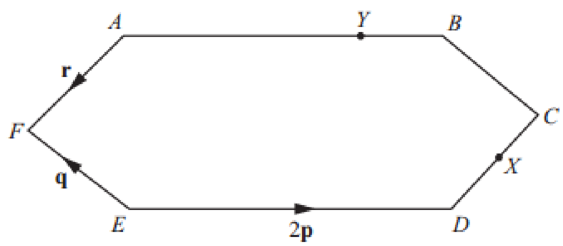
(b) Given that $s\mathbf{m} + 3\mathbf{n} = \begin{pmatrix} 12 \\ t \end{pmatrix}$, calculate s and t .

Answer $s =$ ....

$t =$ ....[2]

Question 3

(a)



In the diagram, *ABCDEF* is a hexagon with rotational symmetry of order 2.

$\overrightarrow{ED} = 2\mathbf{p}$, $\overrightarrow{EF} = \mathbf{q}$ and $\overrightarrow{AF} = \mathbf{r}$.

X is the midpoint of *CD* and *Y* is the point on *AB* such that $AY : YB$ is $3 : 1$.

(i) How many lines of symmetry does *ABCDEF* have?

Answer .... [1]

(ii) Express, as simply as possible, in terms of one or more of the vectors **p**, **q** and **r**,

(a) $\overrightarrow{EA}$,

Answer .... [1]

(b) $\overrightarrow{FC}$,

Answer .... [1]

(c) $\overrightarrow{FY}$,

Answer .... [1]

(d) $\overrightarrow{YX}$.

Answer .... [1]

Question 4

(a) $\mathbf{A} = \begin{pmatrix} -1 & 2 \\ 3 & -1 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 4 & 2 \\ -3 & -1 \end{pmatrix}$.

(i) Find $\mathbf{AB}$.

Answer [2]

(ii) Find $\mathbf{B}^{-1}$.

Answer [2]

(b) $\overrightarrow{PQ} = \begin{pmatrix} 12 \\ 5 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}$.

(i) Calculate $|\overrightarrow{PQ}|$.

Answer .... [2]

(ii) Find $\overrightarrow{PR}$.

Answer [1]

(c) You may use the grid below to help you answer this question.
T is the point (13, 7) and U is the point (8, 9).

(i) Find $\overrightarrow{TU}$.

Answer [1]

(ii) TUV is an isosceles triangle with $TU = TV$.
The y-coordinates of the points U and V are equal.

Find the coordinates of V.

Answer (.......... , ...) [1]

(iii) W is the point (1, 3).

Calculate the area of triangle TUW.

Answer .... units^2 [3]