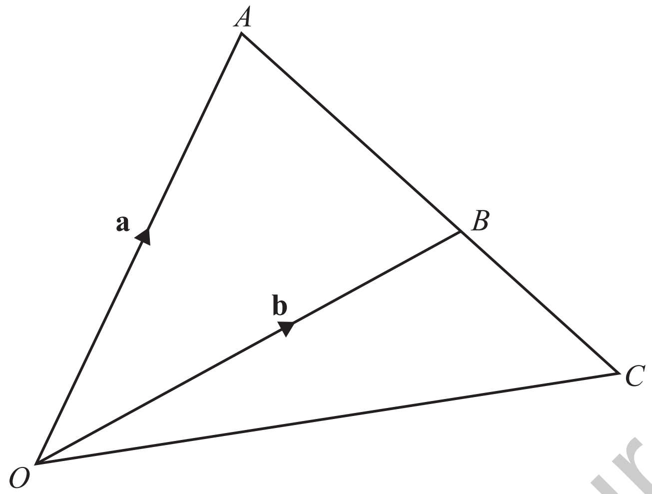
Name:

Section:

Vectors Worksheet

1



NOT TO SCALE

OAC is a triangle and B is a point on AC such that $AB : BC = 3 : 2$.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Find $\overrightarrow{OC}$ in terms of **a** and **b**, giving your answer in its simplest form.

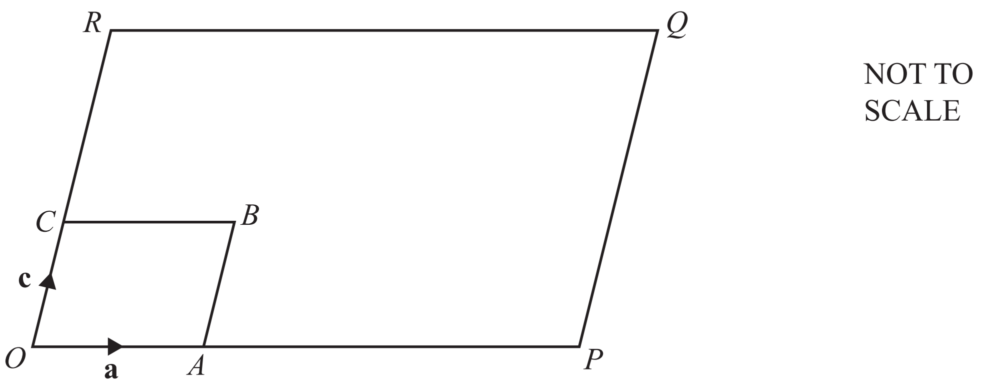
$\overrightarrow{OC} =$ .... [3]

(b) D is a point on OC such that $\overrightarrow{OD} = \mathbf{b} - \frac{2}{5}\mathbf{a}$.

Show that $OABD$ is a trapezium.

[2]

2



OABC and *OPQR* are parallelograms.
A is a point on *OP* and *C* is a point on *OR*.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$.
$OA : OP = 1 : 4$ and $OC : CR = 2 : 3$.

(a) Find $\overrightarrow{OR}$ in terms of **c**.

$\overrightarrow{OR} =$ .... [1]

(b) Find $\overrightarrow{CQ}$, as simply as possible, in terms of **a** and **c**.

$\overrightarrow{CQ} =$ .... [2]

(c) Find the ratio area *OABC* : area *OPQR*.

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

3 **(a)** *P* is the point $(-5, 2)$, *Q* is the point $(3, 7)$ and $\overrightarrow{QR} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}$.

(i) Find the coordinates of the midpoint of *PQ*.

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

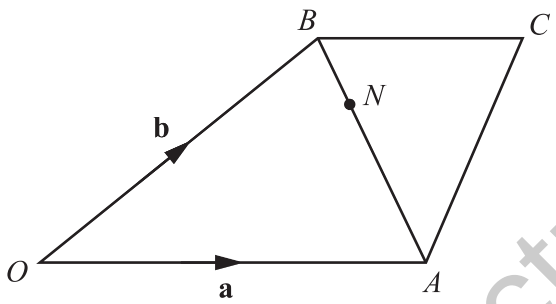
(ii) Find the coordinates of point R.

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

(iii) Find $|\overrightarrow{QR}|$.

$|\overrightarrow{QR}|$ = ... units [2]

(b)



$OACB$ is a quadrilateral and N is a point on AB.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.
$\overrightarrow{OA} = 2\overrightarrow{BC}$ and $BN : NA = 1 : 3$.

Find, in terms of **a** and **b**, in its simplest form

(i) $\overrightarrow{AB}$,

$\overrightarrow{AB}$ = ... [1]

(ii) $\overrightarrow{NC}$.

$\overrightarrow{NC}$ = ... [3]

4 **(a)** A is the point (2, 3) and B is the point (3, −5).

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

$\overrightarrow{AB} = \begin{pmatrix} \\ \end{pmatrix}$ [2]

(ii) $\overrightarrow{BC} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$

Find the coordinates of C.

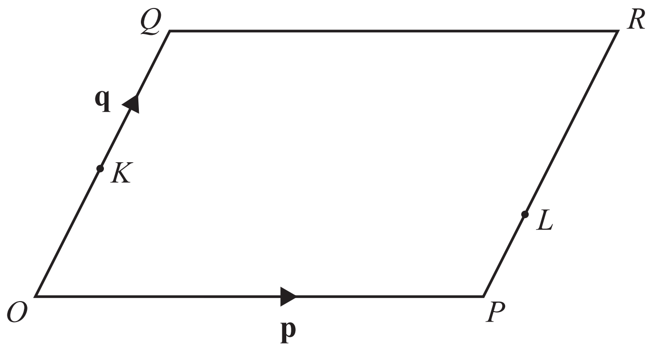
(..................... , ...) [1]

(iii) $\left|\overrightarrow{AD}\right| = \sqrt{74}$ and $D = (-3, n)$.

Find the possible values of n.

n = ... or n = ... [3]

(b)



NOT TO SCALE

OQRP is a parallelogram.

$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$.

K is the midpoint of *OQ* and *L* is a point on *PR*.

$\overrightarrow{KL} = \mathbf{p} - \frac{1}{10}\mathbf{q}$.

Find $PL : LR$.

.... : .... [3]

5 **(a)** *H* is the point (−7, 4) and $\overrightarrow{HJ} = \begin{pmatrix} 10 \\ -6 \end{pmatrix}$.

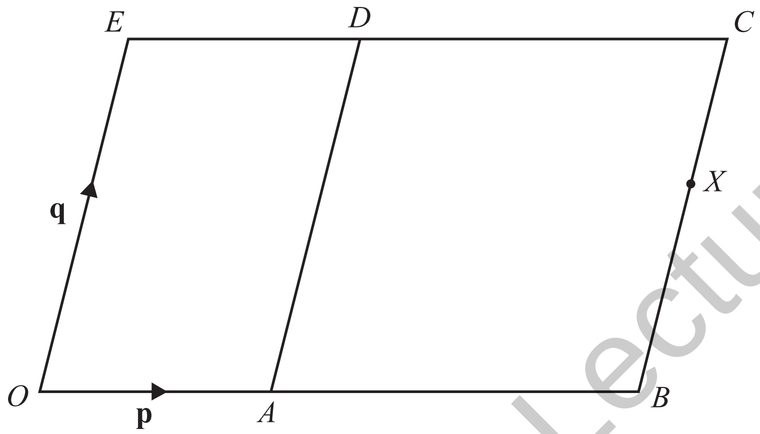
(i) Calculate the magnitude of $\overrightarrow{HJ}$.

.... [2]

(ii) Given that $\overrightarrow{HK} = 3\overrightarrow{HJ}$, find the coordinates of point K.

(..................... , ...) [2]

(b)



NOT TO SCALE

The diagram shows a parallelogram *OBCE*.
$\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{OE} = \mathbf{q}$.
AD is parallel to *OE* and *OA* : *AB* = 1 : 3.
X is a point on *BC* such that *BX* : *XC* = 3 : 2.

Express, as simply as possible, in terms of **p** and/or **q**

(i) $\overrightarrow{OC}$,

$\overrightarrow{OC}$ = ... [1]

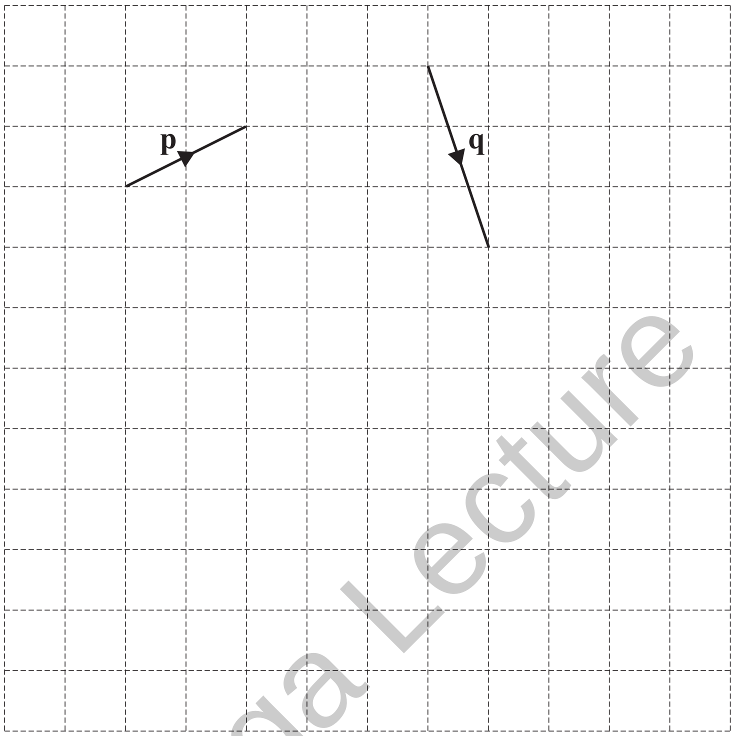
(ii) $\overrightarrow{AX}$,

$\overrightarrow{AX}$ = ... [2]

(iii) $\overrightarrow{EX}$.

$\overrightarrow{EX}$ = ... [2]

6



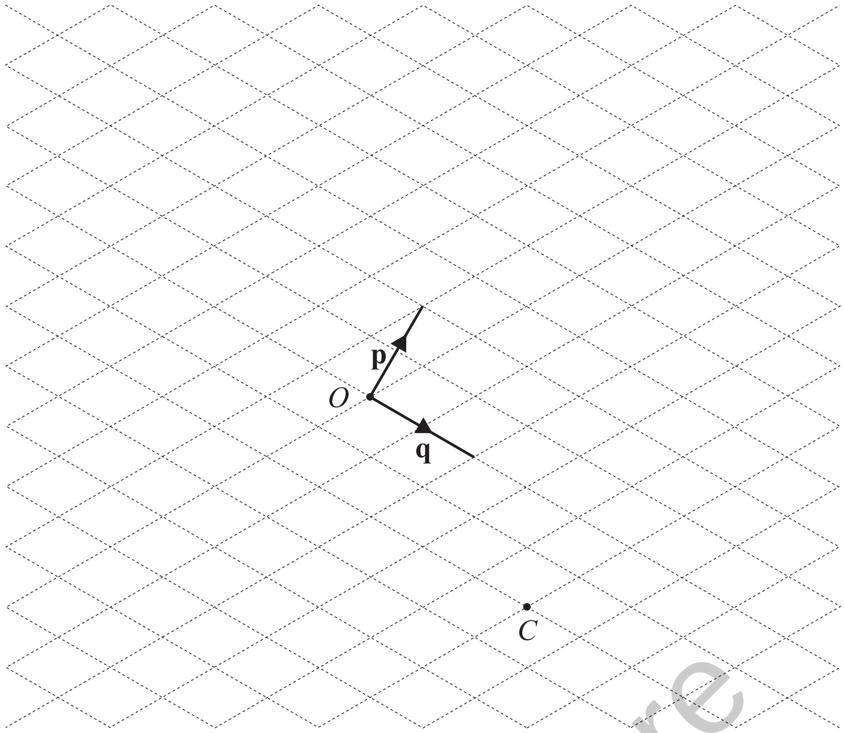
Vectors **p** and **q** are shown on the grid.

On the grid, draw the vector

(a) 3**p**, [1]

(b) **q** − **p**. [1]

7



The diagram shows points O and C and the vectors **p** and **q**.

(a) Given that $\overrightarrow{OA} = 2\mathbf{p}$, mark and label the point A on the diagram. [1]

(b) Given that $\overrightarrow{OB} = \mathbf{p} - 2\mathbf{q}$, mark and label the point B on the diagram. [1]

(c) Express $\overrightarrow{OC}$ in terms of **p** and **q**.

.... [2]

8 **(a)** $\mathbf{f} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$ $\mathbf{g} = \begin{pmatrix} 1 \\ -5 \end{pmatrix}$

(i) Find $\mathbf{g} - 2\mathbf{f}$.

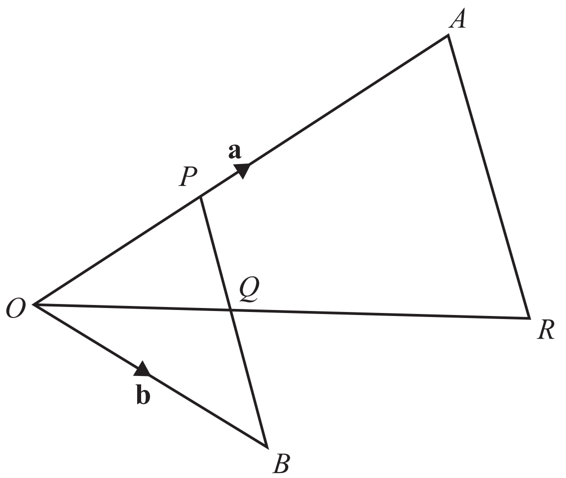
$\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(ii) Petra writes $|\mathbf{f}| > |\mathbf{g}|$.

Show that Petra is wrong.

[3]

(b)



O, A and B are points with $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

P is the point on OA such that $OP = \frac{1}{3}OA$.

O, Q and R lie on a straight line and Q is the midpoint of PB.

(i) Find $\overrightarrow{PB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

$\overrightarrow{PB} =$ .... [1]

(ii) Find $\overrightarrow{OQ}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

$\overrightarrow{OQ} =$ .... [2]

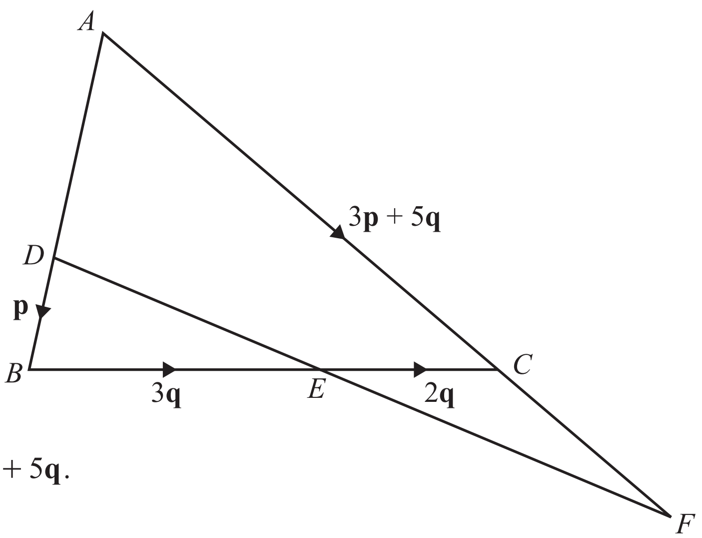
(iii) $QR = 2OQ$.

Show that AR is parallel to PB.

[3]

9 In the diagram, ADB and ACF are straight lines.

BC intersects DF at E.



$AC : CF = 2 : 1$.

$\overrightarrow{DB} = \mathbf{p}$, $\overrightarrow{BE} = 3\mathbf{q}$, $\overrightarrow{EC} = 2\mathbf{q}$ and $\overrightarrow{AC} = 3\mathbf{p} + 5\mathbf{q}$.

(a) Express $\overrightarrow{AB}$ in terms of **p**.

Answer $\overrightarrow{AB} =$ .... [1]

(b) Express $\overrightarrow{CF}$ in terms of **p** and/or **q**.

Answer $\overrightarrow{CF} =$ .... [1]

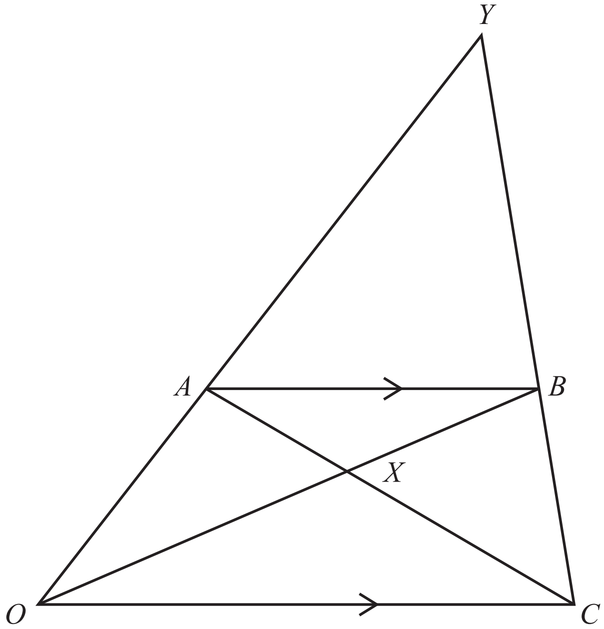
(c) Express $\overrightarrow{EF}$ in terms of **p** and/or **q**.

Answer $\overrightarrow{EF} =$ .... [1]

(d) $\overrightarrow{EF} = k\overrightarrow{DE}$.

Find k.

Answer $k =$ .... [2]



OYC is a triangle.
A is a point on *OY* and *B* is a point on *CY*.
AB is parallel to *OC*.
AC and *OB* intersect at *X*.

(a) Prove that triangle *ABX* is similar to triangle *COX*.
Give a reason for each statement you make.

....

....

....

.... [3]

(b) $\overrightarrow{OA} = 3\mathbf{a}$ and $\overrightarrow{OC} = 6\mathbf{c}$ and $CB : BY = 1 : 2$.

Find, as simply as possible, in terms of **a** and/or **c**

(i) $\overrightarrow{AB}$,

Answer $\overrightarrow{AB} =$ .... [1]

(ii) $\overrightarrow{CY}$.

Answer $\overrightarrow{CY} =$ .... [2]

(c) Find, in its simplest form, the ratio

(i) $OX : XB$,

Answer .... : .... [2]

(ii) area of triangle COX : area of triangle ABX,

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

(iii) area of triangle AYB : area of trapezium $OABC$.

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

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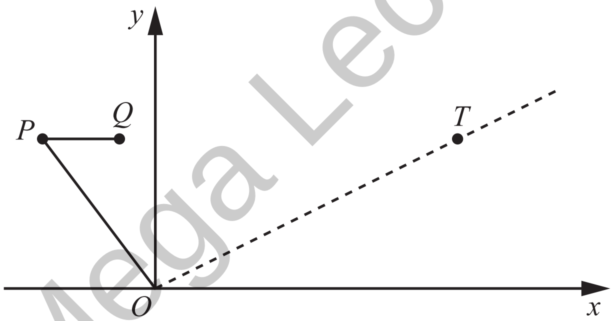


In the diagram, $\overrightarrow{OP} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ $\overrightarrow{PQ} = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$.

(a) Find $|\overrightarrow{OP}| + |\overrightarrow{PQ}|$.

Answer .... [3]

(b) *T* is the point where $\overrightarrow{PT} = k\overrightarrow{PQ}$.

(i) Express $\overrightarrow{OT}$ as a column vector in terms of *k*.

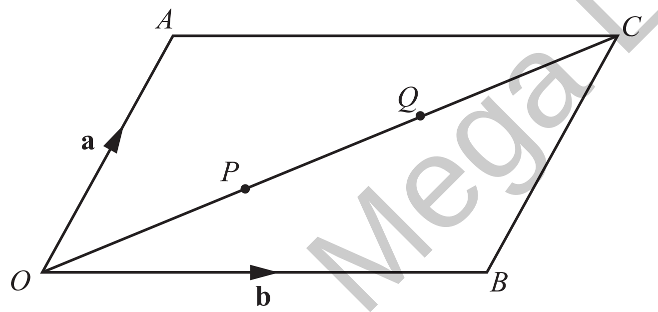
Answer [1]

(ii) *M* is the point such that *O*, *T* and *M* lie on a straight line and $\overrightarrow{OM} = \begin{pmatrix} 24 \\ 16 \end{pmatrix}$.

Find the value of *k*.

Answer $k =$ .... [2]

12



OACB is a parallelogram.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.
P and *Q* are points on *OC* such that $OP = PQ = QC$.

(a) Express, as simply as possible, in terms of **a** and **b**,

(i) $\overrightarrow{OP}$,

Answer .... [1]

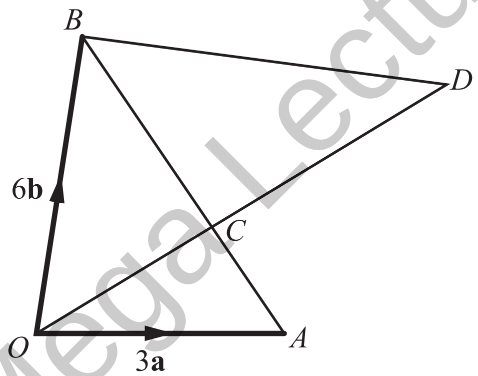
(ii) $\overrightarrow{BP}$.

Answer .... [1]

(b) Show that triangles *OAQ* and *CBP* are congruent.

[2]

13 (a)



ACB and *OCD* are straight lines.
AC : *CB* = 1 : 2 .
$\overrightarrow{OA} = 3\mathbf{a}$ and $\overrightarrow{OB} = 6\mathbf{b}$.

(i) Express $\overrightarrow{AB}$ in terms of **a** and **b**.

Answer .... [1]

(ii) Express $\overrightarrow{AC}$ in terms of **a** and **b**.

Answer .... [1]

(iii) $\overrightarrow{BD} = 5\mathbf{a} - \mathbf{b}$.

Showing your working clearly, find $OC : CD$.

Answer .... : .... [4]

14 **(a)** $\overrightarrow{JK} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$ $\overrightarrow{KL} = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$ $\overrightarrow{LM} = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$

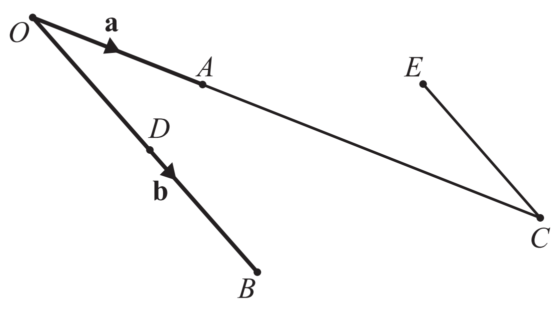
(i) Find $\overrightarrow{JM}$.

Answer [1]

(ii) Calculate $|\overrightarrow{KL}|$.

Answer .... [2]

(b)



In the diagram, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.
C is the point such that OAC is a straight line and $AC = 2OA$.
D is the midpoint of OB.
E is the point such that $\overrightarrow{EC} = \overrightarrow{OD}$.

(i) Express, as simply as possible, in terms of **a** and **b**,

(a) $\overrightarrow{AD}$,

Answer .... [1]

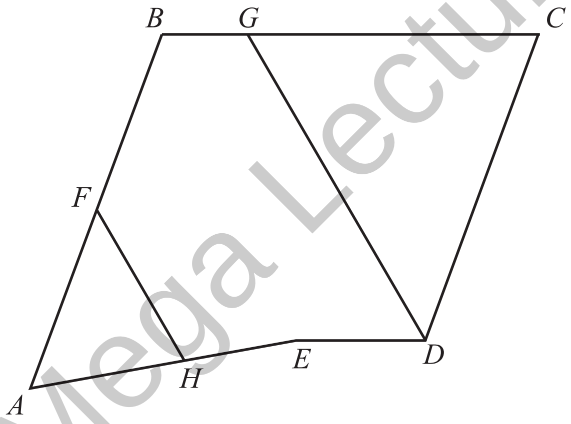
(b) $\overrightarrow{EB}$.

Answer .... [1]

(ii) Find $|\overrightarrow{EB}| : |\overrightarrow{AD}|$.

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

15 **(a)**



ABCDE is a pentagon.
AFB, *AHE* and *BGC* are straight lines.

(i) $\overrightarrow{AE} = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$.

Calculate $|\overrightarrow{AE}|$.

Answer .... units [1]

(ii) H is the midpoint of AE, and $\overrightarrow{FH} = \begin{pmatrix} 2 \\ -3.5 \end{pmatrix}$.

Find $\overrightarrow{AF}$.

Answer [2]

(iii) G divides BC in the ratio 1 : 2.

$\overrightarrow{BG} = \begin{pmatrix} 2.5 \\ 0 \end{pmatrix}$ and $\overrightarrow{CD} = \begin{pmatrix} -1 \\ -7 \end{pmatrix}$.

(a) Find $\overrightarrow{GD}$.

Answer .... [1]

(b) Explain why GD is parallel to FH.

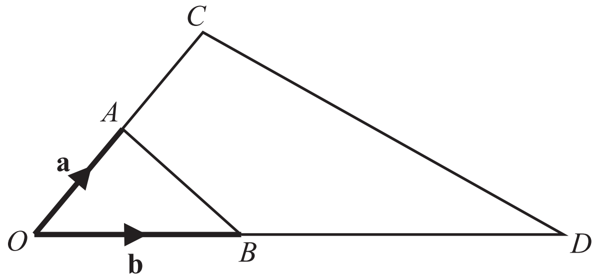
[1]

(iv) B is the point (3, 10).

Find the coordinates of D.

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

16



In the diagram, A is the midpoint of OC and B is the point on OD where $OB = \frac{1}{3} OD$.

$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Express, as simply as possible, in terms of **a** and **b**

(i) $\overrightarrow{AB}$,

Answer .... [1]

(ii) $\overrightarrow{CD}$.

Answer .... [1]

(b) E is the point on CD where $CE : ED = 1 : 2$.

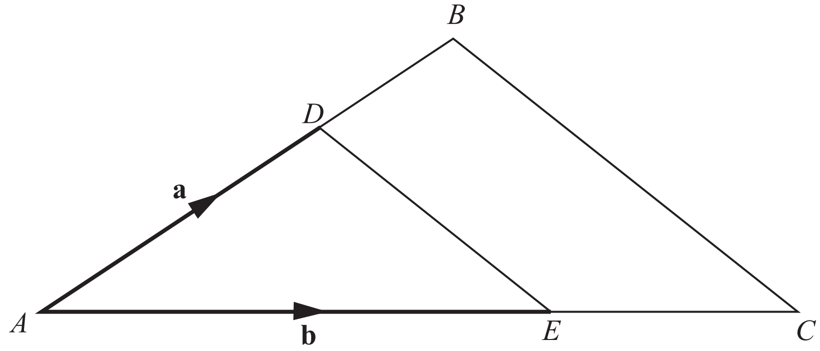
(i) Express $\overrightarrow{BE}$, as simply as possible, in terms of **a** and/or **b**.

Answer .... [2]

(ii) What special type of quadrilateral is $ABEC$?

Answer .... [1]

17 **(a)**



In the triangle ABC, D divides AB in the ratio 3 : 2, and E divides AC in the ratio 3 : 2 .
$\overrightarrow{AD} = \mathbf{a}$ and $\overrightarrow{AE} = \mathbf{b}$.

(i) Show, using vectors, that DE is parallel to BC.

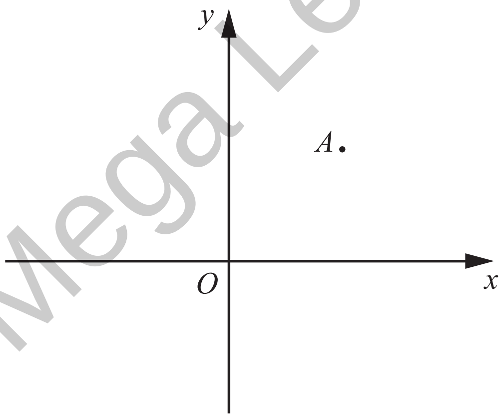
(i) Show, using vectors, that DE is parallel to BC.

[3]

(ii) Find the ratio   Area of triangle ADE : Area of triangle ABC.

Answer .... : ....[2]

18



A is the point (5, 5) $\overrightarrow{AB} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$

(a) AB is mapped onto CD by a reflection in the y-axis.

Find $\overrightarrow{CD}$.

Answer .... [1]

(b) AB is mapped onto AE by a rotation, centre A, through an angle of 90° clockwise.

Find $\overrightarrow{AE}$.

Answer .... [1]

(c) Find $|\overrightarrow{AB}|$.

Answer .... [1]

19 **(a)** In this question you may use the grid below to help you.

The point P has position vector $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$ and the point Q has position vector $\begin{pmatrix} 8 \\ -3 \end{pmatrix}$.

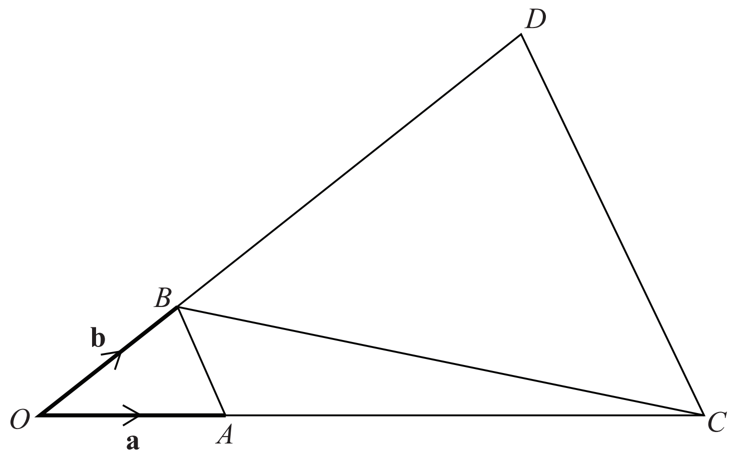
(i) Find $\overrightarrow{PQ}$.

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

(ii) Find $|\overrightarrow{PQ}|$.

Answer .... [1]

(b)



In the diagram triangles *OAB* and *OCD* are similar.

$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{BC} = 4\mathbf{a} - \mathbf{b}$.

(i) Express, as simply as possible, in terms of **a** and/or **b**

(a) $\overrightarrow{AB}$,

Answer .... [1]

(b) $\overrightarrow{AC}$,

Answer .... [1]

(c) $\overrightarrow{CD}$.

Answer .... [2]

(ii) Find, in its simplest form, the ratio

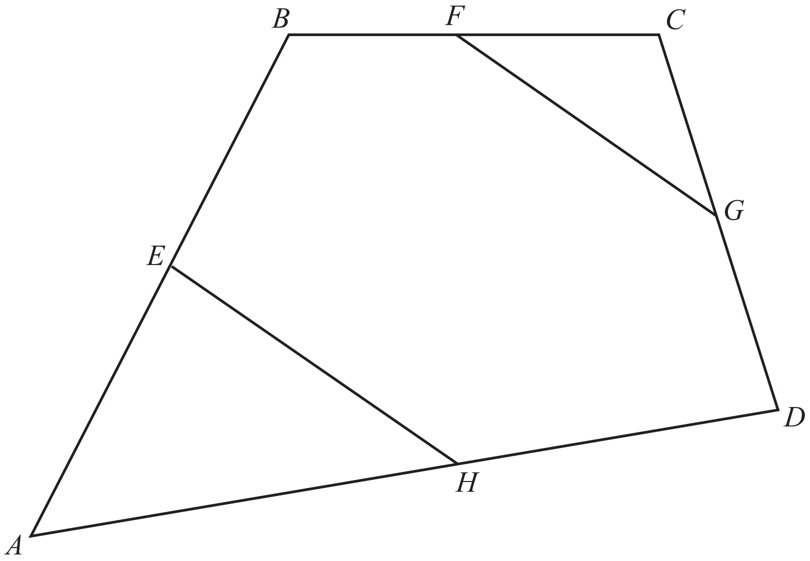
(a) perimeter of triangle *OAB* : perimeter of triangle *OCD*,

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

(b) area of triangle *OAB* : area of trapezium *ABDC*.

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

20 **(a)**



(i) $\overrightarrow{AD} = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$

Calculate $|\overrightarrow{AD}|$.

Answer .... [1]

(ii) $\overrightarrow{AE} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$

H is the midpoint of AD.

Find $\overrightarrow{EH}$.

Answer $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [2]

(iii) $\overrightarrow{BF} = \begin{pmatrix} 1.5 \\ 0 \end{pmatrix}$ $\overrightarrow{CG} = \begin{pmatrix} 0.5 \\ -1.5 \end{pmatrix}$

F is the midpoint of *BC*.

Find $\overrightarrow{FG}$.

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

(iv) Use your answers to **parts (ii)** and **(iii)** to complete the following statement.

The lines *EH* and *FG* are .... and .... [1]

(v) Given that *E* is the midpoint of *AB,* show that *G* is the midpoint of *CD*.

[2]