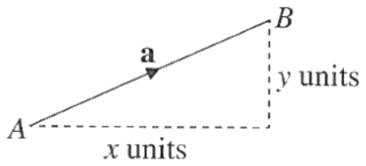
Secondary 4 Mathematics: Vectors

1. Vectors

- A vector is a quantity that has both **magnitude** and **direction**.
- A vector can be represented by a directed line segment as shown below.



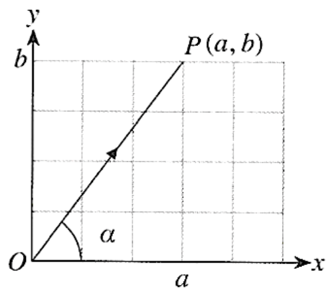
- Point *A* is known as the **starting point** and point *B* is the **ending point**.
- The vector above can be denoted by $\overrightarrow{AB}$ or $\begin{pmatrix} x \\ y \end{pmatrix}$ or *a*.

A. Magnitude of a Column Vector

- For $\overrightarrow{AB} = \boldsymbol{a} = \begin{pmatrix} x \\ y \end{pmatrix}$, magnitude of $\boldsymbol{a} = |\boldsymbol{a}| = \sqrt{x^2 + y^2}$

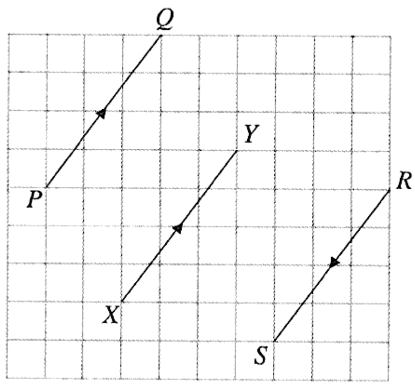
B. Position Vector and Coordinates of a Point

- If a point *P* has coordinates (*a, b*), the position vector of P is $\overrightarrow{OP} = \begin{pmatrix} a \\ b \end{pmatrix}$.



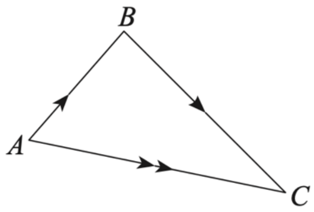
2. Equal and Negative Vectors

- **Equal vectors** are vectors with the same magnitude and direction.
  $\overrightarrow{PQ} = \overrightarrow{XY}$
- **Negative vectors** are vectors with the same magnitude but are in opposite directions.
  $\overrightarrow{PQ} = -\overrightarrow{RS}$



3. Sum and Differences of Two Vectors

A. Triangular Law of Addition



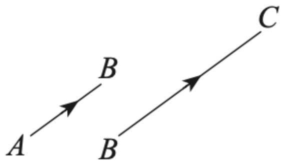
$$\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AC}$$

B. Subtraction of Vectors

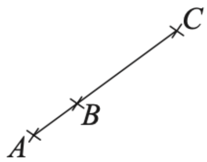
$$\overrightarrow{BC} = \overrightarrow{AC} - \overrightarrow{AB}$$

4. Multiplying a Vector by a Scalar

For parallel vectors or points that are collinear, $\overrightarrow{AB} = k\overrightarrow{BC}$.



or



5. Ratio of Areas of Triangles

Method 1: If both triangles are similar

$$\frac{A_1}{A_2} = \left(\frac{l_1}{l_2}\right)^2$$

Method 2: If both share a common height,

$$\frac{A_1}{A_2} = \frac{\frac{1}{2} \times b_1 \times h}{\frac{1}{2} \times b_2 \times h} = \frac{b_1}{b_2}$$

Vectors (Worksheet 1)

1. Find the magnitude of the following vectors:

   (a) $\overrightarrow{AB} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$

Answer: (a) ________________ units

   (b) $\overrightarrow{BC} = \begin{pmatrix} -12 \\ -5 \end{pmatrix}$

Answer: (b) ________________ units

   (c) $\overrightarrow{CD} = \begin{pmatrix} 3 \\ -5 \end{pmatrix}$

Answer: (c) ________________ units

2. Given that A is the point $(-4, 6)$, B is the point $(-1, y-2)$ and $\overrightarrow{AC} = \begin{pmatrix} 4 \\ -10 \end{pmatrix}$, find

(a) the position vectors of points A and B,

Answer: (a) $\overrightarrow{OA}$ = ________________, $\overrightarrow{OB}$ = ________________

(b) $\overrightarrow{OC}$ and thus the coordinates of C,

Answer: (b) $\overrightarrow{OC}$ = ________________,

C = (_______, _______)

(c) $\overrightarrow{AO}$.

Answer: (c) $\overrightarrow{OA}$ = ________________

(d) Hence, using your answer in (c), find the value of y if A, B and C are collinear.

Answer: (d) y = ________________

3. Given that P is the point $(0, 3)$, $\overrightarrow{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ and R is a point on the x-axis, such that P, Q and R lies on the same straight line, find

(a) $|\overrightarrow{PQ}|$,

Answer: (a) $|\overrightarrow{PQ}|$ = ________________ units

(b) the coordinates of Q,

Answer: (b) Q = (_______, _______)

R is a point on the x-axis such that point R is $(x , 0)$. Find

(c) $\overrightarrow{PR}$ in terms of x,

Answer: (c) $\overrightarrow{PR}$ = ________________

Since *P, Q* and *R* lies on the same straight line, it is given that $\overrightarrow{PQ} = k\overrightarrow{PR}$. Find

(d) the value of *k*,

Answer: (d) $k =$ ________________

(e) the position vector of *R*.

Answer: (e) $\overrightarrow{OR} =$ ________________

4. Given that A is the point $(5, 2)$ and $\overrightarrow{OB} = \begin{pmatrix} 6 \\ -3 \end{pmatrix}$.

(a) Calculate $\left|\overrightarrow{AB}\right|$.

Answer: (a) $\left|\overrightarrow{AB}\right|$ = ________________ units

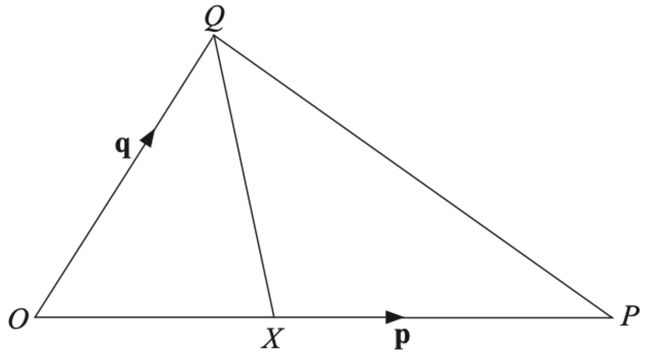
(b) Find the equation of the line AB.

Answer: (b) y = ________________

(c) Given that C is the midpoint of AB, find the coordinates of C.

Answer: (c) C = (________, ________)

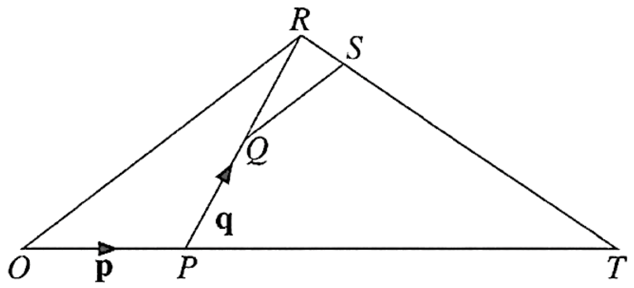
5. In the figure below, $\overrightarrow{OP} = \boldsymbol{p}$ and $\overrightarrow{OQ} = \boldsymbol{q}$. If $\overrightarrow{OX} = \frac{3}{5}\overrightarrow{OP}$, find $\overrightarrow{QX}$ in terms of $\boldsymbol{p}$ and $\boldsymbol{q}$.



Answer: $\overrightarrow{QX}$ = ________________

6. In the diagram, $OT = 3OP$, $RT = 6RS$ and Q is the midpoint of PR.

   It is given that $\overrightarrow{OP} = \boldsymbol{p}$ and $\overrightarrow{PQ} = \boldsymbol{q}$.



   (a) Express, as simply as possible, in terms of $\boldsymbol{p}$ and $\boldsymbol{q}$,

      (i) $\overrightarrow{OR}$,

      (ii) $\overrightarrow{TR}$,

      (iii) $\overrightarrow{QS}$.

Answer: (a)(i) $\overrightarrow{OR}$ = ________________

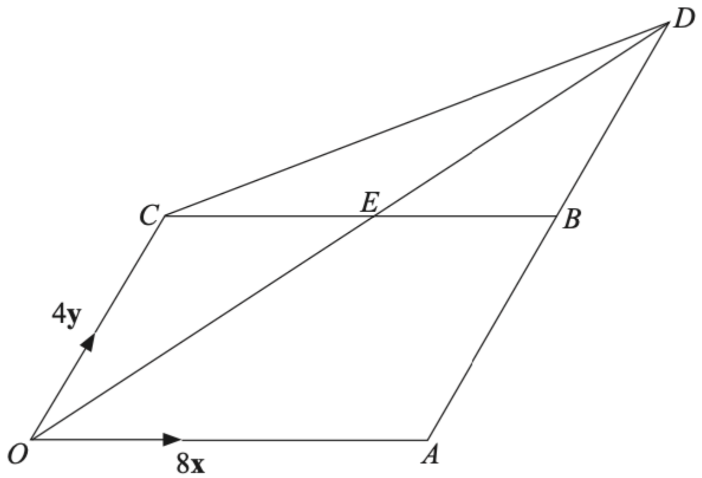
(a)(ii) $\overrightarrow{TR}$ = ________________

(a)(iii) $\overrightarrow{QS}$ = ________________

(b) Determine if the lines *OR* and *QS* are parallel, showing your reasons clearly.

7. In the figure below, *OABC* is a parallelogram.

The vectors $\overrightarrow{OA} = 8\boldsymbol{x}$ and $\overrightarrow{OC} = 4\boldsymbol{y}$. The lines *AB* = 2*BD* and *CE* = *EB*.



(a) Express the following vectors in terms of $\boldsymbol{x}$ and $\boldsymbol{y}$.

(i) $\overrightarrow{AC}$,

Answer: (a)(i) $\overrightarrow{AC}$ = ________________

(ii) $\overrightarrow{OD}$.

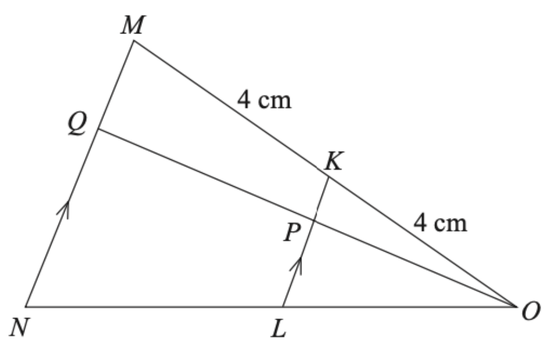
Answer: (a)(ii) $\overrightarrow{OD}$ = ________________

(b) Find the value of the ratio of the area of triangle *OCE* to the area of triangle *OAD*.

Answer: (b) $\dfrac{\text{Area of triangle } OCE}{\text{Area of triangle } OAD}$ = ________________

8. In the diagram below, $OK = MK = 4$ cm, *MN* is parallel to *KL*, *OQ* and *KL* intersect at *P* and $\frac{KP}{PL} = \frac{1}{3}$.

(a) Name a triangle which is similar to $\triangle OMN$.



Answer: (a) $\triangle$ ________________

(b) Write down the numerical value of

(i) $\frac{\text{Area of } \triangle OKP}{\text{Area of } \triangle OKL}$

Answer: (b)(i) $\frac{\text{Area of } \triangle OKP}{\text{Area of } \triangle OKL}$ = ________________

(ii) $\frac{\text{Area of } \triangle OKL}{\text{Area of } \triangle OMN}$

Answer: (b)(i) $\frac{\text{Area of } \triangle OKL}{\text{Area of } \triangle OMN}$ = ________________

9. Given that P is the point (1, 1) and $\overrightarrow{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ and $\overrightarrow{SR} = \begin{pmatrix} k \\ -12 \end{pmatrix}$, find

(a) $\left|\overrightarrow{PQ}\right|$,

Answer: (a) $\left|\overrightarrow{PQ}\right|$ = ________________ units

(b) the coordinates of Q,

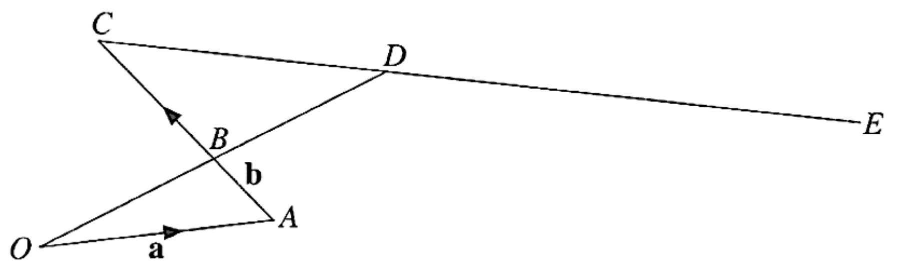
Answer: (b) Q = (_______, _______)

(c) the value of k if PQ is parallel to SR.

Answer: (c) k = ________________

<u>Vectors (Worksheet 2)</u>

1. In the diagram below, $\overrightarrow{OA} = \boldsymbol{a}$ and $\overrightarrow{OB} = \boldsymbol{b}$**.** It is given that $\overrightarrow{OB} = \overrightarrow{BD}$, $\overrightarrow{BC} = 2\overrightarrow{AB}$ and $\overrightarrow{DE} = 2\overrightarrow{CD}$.



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

(i) $\overrightarrow{OB}$,

(ii) $\overrightarrow{CD}$,

(iii) $\overrightarrow{OD}$,

(iv) $\overrightarrow{OE}$.

Answer: (a)(i) $\overrightarrow{OB}$ = ________________

(a)(i) $\overrightarrow{CD}$ = ________________

(a)(iii) $\overrightarrow{OD}$ = ________________

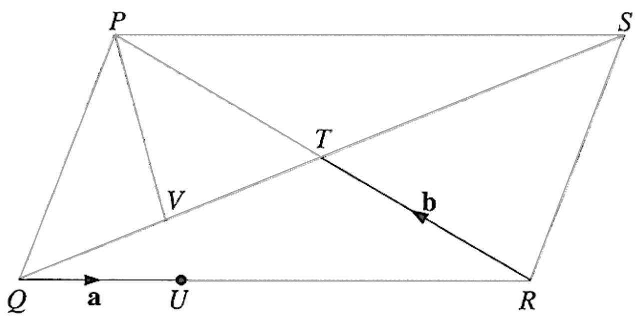
(a)(iv) $\overrightarrow{OE}$ = ________________

(b) Hence, wite down two facts about *O, A* and *E*.

(1) ____

(2) ____

2. In the diagram below, *PQRS* is a parallelogram. The diagonals *PR* and *QS* intersect at *T*.



U is a point on *QR* such that *QR* = 3*QU*. *V* is the midpoint of *QT*. $\overrightarrow{QU} = \boldsymbol{a}$ and $\overrightarrow{RT} = \boldsymbol{b}$.

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

(i) $\overrightarrow{QP}$,

Answer: (a)(i) $\overrightarrow{QP}$ = ________________

(ii) $\overrightarrow{QV}$,

Answer: (a)(ii) $\overrightarrow{QV}$ = ________________

(iii) $\overrightarrow{PV}$

Answer: (a)(iii) $\overrightarrow{PV}$ = ________________

(b) Show that PV produced passes through U.

(c) Calculate the value of

(i) $\dfrac{\text{Area of } \triangle PQS}{\text{Area of } \triangle PVS}$

(ii) $\dfrac{\text{Area of } \triangle PVS}{\text{Area of } \triangle PQRS}$

Answer: (c)(i) $\dfrac{\text{Area of } \triangle PQS}{\text{Area of } \triangle PVS}$ = ________________

Answer: (c)(ii) $\dfrac{\text{Area of } \triangle PVS}{\text{Area of } \triangle PQRS}$ = ________________

3. In the diagram, $\overrightarrow{OA} = \frac{1}{3}\overrightarrow{OP}$ and $\overrightarrow{OB} = \frac{1}{4}\overrightarrow{OQ}$. M is the midpoint of OQ, and $MX = \frac{1}{5}MP$.

(a) Given that $\overrightarrow{OA} = \boldsymbol{a}$ and $\overrightarrow{OB} = \boldsymbol{b}$, express as simply as possible, in terms of $\boldsymbol{a}$ and/or $\boldsymbol{b}$,

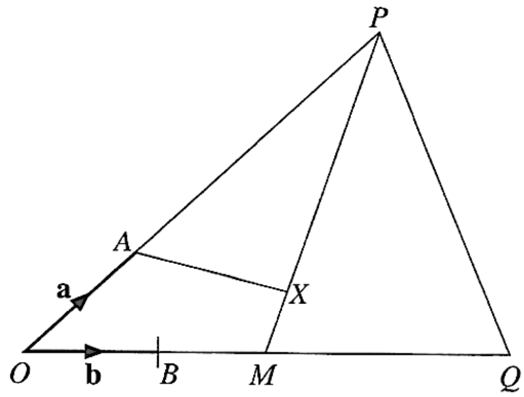
(i) $\overrightarrow{OP}$,

(ii) $\overrightarrow{OM}$,

(iii) $\overrightarrow{AQ}$,

(iv) $\overrightarrow{MP}$,

(v) $\overrightarrow{MX}$.



Answer: (a)(i) $\overrightarrow{OP}$ = ________________

(a)(ii) $\overrightarrow{OM}$ = ________________

(a)(iii) $\overrightarrow{AQ}$ = ________________

(a)(iv) $\overrightarrow{MP}$ = ________________

(a)(v) $\overrightarrow{MX}$ = ________________

(b) Prove that *AX* produced will pass through *Q*.

(c) Find the ratio of *AX : XQ*.

Answer: (b) *AX : XQ* = ________________

(d) Given that the area of $\triangle\ OPQ = 30$ cm^2, calculate the area of

(i) $\triangle\ PMQ$,

Answer: (d)(i) Area of $\triangle\ PMQ$ = ________________ cm^2

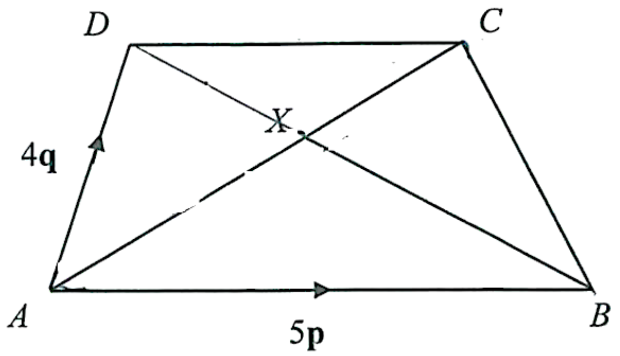
(ii) $\triangle PQX$,

(d)(ii) Area of $\triangle PQX$ = __________________ cm^2

(iii) $\triangle OAB$.

(d)(iii) Area of $\triangle OAB$ = __________________ cm^2

4.



ABCD is a quadrilateral.

$\overrightarrow{AB} = 5\boldsymbol{p}$, $\overrightarrow{AD} = 4\boldsymbol{q}$, $DC : AB = 3 : 5$, $AX : AC = 5 : 8$.

(a) Write down the following in terms of $\boldsymbol{p}$ and $\boldsymbol{q}$.

(i) $\overrightarrow{AC}$,

Answer: (a)(i) $\overrightarrow{AC}$ = ________________

(ii) $\overrightarrow{BX}$,

Answer: (a)(ii) $\overrightarrow{BX}$ = ________________

(iii) $\overrightarrow{XD}$.

Answer: (a)(i) $\overrightarrow{XD}$ = ________________

(b) Explain why B, X and D lie on a straight line.

____

____

5. (a) The position vector of point A is $\begin{pmatrix} -1 \\ 5 \end{pmatrix}$ and the position vector of point B is $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.

(i) Find the column vector of $\overrightarrow{AB}$.

Answer: (a)(i) $\overrightarrow{AB}$ = ________________

(ii) Find $\left|\overrightarrow{AB}\right|$.

Answer: (a)(ii) $\left|\overrightarrow{AB}\right|$ = ________________ units

(iii) Given that $\overrightarrow{AC} = 3\overrightarrow{AB}$, find the coordinates of C.

Answer: (a)(iii) C = (_______, _______)

(b) The point P has coordinates (4, –2) and $\overrightarrow{PQ} = \begin{pmatrix} -8 \\ 12 \end{pmatrix}$.

(i) Find the equation of the line PQ.

Answer: (b)(i) y = ________________

(ii) The equation of another line $3x + 2y = 11$. Show how you can tell that this line does **not** intersect the line PQ.

6. A is the point (1, 1), $\overrightarrow{AB} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and $\overrightarrow{AC} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$.

D divides BC such that $BD : DC = 1 : 1$.

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

Answer: (a) $\overrightarrow{BC}$ = ________________

(b) Find $|\overrightarrow{AD}|$.

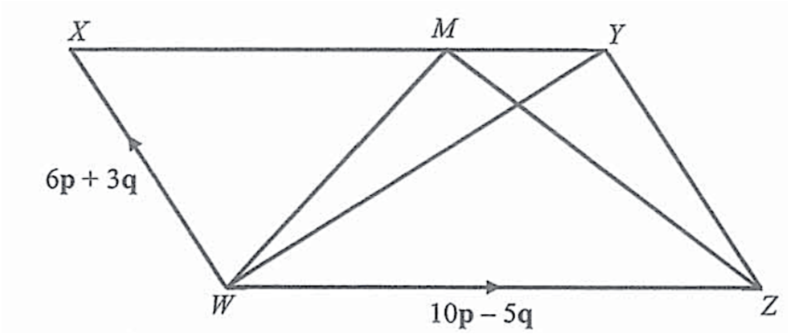
Answer: (b) $|\overrightarrow{AD}|$ = ________________ units

(c) P is the point (3, 9)

Use the vectors to show whether or not $ABPC$ is a parallelogram.

7. In the diagram, $WXYZ$ is a parallelogram.

M is a point on XY such that $XM : MY = 3 : 2$, $\overrightarrow{WX} = 6\boldsymbol{p} + 3\boldsymbol{q}$ and $\overrightarrow{WZ} = 10\boldsymbol{p} - 5\boldsymbol{q}$.



(a) Find, in terms of $\boldsymbol{p}$ and/or $\boldsymbol{q}$,

(i) $\overrightarrow{WM}$,

Answer: (a)(i) $\overrightarrow{WM}$ = ________________

(ii) $\overrightarrow{ZM}$

Answer: (a)(i) $\overrightarrow{ZM}$ = ________________

(b) Find

(i) the area of triangle WMX : area of $WXYZ$,

Answer: (b)(i) ________________

(ii) area of $WXYZ$, given that the area of triangle WMX is 8 units^2.

Answer: (b)(ii) area of $WXYZ$ = ________________ units^2

(iii) Given that N is on WX produced such that ZMN is a straight line. Express $\overrightarrow{WN}$ in terms of p and q.

Answer: (b)(iii) $\overrightarrow{WN}$ = ________________

8. Coordinates of A and B are (–3, 3) and (7, –13) respectively.

(a) Write $\overrightarrow{AB}$ as a column vector.

Answer: (a) $\overrightarrow{AB}$ = ________________

(b) Find the acute angle formed by the line AB with the horizontal axis.

Answer: (b) $angle$ = ________________ °

(c) If the gradient of $AB = -\frac{2m}{n}$, express $\overrightarrow{AB}$ in terms of m and n.

Answer: (C) $\overrightarrow{AB}$ = ________________

9. A is the point (–2, 5) and $\overrightarrow{BA} = \begin{pmatrix} -4 \\ 8 \end{pmatrix}$.

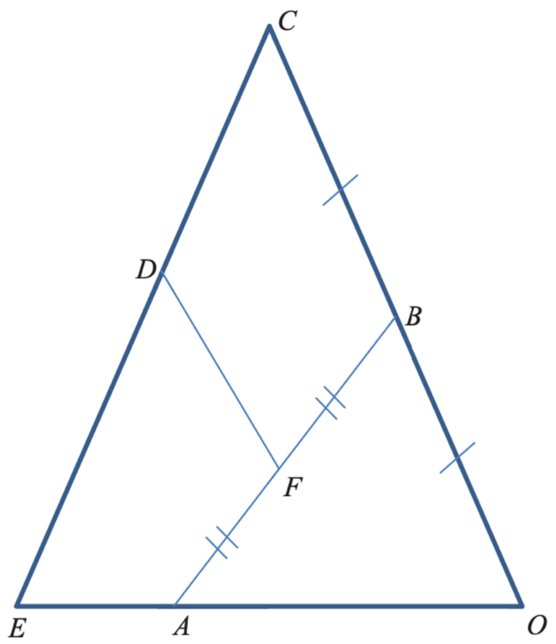
(a) Find the coordinates of point B.

Answer: (a) B = (________, ________)

(b) Calculate $\left|\overrightarrow{BA}\right|$.

Answer: (b) $\left|\overrightarrow{AB}\right|$ = _________________ units

10. In the diagram below, $OB = BC$ and $AF = FB$. It is given that $OA : AE = 2 : 1$ and $ED : DC = 4 : 3$. $\overrightarrow{OA} = 2\boldsymbol{a}$ and $\overrightarrow{OB} = \boldsymbol{b}$.



(a) Express, as simply as possible, in terms of $\boldsymbol{a}$ and/or $\boldsymbol{b}$,

(i) $\overrightarrow{CE}$,

Answer: (a)(i) $\overrightarrow{CE}$ = ________________

(ii) $\overrightarrow{CD}$,

Answer: (a)(ii) $\overrightarrow{CD}$ = ________________

(iii) $\overrightarrow{BA}$,

Answer: (a)(iii) $\overrightarrow{BA}$ = ________________

(iv) $\overrightarrow{OF}$,

Answer: (a)(iv) $\overrightarrow{OF}$ = ________________

(v) $\overrightarrow{FD}$.

Answer: (a)(ii) $\overrightarrow{FD}$ = ________________

(b) Find

(i) $\frac{\text{Area of } \triangle OBA}{\text{Area of } \triangle OBE}$

Answer: (b)(i) $\frac{\text{Area of } \triangle OBA}{\text{Area of } \triangle OBE}$ = ________________

(ii) $\frac{\text{Area of } \triangle OBA}{\text{Area of } \triangle OCE}$

Answer: (b)(ii) $\frac{\text{Area of } \triangle OBA}{\text{Area of } \triangle OCE}$ = ________________

<u>**Vectors (Worksheet 3)**</u>

1. *OPQR* is a parallelogram such that $\overrightarrow{PQ} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$ and *P* is the point (3, 2).

   (a) Express $\overrightarrow{RP}$ as a column vector.

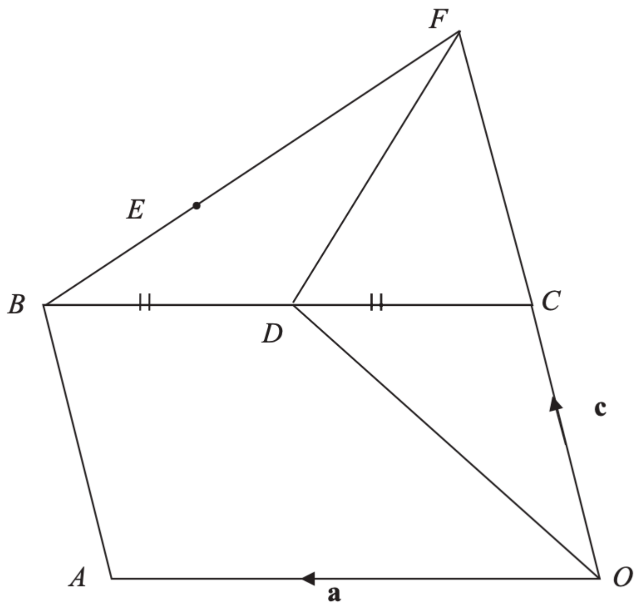
Answer: (a) $\overrightarrow{RP}$ = ________________

   (b) The point *J* lies on $\overrightarrow{RP}$ produced such that $\overrightarrow{PJ} = m\overrightarrow{RP}$.

   Show that $\overrightarrow{OJ} = \begin{pmatrix} 3+m \\ 2-2m \end{pmatrix}$.

2. In the diagram, *OABC* is a parallelogram and *D* is the midpoint of *BC*. *BE* and *OC* produced intersecy at the point *F*. *BE : BF* = 1 : 3 and *OC* : *OF* = 1 : 2.

Let $\overrightarrow{OA} = \boldsymbol{a}$ and $\overrightarrow{OC} = \boldsymbol{c}$.



(a) Express and simply the following vectors in terms of $\boldsymbol{a}$ and $\boldsymbol{c}$.

(i) $\overrightarrow{AC}$,

Answer: (a)(i) $\overrightarrow{AC}$ = ________________

(ii) $\overrightarrow{BF}$,

Answer: (a)(ii) $\overrightarrow{BF}$ = ________________

(iii) $\overrightarrow{OD}$,

Answer: (a)(iii) $\overrightarrow{OD}$ = ________________

(iv) $\overrightarrow{OE}$.

Answer: (a)(iv) $\overrightarrow{OE}$ = ________________

(b) State two facts about the vectors $\overrightarrow{OD}$ and $\overrightarrow{OE}$ from the results in (a).

(c) Find the ratio of the areas of

(i) $\triangle ODF$ and $\triangle OEF$,

Answer: (c)(i) ________________

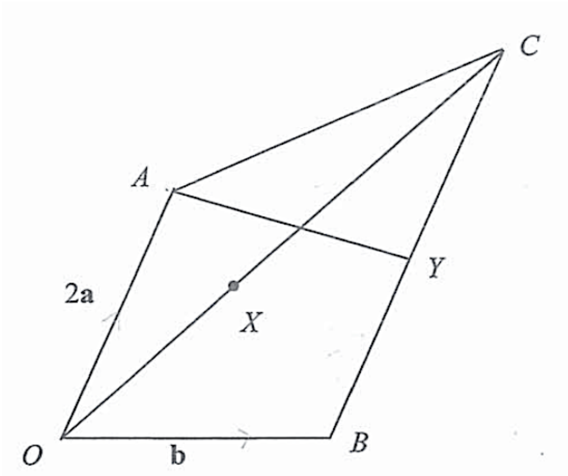
(ii) $\triangle OCD$ and $OABC$

Answer: (c)(ii) ________________

(iii) $\triangle OCD$ and $OABF$

Answer: (c)(iii) ________________

3.



In the diagram, $\overrightarrow{OA} = 2\boldsymbol{a}$, $\overrightarrow{OB} = \boldsymbol{b}$. BC is parallel to OA and $BC = \frac{3}{2}OA$. X is a point on OC such that $OX = \frac{2}{3}XC$. Y is the midpoint of BC.

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

(i) $\overrightarrow{AB}$,

Answer: (a)(i) $\overrightarrow{AB}$ = ________________

(ii) $\overrightarrow{OC}$,

Answer: (a)(ii) $\overrightarrow{OC}$ = ________________

(iii) $\overrightarrow{OX}$,

Answer: (a)(iii) $\overrightarrow{OX}$ = ________________

(iv) $\overrightarrow{AX}$,

Answer: (a)(iv) $\overrightarrow{AX}$ = ________________

(b) What can you deduce about *A, X* and *B*?

Justify your answer.

(c) *AY* produced meets *OB* at a point *Z.*

(i) Given that $\overrightarrow{AZ} = h\overrightarrow{AY}$, express $\overrightarrow{AZ}$ in terms of ***a, b*** and *h*.

Answer: (c)(i) $\overrightarrow{AZ}$ = ________________

(ii) Given also that $\overrightarrow{OZ} = k\overrightarrow{OB}$, express $\overrightarrow{OZ}$ in terms of ***a, b*** and *k*.

Answer: (c)(i) $\overrightarrow{OZ}$ = ________________

(iii) Hence, show that $h = 4$ and $k = 4$

(d) Find the value of,

(i) $\frac{Area\ of\ \triangle OAX}{Area\ of\ \triangle OAC}$,

Answer: (d)(i) $\frac{Area\ of\ \triangle OAX}{Area\ of\ \triangle OAC}$ = ________________

(ii) $\frac{Area\ of\ \triangle OBX}{Area\ of\ \triangle ABC}$

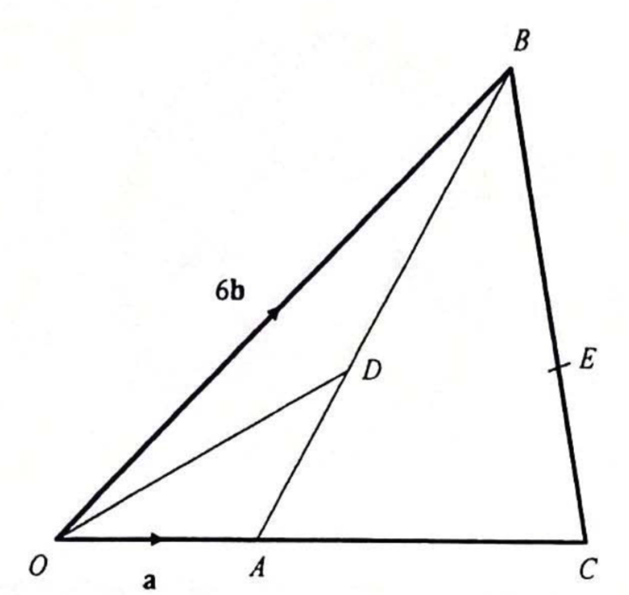
Answer: (d)(i) $\frac{Area\ of\ \triangle OBX}{Area\ of\ \triangle ABC}$ = ________________

4. *PQRS* is a parallelogram such that $\overrightarrow{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ and $\overrightarrow{PS} = \begin{pmatrix} 12 \\ 5 \end{pmatrix}$.

Calculate $|\overrightarrow{PR}|$.

Answer: $|\overrightarrow{PR}|$ = ________________ units

5.



In the diagram, $\overrightarrow{OA} = \boldsymbol{a}$, $\overrightarrow{OB} = 6\boldsymbol{b}$ and , $\overrightarrow{OA} = \frac{1}{3}, \overrightarrow{OC}$.

D is a point on AB such that $3AD = 2DB$ and E is a point on BC such that $CE : EB = 4 : 5$.

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

(i) $\overrightarrow{BA}$,

Answer: (a)(i) $\overrightarrow{BA}$ = ________________

(ii) $\overrightarrow{OD}$,

Answer: (a)(ii) $\overrightarrow{OD}$ = ________________

(iii) $\overrightarrow{CB}$,

Answer: (a)(iii) $\overrightarrow{CB}$ = ________________

(iv) $\overrightarrow{AE}$,

Answer: (a)(iv) $\overrightarrow{AE}$ = ________________

(b) Write down the relationship between *OD* and *AE*. Explain your answer.

(c) Find the ratio of

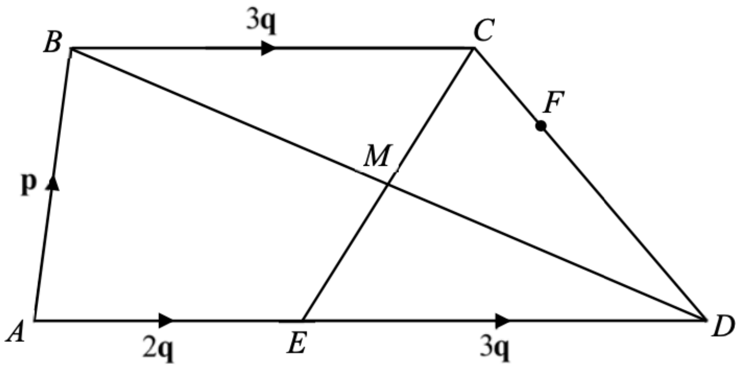
(i) area of triangle *CAE :* area of triangle *AOD*,

Answer: (c)(i) ________________

(ii) area of triangle *CAE :* area of triangle *AOB*.

Answer: (c)(ii) ________________

6.



ABCD is a quadrilateral and *E* is a point on *AD* .

M is the point of intersection of *BD* and *CE*.

$\overrightarrow{AB} = \boldsymbol{p}$, $\overrightarrow{AE} = 2\boldsymbol{q}$ and $\overrightarrow{BC} = \overrightarrow{ED} = 3\boldsymbol{q}$.

(a) Show that triangles *BMC* and *DME* are congruent. Give a reason for each statement you make.

(b) Express in terms of $\boldsymbol{p}$ and/or $\boldsymbol{q}$, as simply as possible,

(i) $\overrightarrow{AC}$,

Answer: (a)(i) $\overrightarrow{AC}$ = ________________

(ii) $\overrightarrow{BD}$,

Answer: (a)(ii) $\overrightarrow{BD}$ = ________________

(iii) $\overrightarrow{AM}$,

Answer: (a)(iii) $\overrightarrow{AM}$ = ________________

(c) *F* is a point on *CD* such that *CF* : *FD* = 2 : 5.

(i) Explain why *A, M* and *F* lie on a straight line.

(ii) Find the ratio of area of triangle *AME :* area of triangle *FMD.*

Answer: (c)(ii) ________________

7. Given that ABC is a triangle where $\overrightarrow{AB} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$ and $\overrightarrow{AC} = \begin{pmatrix} -1 \\ 8 \end{pmatrix}$.

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

Answer: (a) $\overrightarrow{BC}$ = ________________

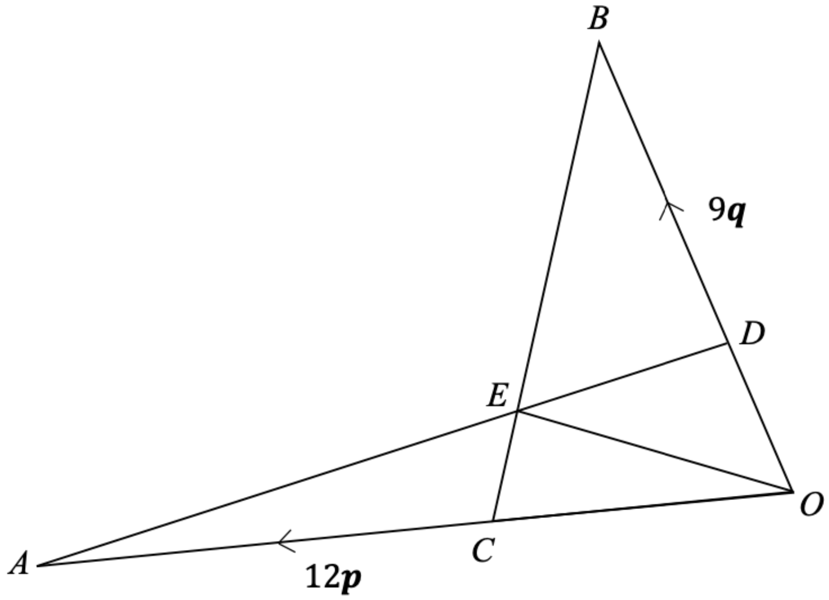
(b) Hence, or otherwise, show that $\angle BAC = 108.4°$.

(c) Hence, calculate the area of $\triangle ABC$.

Answer: (c) area of $\triangle ABC$ = ________________ units^2

8. In the diagram, $\overrightarrow{OA} = 12\boldsymbol{p}$ and $\overrightarrow{OB} = 9\boldsymbol{q}$

It is given that $3DB = 2OB$ and $OA = 3OC$.



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

(i) $\overrightarrow{BC}$,

Answer: (a)(i) $\overrightarrow{BC}$ = ________________

(ii) $\overrightarrow{DA}$,

Answer: (a)(ii) $\overrightarrow{DA}$ = ________________

(b) Given that $\frac{\text{area of } \triangle ODE}{\text{area of } \triangle ODA} = \frac{1}{4}$, find $\overrightarrow{OE}$ in terms of $\boldsymbol{p}$ and $\boldsymbol{q}$.

Answer: (b) $\overrightarrow{OE}$ = ________________

(c) Find the value of $\frac{\text{area of } \triangle BDE}{\text{area of quadrilateral } EDOC}$.

Answer: (c) $\frac{\text{area of } \triangle BDE}{\text{area of quadrilateral } EDOC} =$ ________________