TOPICAL MODULE

GEOMETRIC COMPONENT

TOPICS	2003		2004		2005		2006		2007		2008	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
COORDINATE GEOMETRY	2	1	2	1	1	1½	1	1½	2	1	2	1
VECTOR	3	1	2	1	2	1	2	1	2	1	2	1
Total Question By Paper	5	2	4	2	3	2½	3	2½	4	2	4	2

COORDINATE GEOMETRY

PAPER 1

1. Diagram 1 shows a straight line *PQ*. Point *P* lies on the *x*-axis and *Q* lies on the y-axis. Given that the equation of the straight line is $3y - 2x - 4 = 0$. Find

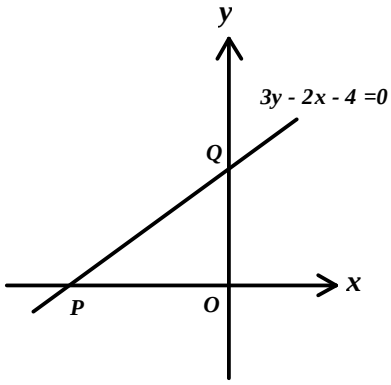


Diagram 1

   a. the coordinates of *P*.
   b. the equation of a straight line which is perpendicular to *PQ* and passes through the point *P*.

2. Given two fixed points *M(-2 , 2)* and *N(4 , -3)*. A point *P* moves such that *PM:PN* = 1:3. Find the equation of the locus *P*.

3. The triangle with vertices *A(4 , 3)*, *B(-1 , 1)* and *C(t , -3)* has an area 11 units^2. Find the possible values of *t*.

4. Given a straight line $3y = mx + 1$ is parallel to $\frac{x}{3} + \frac{y}{5} = 1$. Find the value of *m*.

5. Given that the points *K*(2 , 1), *L*(-2 , 5*h* – 1) and *M* (-2*h* , 4) lie on a straight line, find the possible values of *h*.

6. The points $P(3, p)$, $B(-1, 2)$ and $C(9,7)$ lie on a straight line. If P divides BC internally in the ratio $m : n$, find
   (a) $m : n$,
   (b) the value of p.

7. The following information refers to the equations of two straight line JK and RT, which are perpendicular to each other.

$$JK : 3y + x - 2 = 0$$

$$RT : \frac{y}{p} = x + 7$$

   where p is a constant. Find the value of p.

8. The points $P(h, k)$ divides $A(a, 3a)$ and $B(2k, 5h)$ internally in the ratio of 1 : 2 . Express k in terms of h.

9. Find the equation of the line perpendicular to $3y = 2x + 5$ and intercepts the x-axis at $x = 4$.

10. Find the equation of the locus of the moving point P such that its distance from two fixed points $A(-2, 0)$ and $B(0, 4)$ is such that $3PA = PB$

PAPER 2 (SECTION A)

1. Diagram 1 shows a rhombus *ABCD*. Given that the straight line *AC* intersects the straight line *BD* at point *T*(2 , 4) and the equation of straight line *AD* is $9y - 7x + 36 = 0$

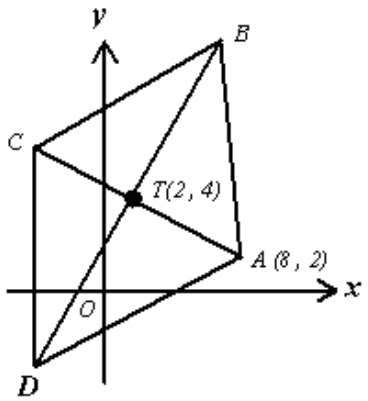


Diagram 1

a. Find
   i. the coordinates of *C*.
   ii. the equation of *BD*

b. A point *P* moves such that its distance from point *A* is always equals to the distance of *AT*. Find the equation of the locus of *P*.

2. Diagram 2 shows two straight lines, *AB* and *BC* that are perpendicular to each other at point *B*. Points *A* and *B* are on the *x*-axis and *y*-axis respectively. The equation of the line *AB* is $4y - 3x - 16 = 0$

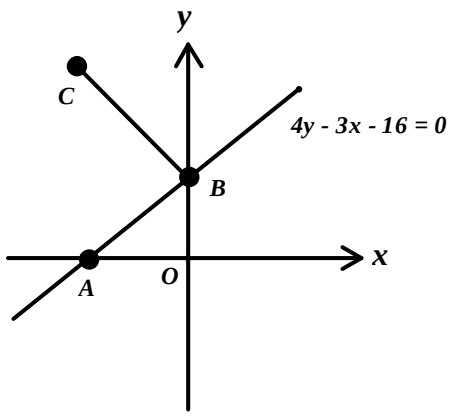


Diagram 2

a. Find the equation of *CB*

b. If *CB* is extended until it intersects the *x*-axis at point *D* such that $CB : BD = 1 : 3$, find the coordinates of point *C*.

3. Diagram 3 shows a straight line *CD* which meets a straight line *AB* at point *D*. The point *C* lies on the *y*-axis.

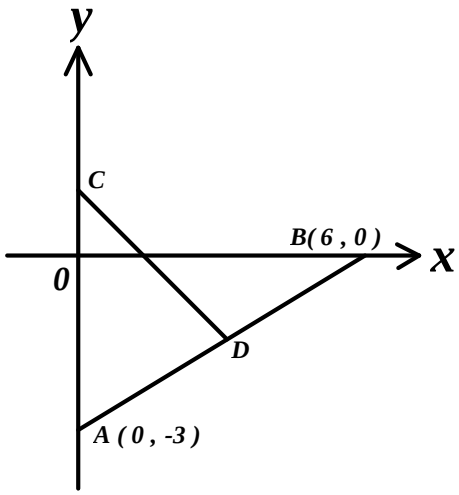


Diagram 3

a. State the equation of *AB* in the intercept form.
b. Given that $2AD = DB$, find the coordinates of *D*
c. Given that *CD* perpendicular to *AB*, find the *y*-intercept of *CD*

4. (a) A point *S* moves such that its distance from point *A*(–3,4) is always twice its distance from point *B*(6,-2). Find the equation of the locus of *S*.

(b) Given point *A* (1,2) and point *B* (4, –5). Find the locus of point *W* which moves such that $\angle AWB$ is always 90^0.

5. Diagram 5 shows the straight line $y - 3x = 5$ and the points $P(-4 , 1)$, $Q(5 , -2)$ and $R(8 , n)$

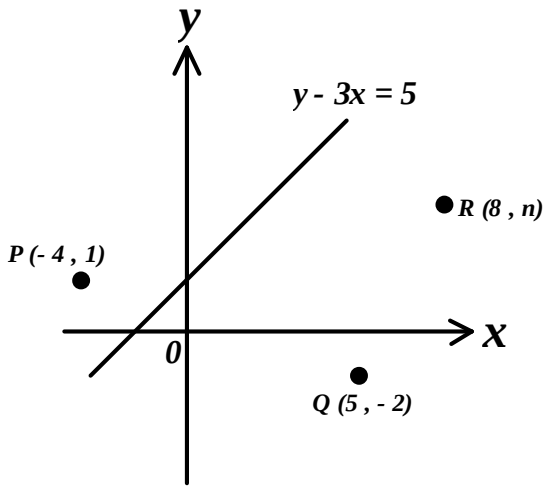


Diagram 5

Given that the straight line passing through Q and R is parallel to the straight line $y - 3x = 5$

a. find the value of n
b. show that $\angle PQR = 90°$
c. find the area, in units^2, of the quadrilateral $OPRQ$

6. Diagram 6 shows a parallelogram $PQRS$ on a Cartesian Plane.

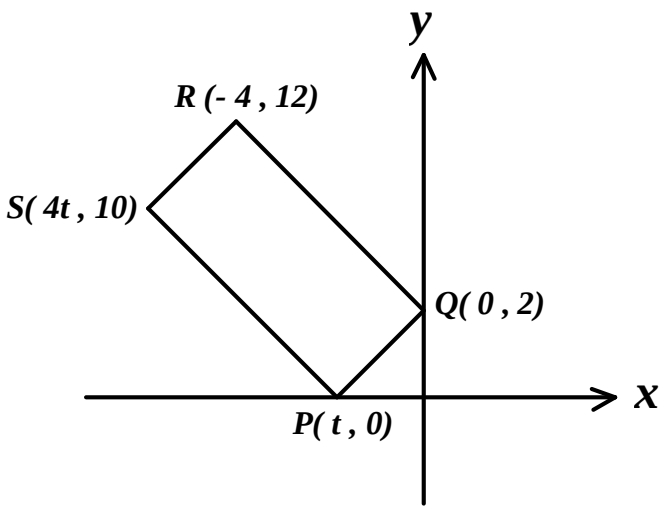


Diagram 6

a. Find the value of t.
   Hence, state the equation of a straight line PQ in the intercept form.
b. N is a moving point such that its distance is in the ratio $NR : NQ = 2 : 3$.
   Find the equation of the locus of N.
c. Calculate the area of $PQRS$.

7. In Diagram 7, the straight line *PR* cuts *y*-axis at *Q* such that *PQ* : *QR* = 1 : 3. The equation of *PS* is $2y = x + 3$.

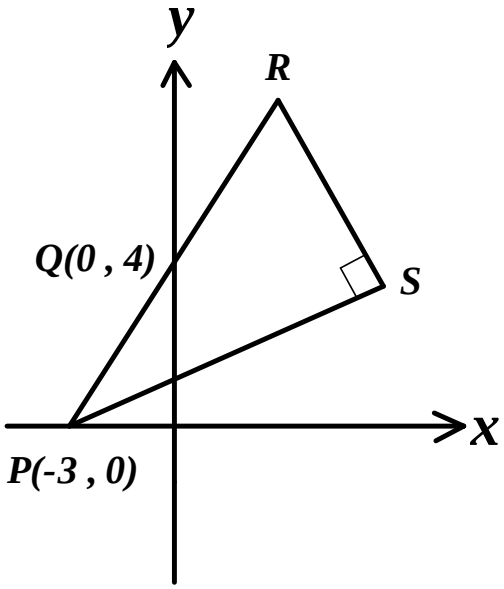


Diagram 7

a. Find (i) the coordinates of *R*,
(ii) the equation of the straight line *RS*,
(iii) the area ΔPRS.

b. A point *T* moves such that its locus is a circle which passes through the points *P*, *R* and *S*. Find the equation of the locus of *T*.

8. The diagram 8 shows a straight line *PQ* which meets a straight line *AB* at the point *Q*. The point *P* lies on the *y*-axis.

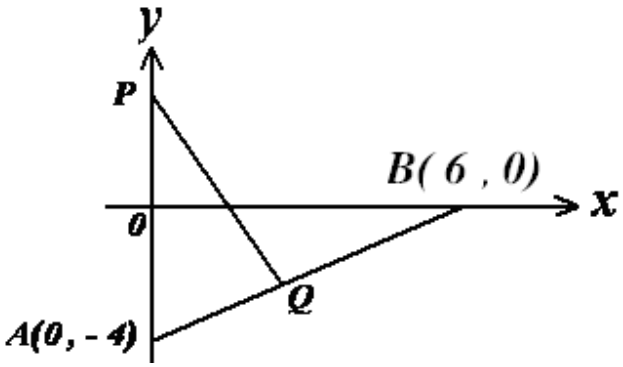


Diagram 8

a. Write down the equation of *AB* in the intercept form.
b. Given that $2AQ = QB$, find the coordinates of *Q*.
c. Given that *PQ* is perpendicular to *AB*, find the *y*-intercept of *PQ*

9. Given the points $A(2 , 3)$, $B(8 , 3)$ find
   a. The locus of P such that its distance from A is 5 units.
   b. The locus of Q that moves such that its distance from A and B are equal. Hence, show that the two loci intersect at the points (5 , 7) and (5 , -1).
   c. The locus of R that moves such that $RA = 2\ RB$.

10. Given that $A(3 , 6)$ and $B(1 , -4)$, find
   a. The equation of the perpendicular of AB and past point A.
   b. The equation of the perpendicular bisector of AB.
   c. The area of triangle ABO if $O(0 , 0)$

PAPER 2 (SECTION B)

1. Diagram 1 shows a straight line *AB* intersecting a straight line *CD* at *D*.

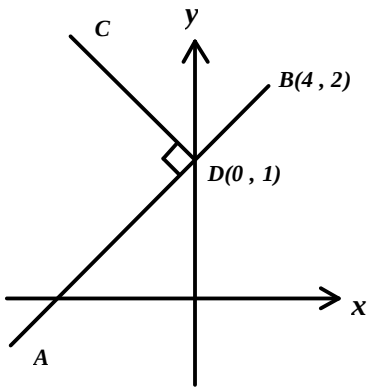


Diagram1

a. Given *AB* = *3DB*. Find the coordinates of point *A*.
b. Find the equation of *CD*
c. If point C lies on the straight line $y = 3x + 8$, find the coordinates of point *C*.
d. If *P*(*x* , *y*) is moving point where the ratio of the distance from point *A* to point *B* is 1:2. Find the equation of locus *P*.

2. Diagram 2 shows a triangle *ABC*. Point *T* internally divides line *AB* with a ratio 1:2

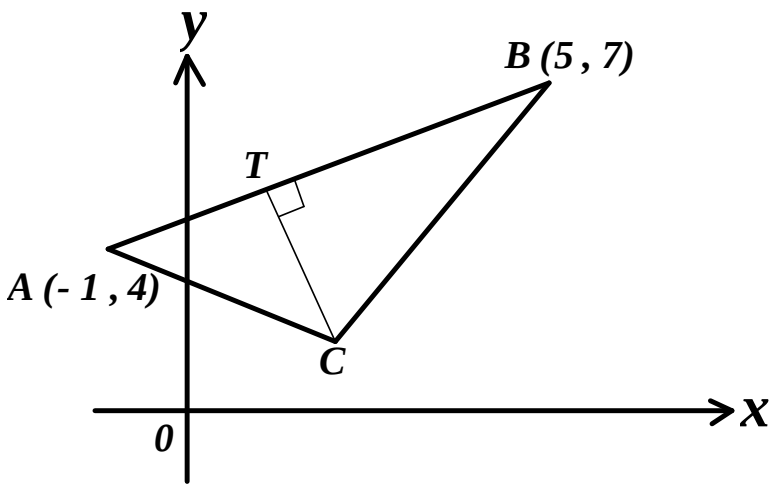


Diagram 2

a. Find the coordinates of point *T*.
b. (i) Given that, the equation of the line *BC* is $y - 3x + +8 = 0$, find the coordinates of point *C*
(ii) Find the area of triangle *ABC*
c. The point *P(x ,y)* moves such that its distance from point *A* is two times its distance from *B*. Find the equation of the locus of *P*.

3. Diagram 3 shows three points *A*, *B* and *C* on the straight line $2y = x + 4$ such that $AB : BC = 1 : 4$. Find

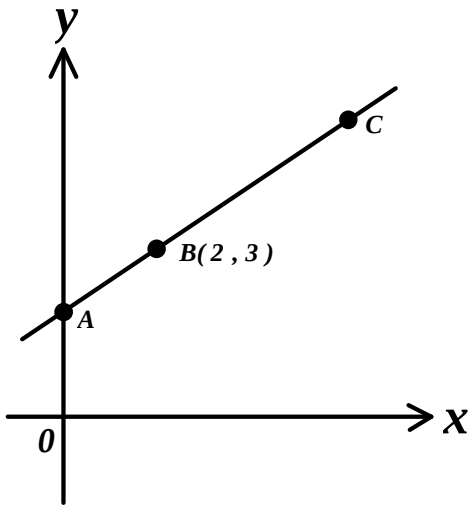


Diagram 3

a. the coordinates of *A*
b. the coordinates of *C*
c. the area of triangle *COA*
d. the equation for the image of *AC* under a reflection on the $x = 0$

4. Diagram 4 shows the straight line *ABC* intersects the line $5y + x + 35 = 0$ at point *C*.

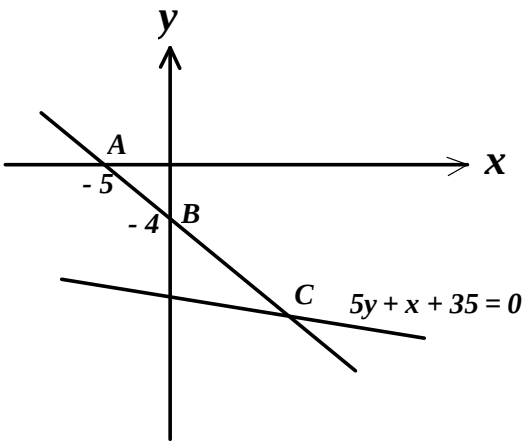


Diagram 4

a. Write the equation of *AC* in intercept form
b. Find the coordinates of *C*
c. Given the point *R* moves such that ratio *RA : RC* = 1 : 2, find the equation of the locus *R*.
d. Find the area of $\Delta A0B$

5. The diagram 5 below shows the straight line *LK* and *MN*.

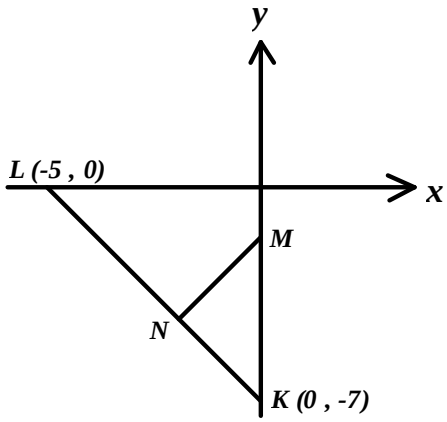


Diagram 5

a. Write down the equation of *LK* in intercept form.
b. Given that *LN* = 3*NK*. Find the coordinates of *N*.
c. Given that *MN* is perpendicular to *LK*. Find the *y*- intercept of *MN*.
d. Given that point *A*(*x* , *y*) that moves such that *AL* : *AK* = 1:2. Find the equation of locus of *A*.

6. Given *A*(5 , -2) and *B*(2 , 1) are two fixed points. Point *Q* moves such that the ratio of *AQ* to *QB* is 2 : 1
   a. Show that the equation of the locus of points *Q* is $x^2 + y^2 - 2x - 4y - 3 = 0$
   b. Show that points *C*(-1 , 0) lies on the locus of point *Q*.
   c. Find the equation of the straight line *AC*.
   d. Given the straight line *AC* intersects the locus of point *Q* again at point *D*, find the coordinates of points *D*.

7. A point *P* moves along the arc of the circle with centre *G*(2 , 3). The arc passes through *A*(-2 , 0) and *B*(5 , *t*)
   a. Find
      i. the equation of the locus of the points *P*.
      ii. the values of *t*.
   b. The tangent to the circle at point *A* intersects the *y*-axis at point *H*. Find the area or triangle *OAH*.

8. The diagram 8 shows a rhombus *PQRS*. The equation of *PS* is $3y + 7x = 33$. Given that *PR* is parallel to the straight line $y = -x$

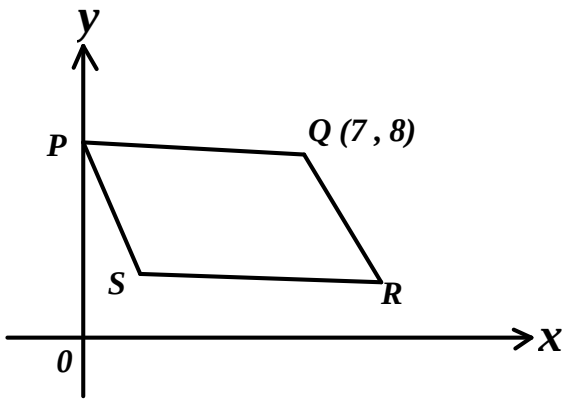


Diagram 8

a. the coordinates of *P*
b. the equation of *PR*
c. the equation of *QS*
d. the coordinates of *S*
e. the area of *PQRS*

9.

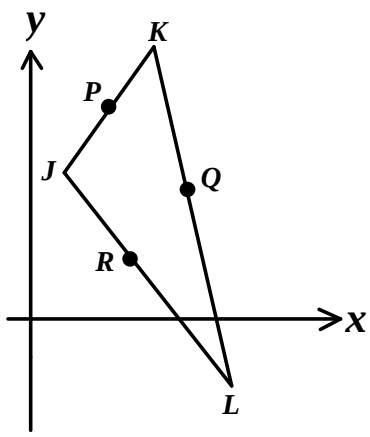


Diagram 9

In diagram 9, *P*(2, 9), *Q*(5, 7) and *R*($4\frac{1}{2}$, 3) are the mid point of the straight line *JK*, *KL* and *LJ* such that *JPQR* form a parallelogram.

(a) Find,
  (i) the equation of the straight line *JK*,
  (ii) the equation of the perpendicular bisector of the straight line *LJ*.

(b) Straight line *KJ* is extended until it intersects the perpendicular bisector of the straight line *LJ* at the point *S*. Find the coordinates of the point *S*.

(c) Calculate the area of ΔPQR and consequently the area of Δ*JKL*.

10. Diagram 10 shows the straight line graphs *PQS* and *QRT* in a Cartesian plane. Point *P* and point *S* lies on the x-axis and y-axis respectively. *Q* is the mid point of *PS*.

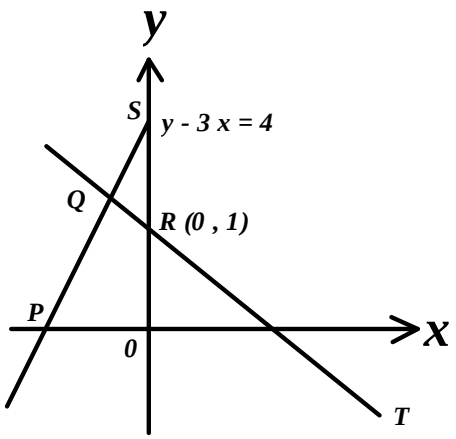


Diagram 10

a. Find,
   (i) coordinates of the point *Q*,
   (ii) area of the quadrilateral *OPQR*.
   (iii) The equation of the straight line which is parallel to *QT* and passes through *S*.

b. Given $3QR = RT$, calculate the coordinates of the point *T*.

c. A point moves in such a way that it's distance from *S* is $\frac{1}{2}$ it's distance from the point *T*.
   (i) Find the equation of locus of the point *T*.
   (ii) Hence, determine whether the locus cuts the *x*-axis or not.

VECTOR

PAPER 1

1. Diagram 1 shows vectors $\overrightarrow{OA}$ and $\overrightarrow{OB}$ drawn on a Cartesian plane. Given that $A(4 , 3)$ and $B(3 , -4)$

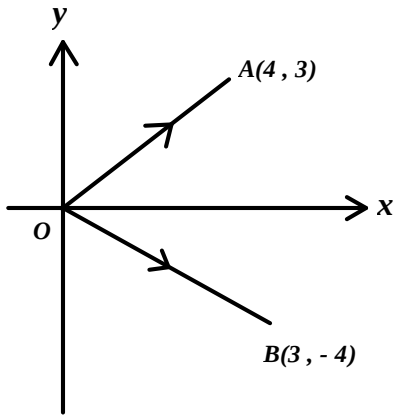


Diagram 1

a. express $\overrightarrow{AB}$ in form $x\underline{i} + y\underline{j}$

b. find the magnitude of $\overrightarrow{OA}$

2. Given that $\underline{a} = 3\underline{i} + 2\underline{j}$, $\underline{b} = -2\underline{i} + 5\underline{j}$ and $\underline{c} = 3\underline{i} - 4\underline{j}$. Find the unit vector in the direction of $\underline{a} - 2\underline{b} + \underline{c}$

3. Diagram 3 shows *PQRS* is parallelogram and *PMR* is a straight line. Given that $\overrightarrow{PQ} = 3\underline{x}$, $\overrightarrow{PS} = 2\underline{y}$ and $PM = 2MR$, express $\overrightarrow{QM}$ in terms of $\underline{x}$ and $\underline{y}$

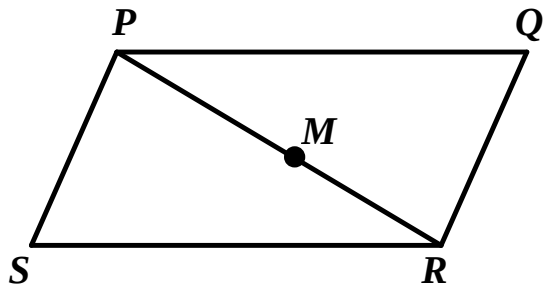


Diagram 3

4. $O(0, 0)$, $A(3 , 12)$ and $B(0 , 4)$ are 3 points on a Cartesian plane. Given $\overrightarrow{OA} = 2\underline{r}$, $\overrightarrow{OB} = 3\underline{s}$ and M is a point such that $\overrightarrow{OM} = 4\underline{r} - 6\underline{s}$. Find

a. the coordinates of M

b. $\left|\overrightarrow{AB}\right|$

5. In diagram 5, *ABCD* is a quadrilateral. *AC* intersects the line *BD* at *E*.

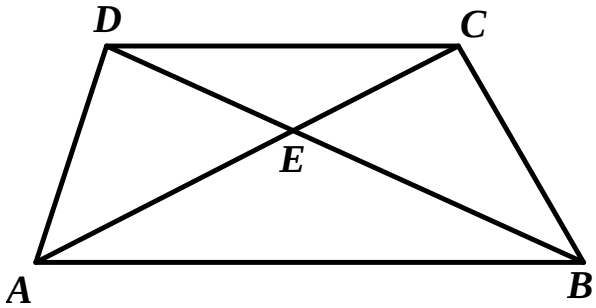


Diagram 5

Given that $\overrightarrow{AB} = 12\underline{u}$, $\overrightarrow{AD} = 9\underline{v}$, $DC : AB = 3 : 4$ and $AE : EC = 3 : 2$. Express

a. $\overrightarrow{BC}$

b. $\overrightarrow{AE}$

in terms of **u** and **v**.

6. It is given the vector **u** = $\begin{pmatrix} 4 \\ 8 \end{pmatrix}$ and **v** = $\begin{pmatrix} 5 \\ k+1 \end{pmatrix}$, find the value of *k* in each of the following cases.

a. 2**v** + **u** = $\begin{pmatrix} 14 \\ 12 \end{pmatrix}$

b. **u** and **v** are parallel

7. Diagram 7 shows the vector $\underline{a}$ and $\underline{b}$. On the square=grid, draw and label clearly a line with direction that represents the vector $\overrightarrow{OP} = 3\underline{b} - 2\underline{a}$

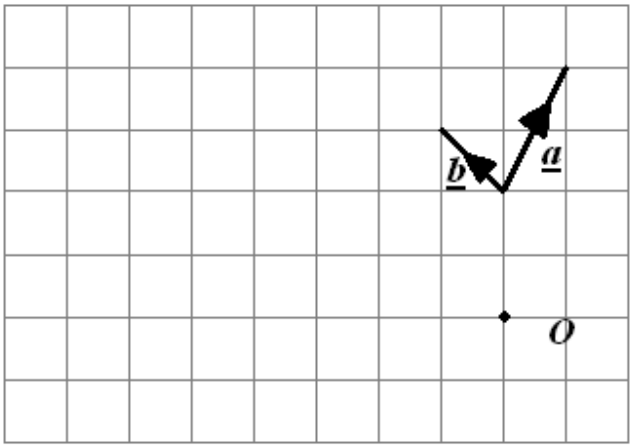


Diagram 7

8. Given $\overrightarrow{OA} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$, $\overrightarrow{OB} = \begin{pmatrix} 12 \\ 9 \end{pmatrix}$ and C is a point lies on the straight line of AB with $5AC = 2AB$. Find
   a. $\overrightarrow{AB}$
   b. $\left|\overrightarrow{OC}\right|$

9. Given $\mathbf{u} = \begin{pmatrix} m-2 \\ 1 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} 10 \\ 5 \end{pmatrix}$. Find the value of m if:
   a. $\mathbf{u}$ and $\mathbf{v}$ are parallel
   b. $2\mathbf{u} + \mathbf{v}$ parallel wit y – axis

10. Given $\underline{u} = 2\underline{i} + 3\underline{j}$ and $\underline{v} = 2\underline{i} + k\underline{j}$, find the values of k if $\left|2\underline{u} + \underline{v}\right| = 10$

PAPER 2 (SECTION A)

1. *O*, *A*, *B* and *C* are four points such that $\overrightarrow{OA}=\begin{pmatrix}3\\5\end{pmatrix}$, $\overrightarrow{OB}=\begin{pmatrix}-1\\3\end{pmatrix}$ and $\overrightarrow{OC}=\begin{pmatrix}5\\-3\end{pmatrix}$. If *D* is a point on *AB* such that *AD* = *DB*, find
   a. $\overrightarrow{DC}$
   b. $\left|\overrightarrow{DC}\right|$

2. Diagram 2 shows a triangle *ABC* where point *E* is on *AB*, point *F* is on *AC* and point *D* is on the straight line *CE*. Given that *5AE = 2AB*, *CE = 4CD*, *AC = 6 CF*, $\overrightarrow{CF}=\underline{x}$ and $\overrightarrow{AB}=5\underline{y}$

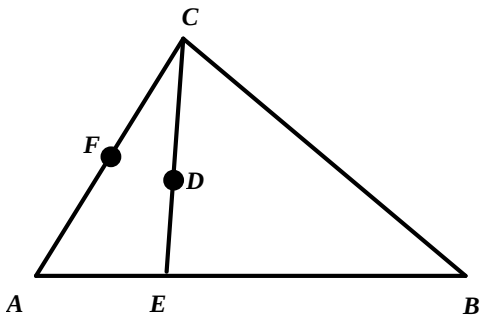


Diagram 2

   a. Find
      i. $\overrightarrow{CE}$
      ii. $\overrightarrow{FD}$
      iii. $\overrightarrow{DB}$
   b. Hence, prove that *F*, *D* and *B* are collinear.

3. Given that $\overrightarrow{AB}=\begin{pmatrix}4\\6\end{pmatrix}$, $\overrightarrow{OB}=\begin{pmatrix}1\\2\end{pmatrix}$ and $\overrightarrow{CD}=\begin{pmatrix}k\\5\end{pmatrix}$, find
   a. the coordinates of A
   b. the unit vector in direction of $\overrightarrow{OA}$
   c. the value of *k* if $\overrightarrow{CD}$ is parallel to $\overrightarrow{AB}$

4. In diagram 3, $\overrightarrow{PS} = \frac{2}{3}\overrightarrow{PQ}$, $2\overrightarrow{PT} = \overrightarrow{TR}$ and $\overrightarrow{OR} = 4\overrightarrow{OQ}$. It is given that $\overrightarrow{OP} = \underline{a}$ and $\overrightarrow{OQ} = \underline{b}$

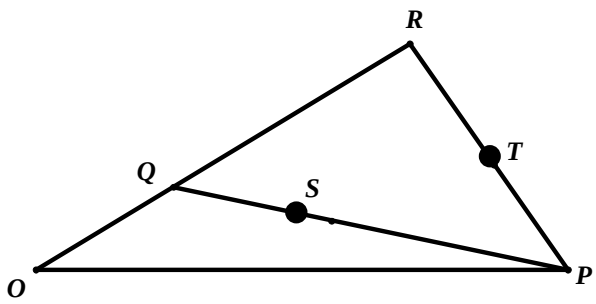


Diagram 3

a. Express $\overrightarrow{ST}$ in terms of ***a*** and ***b***.

b. Find $\overrightarrow{OT}$ and hence, show that *O*, *S* and *T* are collinear

5. Diagram 4 shows triangle *OPQ* straight line *PA* intersects the straight line *OB* at *R*.

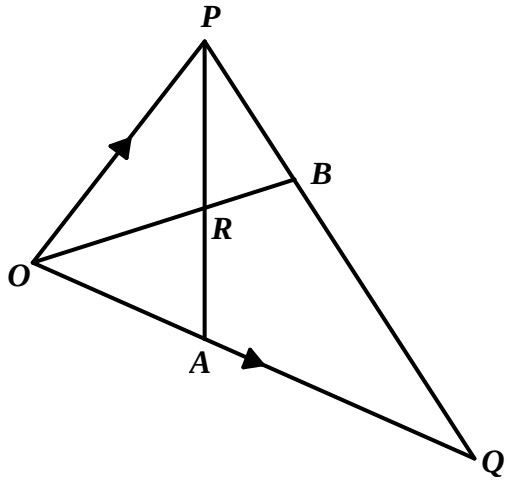


Diagram 4

Given that $OA = \frac{1}{3}OQ$, $PB = \frac{1}{3}PQ$, $\overrightarrow{OA} = 4\underline{b}$ and $\overrightarrow{OP} = 4\underline{a}$

a. Express in terms of $\underline{b}$ and/ or $\underline{a}$

i. $\overrightarrow{PA}$

ii. $\overrightarrow{OB}$

b. (i) Given that $\overrightarrow{PR} = h\overrightarrow{PA}$, state $\overrightarrow{PR}$ in terms of *h*, $\underline{a}$ and $\underline{b}$.

(ii) Given that $\overrightarrow{RB} = k\overrightarrow{OB}$, state $\overrightarrow{RB}$ in terms of *k*, $\underline{a}$ and $\underline{b}$.

c. Given that $\overrightarrow{PB} = \overrightarrow{PR} + \overrightarrow{RB}$, find the value of *h* and *k*.

6.

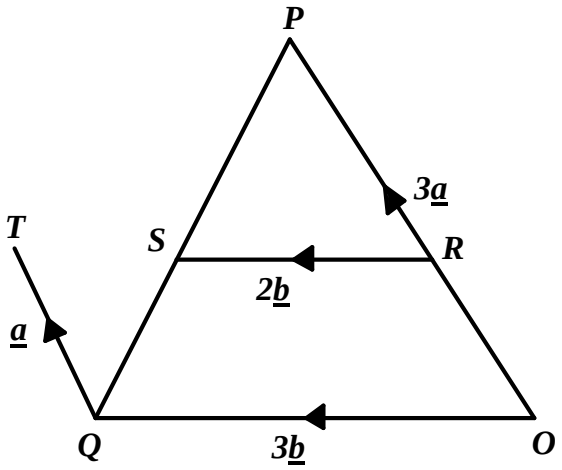


Diagram 5

In the diagram 5 , *OPQ* is a triangle. Given $\overrightarrow{OQ} = 3\underset{\sim}{b}$, $\overrightarrow{RS} = 2\ b$, $\overrightarrow{OP} = 3\underset{\sim}{a}$ and $\overrightarrow{QT} = \underset{\sim}{a}$.

a. Find in terms of $\underset{\sim}{a}$ and $\underset{\sim}{b}$

$\overrightarrow{QP}$, $\overrightarrow{QS}$, $\overrightarrow{ST}$ and $\overrightarrow{PT}$,

b. Show that *R*, *S* and *T* are collinear.

7. In the diagram 6 above, *ABCD* is a rhombus, *E* is a point on *BC* such that $BE : BC = 1 : 4$. Given $\overrightarrow{AB} = 5\underset{\sim}{i} + 3\underset{\sim}{j}$ and $\overrightarrow{AD} = 7\ \underset{\sim}{i} + 5\underset{\sim}{j}$.

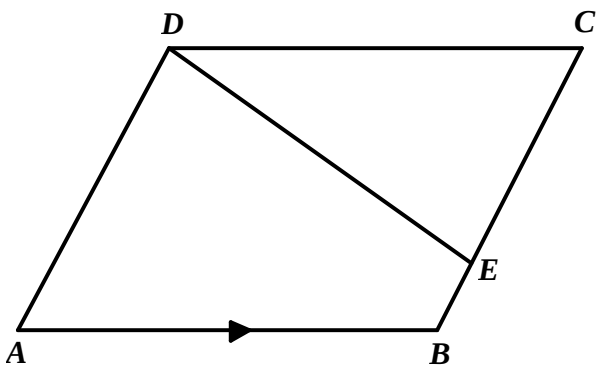


Diagram 6

Find

a. $\overrightarrow{AC}$, $\overrightarrow{DE}$, $\overrightarrow{BE}$ and $\overrightarrow{CE}$,

b. $\left| \overrightarrow{AD} \right|$

8. Given $\underline{u} = \begin{pmatrix} 10 \\ 4 \end{pmatrix}$, $\underline{v} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ and $\underline{w} = \begin{pmatrix} p \\ q \end{pmatrix}$. Find,

   a. $\frac{1}{2}\underline{u} + 3\underline{v}$

   b. Given $\underline{u} - \underline{w} = \underline{w} - \underline{v}$. Find the value of p and of q.

9. Given $\overrightarrow{AB} = \begin{pmatrix} 8 \\ -6 \end{pmatrix}$ and $\overrightarrow{CD} = \frac{3}{2}\overrightarrow{AB}$. Find

   a. the unit vector in the direction of $\overrightarrow{AB}$

   b. Express $\overrightarrow{CD}$ in the form of $\begin{pmatrix} x \\ y \end{pmatrix}$

   c. If A is (6 , 9), find the coordinates of B.

   d. If D (1 , 4), find the coordinates of C.

10. $PQRS$ is a parallelogram. Given that $\overrightarrow{PQ} = \underline{i} + \frac{5}{2}\underline{j}$, $\overrightarrow{PR} = k\underline{i} + 4\underline{j}$ and $\overrightarrow{PS} = 4\underline{i} + h\underline{j}$ where h and k are constants,

   a. find the values of h and k

   b. find the length of the diagonal $\overrightarrow{PR}$

PAPER 2 (SECTION B)

1. Diagram 1 shows a triangle OPQ. T is the midpoint of OQ and the straight line OS intersects the straight line PT at U. Given that $\overrightarrow{OP} = 8\underline{p}$, $\overrightarrow{OQ} = 6\underline{q}$ and $PS = \frac{1}{4}PQ$

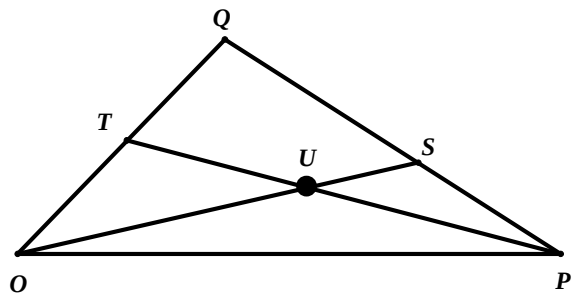


Diagram 1

a. Express in terms of $\underline{p}$ and/or $\underline{q}$.

i. $\overrightarrow{PQ}$

ii. $\overrightarrow{OS}$

iii. $\overrightarrow{PT}$

b. i. Given that $\overrightarrow{PU} = h\overrightarrow{PT}$ express $\overrightarrow{PU}$ in terms of h, $\underline{p}$ and $\underline{q}$.

ii. Given that $\overrightarrow{OU} = k\overrightarrow{OS}$ express $\overrightarrow{OU}$ in terms of k, $\underline{p}$ and $\underline{q}$.

c. Using $\overrightarrow{PU}$ and $\overrightarrow{OU}$ from (b), find the values of h and k.

2. In diagram 2, $\overrightarrow{OP} = \underline{p}$, $\overrightarrow{OQ} = \underline{q}$, $\overrightarrow{PR} = 2\underline{q}$. S is the mid point of OP and $QU = \frac{1}{2}UR$. Given that SU and OR intersects at T.

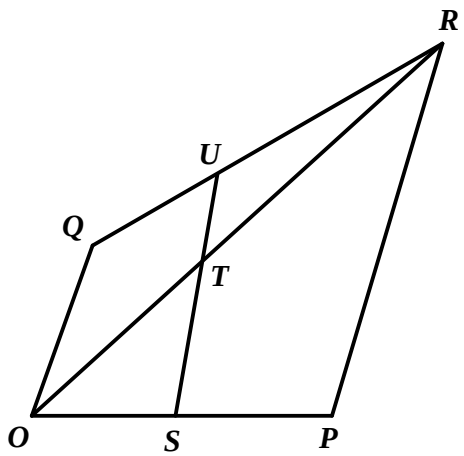


Diagram 2

a. Express in terms of $\underline{p}$ and/ or $\underline{q}$

i. $\overrightarrow{OR}$

ii. $\overrightarrow{QR}$

iii. $\overrightarrow{QU}$

b. Given that $\overrightarrow{ST} = h\overrightarrow{SU}$ and $\overrightarrow{OT} = k\overrightarrow{OR}$. State $\overrightarrow{OT}$

i. in terms of h, $\underline{p}$ and $\underline{q}$.

ii. in terms of k, $\underline{p}$ and $\underline{q}$.

c. Hence, find the values of h and k

3. In diagram 3, APC and BPD are straight lines

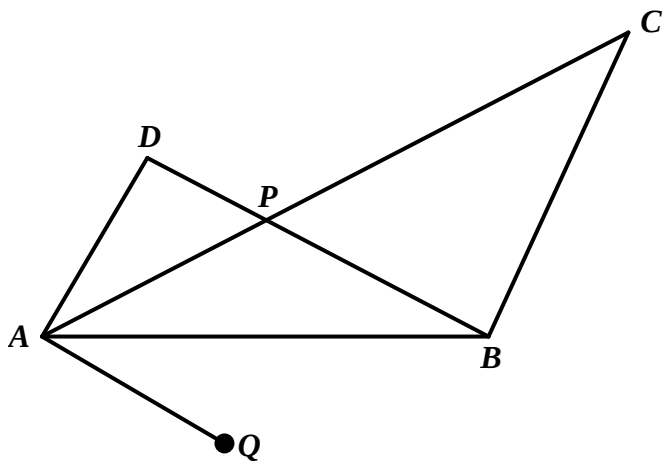


Diagram 3

Given that $\overrightarrow{AB} = 2\underline{x}$, $\overrightarrow{AD} = \underline{y}$ and $\overrightarrow{BC} = 3\overrightarrow{AD}$

a. Express in term of x and / or y.

i. $\overrightarrow{AC}$

ii. $\overrightarrow{BD}$

b. Given that $\overrightarrow{AP} = m\overrightarrow{AC}$ and $\overrightarrow{BP} = n\overrightarrow{BD}$. Express $\overrightarrow{AP}$

i. in terms of m , $\underline{x}$ and $\underline{y}$

ii. in terms of n, $\underline{x}$ and $\underline{y}$

Hence, show that $m + n = 1$

c. If $\overrightarrow{AQ} = \frac{4}{3}\underline{x} - \underline{y}$, prove that AC and QB are parallel.

4. In the Diagram 4, $\overrightarrow{OP} = 8\underline{p}$, $\overrightarrow{OQ} = 10\underline{q}$ and $\overrightarrow{PS} = 4\underline{q}$.

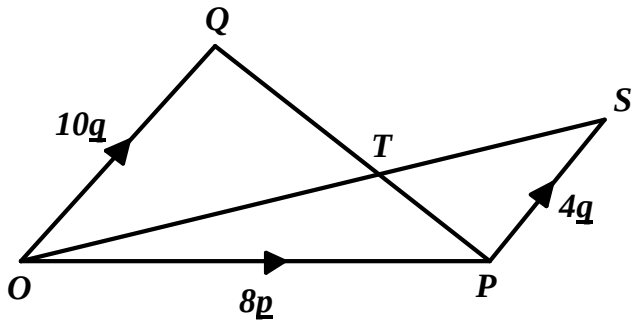


Diagram 4

a. Express each of the following vectors in terms of $\underline{p}$ and/or $\underline{q}$.

(i) $\overrightarrow{OS}$

(ii) $\overrightarrow{QP}$

b. Given that $\overrightarrow{OT} = a\overrightarrow{OS}$ and $\overrightarrow{QT} = b\overrightarrow{QP}$, express $\overrightarrow{OT}$ in terms of

(i) a, $\underline{p}$ and $\underline{q}$

(ii) b, $\underline{p}$ and $\underline{q}$

c. Hence, find the values of a and b.

5. In the diagram 5, O is the midpoint of PR, $\overrightarrow{SP} = \underline{a} + 4\underline{b}$, $\overrightarrow{SR} = 8\underline{a} - 3\underline{b}$ and $\overrightarrow{RQ} = 2k\underline{a} - \underline{b}$ where k is a constant.

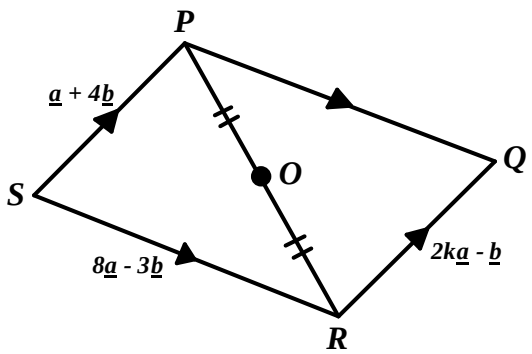


Diagram 5

a. Express in terms of and. $\underset{\sim}{a}$ or $\underset{\sim}{b}$

i. $\overrightarrow{RP}$ ii. $\overrightarrow{PO}$ iii. $\overrightarrow{OS}$

b. Express $\overrightarrow{SQ}$ in terms of $\underset{\sim}{a}, \underset{\sim}{b}$ *and* k.

c. If the points S, O and Q are collinear, find the value of k.

6. Diagram 6 shows a triangle POQ. Given $\overrightarrow{OP} = \underline{p}$ and $\overrightarrow{OQ} = \underline{q}$. Point X lies on OP where $OX : XP = 2:1$ and Y lies on $\overrightarrow{OQ}$ where $OY : YQ = 3:1$. The straight line QX and the straight line PY intersects at point C.

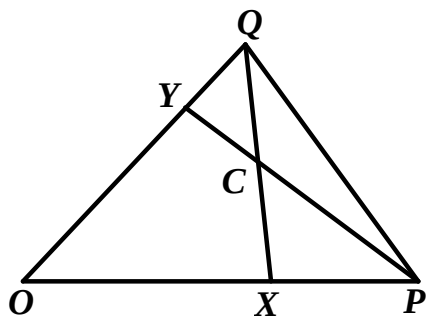


Diagram 6

a. Express $\overrightarrow{PY}$ and $\overrightarrow{QX}$ in terms of $\underline{p}$ and $\underline{q}$.

b. Express $\overrightarrow{OC}$

   i. in terms of m, $\underline{p}$ and $\underline{q}$ if $\overrightarrow{OC} = \overrightarrow{OQ} + m\overrightarrow{QX}$

   ii. in terms of n, $\underline{p}$ and $\underline{q}$ if $\overrightarrow{OC} = \overrightarrow{OP} + n\overrightarrow{PY}$

c. Hence, find the values of m and n.

7. In diagram 7, $\overrightarrow{OA} = \boldsymbol{a}$, $\overrightarrow{BA} = \boldsymbol{b}$, $\overrightarrow{BA} = 3\overrightarrow{BP}$ and $\overrightarrow{OC} = 4\overrightarrow{OA}$. OP is extended and intersects BC at Q.

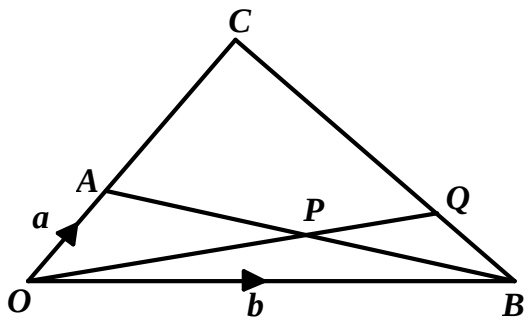


Diagram 7

a. Express $\overrightarrow{OP}$ in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$.

b. Given that $\overrightarrow{OQ} = h\overrightarrow{OP}$ and $\overrightarrow{BQ} = k\overrightarrow{BC}$, express $\overrightarrow{OQ}$ in terms of

   i. h, $\boldsymbol{a}$ and $\boldsymbol{b}$

   ii. k, $\boldsymbol{a}$ and $\boldsymbol{b}$

c. Hence, find the ratio of $BQ : QC$

8. In diagram 8, vector $\overrightarrow{OM} = 2\underline{p}$ and $\overrightarrow{ON} = 5\underline{q}$

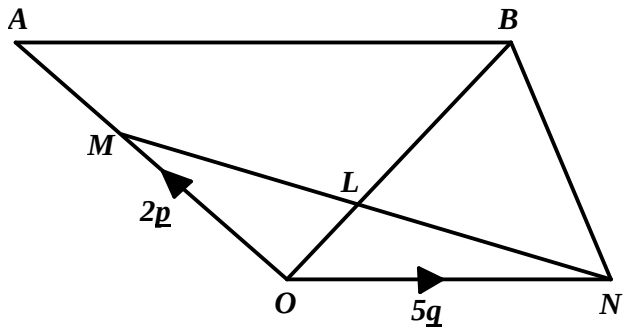


Diagram 8

a. Given that $3\overrightarrow{OM} = \overrightarrow{MA}$ and $\overrightarrow{AB} = 2\overrightarrow{ON}$. Express the following vector in terms of p and/ or q

   i. $\overrightarrow{MN}$

   ii. $\overrightarrow{OB}$

b. Given that $\overrightarrow{LN} = h\overrightarrow{MN}$ and $\overrightarrow{LB} = k\overrightarrow{OB}$. Show that $\overrightarrow{OL} = 2h\underline{p} + 5(1-h)\underline{q}$ and $\overrightarrow{OL} = (8-8k)\underline{p} + (10-10k)\underline{q}$. Hence, find the value of h and of k.

9. In diagram 9, OAC, *OPQ*, *APB* and *BQC* are straight lines. Given that $\overrightarrow{AP} = \frac{1}{3}\overrightarrow{AB}$, $\overrightarrow{OQ} = h\overrightarrow{OP}$, h > 1 and $\overrightarrow{BQ} = k\overrightarrow{BC}$. Given that $\overrightarrow{OA} = \underline{a}$, $\overrightarrow{OB} = \underline{b}$ and $\overrightarrow{OC} = 3\underline{a}$

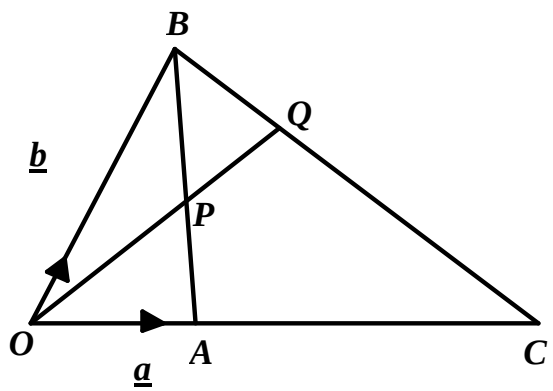


Diagram 9

a. Express $\overrightarrow{OP}$ in terms of $\underline{a}$ and $\underline{b}$.

b. Express

   i. $\overrightarrow{OQ}$ in terms of $\underline{a}$, $\underline{b}$ and h

   ii. $\overrightarrow{BQ}$ in terms of $\underline{a}$, $\underline{b}$ and k.

   Hence, find the value of h and k.

c. Given that $|\underline{a}| = 3$ units and the area of triangle BOC = 45 unit^2, calculate the perpendicular distance from B to OC.

10. In diagram 10, shows a quadrilateral $PQRS$. PTS and TUR are straight lines. It is given that $\overrightarrow{PQ} = 15\underline{x}$, $\overrightarrow{PT} = 6\underline{y}$, $\overrightarrow{SR} = 25\underline{x} - 13\underline{y}$. $\overrightarrow{TS} = 3\overrightarrow{PT}$ and $\overrightarrow{TU} = \frac{2}{5}\overrightarrow{TR}$

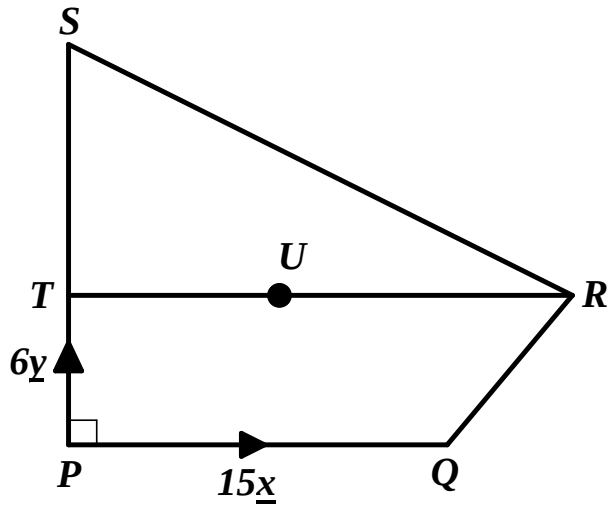


Diagram 10

a. Express, in terms of $\underline{x}$ and $\underline{y}$

   i. $\overrightarrow{QS}$

   ii. $\overrightarrow{TR}$

b. Show that Q, U and S are collinear

c. If $|\underline{x}| = 2$ and $|\underline{y}| = 3$, find $|\overrightarrow{QS}|$

ANSWER COORDINATE GEOMETRY

Paper 1

1. a) $P(-2,0)$

   b) $y=-\frac{3}{2}x-\frac{4}{3}$

2. $8x^2+8y^2+4x-42y+47=0$

3. $t=0$ and $t=-22$

4. $m=-5$

5. $h=1$ and $h=-\frac{8}{5}$

6. a) $m:n=2:3$

   b) $p=4$

7. $p=3$

8. $k=\frac{14}{9}h$

9. $y=-\frac{3}{2}x+6$

10. $2x^2-2y^2+9x+2y+5=0$

Paper 2 (Section A)

1. a) i) $C(-4,6)$

   ii) $y=3x-2$

   b) $x^2+y^2-16x-4y+48=0$

2. a) $y=-\frac{4}{3}x+4$

   b) $C\left(-\frac{16}{9},\frac{16}{3}\right)$

3. a) $\frac{x}{6}+\frac{y}{-3}+1$

   b) $D(2,-2)$

   c) y-intercept = 2

4. a) $x^2+y^2-18x+8y+45=0$

   b) $x^2+y^2-5x+3y-6=0$

5. a) $n=7$

   b) Show

   c) Area quadrilateral $OPRQ$ = 43.5 unit^2

6. a) $t=-\frac{4}{3}$

   b) $5x^2+5y^2+72x-200y+1424=0$

   c) Area $PQRS$ = 32 unit^2

7. a) i) $R(9,16)$

   ii) $y=-2x+34$

   iii) Area $\Delta PRS=80\,\text{unit}^2$

   b) $x^2+y^2-6x-16y-27=0$

8. a) $\frac{x}{6}+\frac{y}{-4}=1$

   b) $Q=\left(2,-\frac{8}{3}\right)$

   c) y –intercept = $-\frac{4}{3}$

9. a) $x^2+y^2-4x-6y-12=0$

   b) $x=5$

   c) $x^2+y^2-20x-6y+93=0$

10. a) $y=-\frac{1}{5}x+\frac{33}{5}$ or $5y=-x+33$

    b) $y=-\frac{1}{5}x+\frac{7}{5}$ or $5y=-x+7$

    c) Area of $\Delta ABO=9$ unit^2

Paper 2 (Section B)

1. a) $A(-12,-2)$

   b) $y=-\frac{1}{4}x+1$

   c) $\left(-\frac{56}{25},\frac{32}{25}\right)$

   d) $3x^2+3y^2+104x-12y+572=0$

2. a) $T=(1,5)$

   b) i) $C=(3,1)$

   ii) Area $\Delta ABC=15\,\text{unit}^2$

   c) $x^2+y^2-14x-16y+93=0$

3. a) $A(0,2)$

   b) $C(10,7)$

   c) Area ΔCOA =10 unit^2

   d) $y=-\frac{1}{2}x+2$

4. a) $\frac{x}{-5}+\frac{y}{-4}=1$

   b) C (5 , -8)

   c) $3x^2+3y^2+50x-16y+11=0$

   d) Area $\Delta AOB=10$ unit^2

5. a) $\frac{x}{-5}+\frac{y}{-7}=1$

b) $N=\left(-\frac{5}{4},-\frac{21}{4}\right)$

c) y-intercept = $-\frac{61}{14}$

d) $3x^2+3y^2+40x-14y+51=0$

6. a) $x^2+y^2-2x-4y-3=0$, show

b) Show, 0 = 0

c) $y=-\frac{1}{3}x-\frac{1}{3}$ or $3y=-x-1$

d) $D=\left(\frac{7}{5},-\frac{4}{5}\right)$

7. a) i) $x^2+y^2-4x-6y-12=0$

ii) $t=7$ or $t=-1$

b) Area $\Delta OAH=\frac{8}{3}$ unit^2

8. a) $P=(0,11)$

b) $y=-x+11$

c) $y=x+1$

d) $S=(3,4)$

e) Area of rhombus $PQRS$ = 40 unit^2

9. a) i) $y = 8x - 7$

ii) $4y = 6x - 15$

b) $S = \left(\frac{1}{2}, 3\right)$

c) Area $\Delta PQR = 6\frac{1}{2}$ unit^2 and Area $\Delta JKL = 26$ unit^2

10. a) i) $Q = \left(-\frac{2}{3}, 2\right)$

ii) Area of quadrilateral $OPQR = \frac{5}{3}$ unit^2

iii) $y = -\frac{3}{2}x + 4$

b) $T = (2, -2)$

c) i) $3x^2 + 3y^2 + 4x - 36y + 56 = 0$

d) Not

ANSWER VECTOR

Paper 1

1. a) $\overrightarrow{AB} = \underline{i} - 7\underline{j}$

   b) $\left|\overrightarrow{OA}\right| = 5$ units

2. Vector unit in the direction $\underline{a} - 2\underline{b} + \underline{c} = \frac{1}{\sqrt{244}}\left(10\underline{i} - 12\underline{j}\right)$

3. $\overrightarrow{QM} = -\underline{x} + \frac{4}{3}\underline{y}$

4. a) $M(6,12)$

   b) $\left|\overrightarrow{AB}\right| = \sqrt{73}$ units

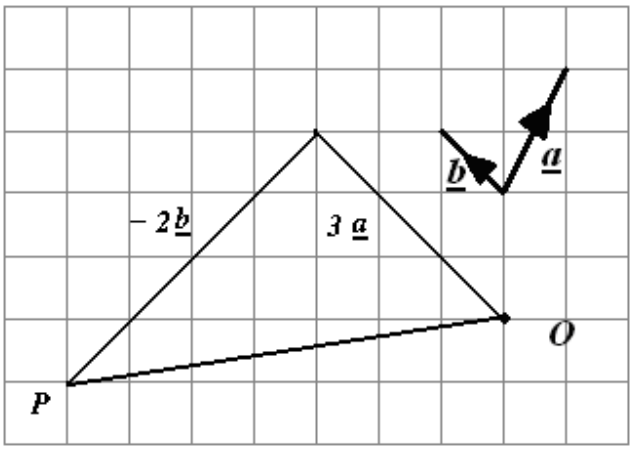
5. a) $\overrightarrow{BC} = -2\underline{u} + 9\underline{v}$

   b) $\overrightarrow{AE} = \frac{27}{5}(\underline{u} + \underline{v})$

6. a) $k = 1$

   b) $k = 9$

7.



8. a) $\overrightarrow{AB} = \begin{pmatrix} 15 \\ 5 \end{pmatrix}$ or $15\underline{i} + 5\underline{j}$

   b) $\left|\overrightarrow{OC}\right| = \sqrt{45}$ units

9. a) $m = 4$

   b) $m = -3$

10. $k = 2$ and $k = -14$

Paper 2 (Section A)

1. a) $\overrightarrow{DC} = \begin{pmatrix} 4 \\ -7 \end{pmatrix}$ or $= 4\underline{i} - 7\underline{j}$

   b) $\left|\overrightarrow{DC}\right| = \sqrt{65}$ units

2. a) i) $\overrightarrow{CE} = 6\underline{x} + 2\underline{y}$

   ii) $\overrightarrow{FD} = \frac{1}{2}\underline{x} + \frac{1}{2}\underline{y}$

   iii) $\overrightarrow{DB} = \frac{9}{2}\underline{x} + \frac{9}{2}\underline{y}$

   Prove $\lambda = \frac{1}{9}$

3. a) $A(-3,-4)$

   b) $\overrightarrow{OA} = \begin{pmatrix} -3 \\ -4 \end{pmatrix}$ or $-3\underline{i} - 4\underline{j}$

   c) $k = \frac{10}{3}$

4. a) $\overrightarrow{ST} = \frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}$

   b) $\overrightarrow{OT} = \frac{4}{3}\underline{b} + \frac{2}{3}\underline{a}$

   Prove, $\lambda = \frac{1}{2}$

5. a) i) $\overrightarrow{PA} = -4\underline{a} + 4\underline{b}$

ii) $\overrightarrow{OB} = \frac{8}{3}\underline{a} + 4\underline{b}$

b) i) $\overrightarrow{PR} = -4h\underline{a} + 4h\underline{b}$

ii) $\overrightarrow{RB} = \frac{8}{3}k\underline{a} + 4k\underline{b}$

c) $k = \frac{2}{5}$ and $h = \frac{3}{5}$

6. a) $\overrightarrow{QP} = -3\underline{b} + 3\underline{a}$

$\overrightarrow{QS} = -\underline{b} + \underline{a}$

$\overrightarrow{ST} = \underline{b}$

$\overrightarrow{PT} = -2\underline{a} + 3\underline{b}$

b) Show $\lambda = 2$

7. a) $\overrightarrow{AC} = 12\underline{i} + 8\underline{j}$

$\overrightarrow{DE} = -\frac{1}{4}\underline{i} - \frac{3}{4}\underline{j}$

$\overrightarrow{BE} = \frac{7}{4}\underline{i} + \frac{5}{4}\underline{j}$

$\overrightarrow{CE} = -\frac{21}{2}\underline{i} - \frac{15}{4}\underline{j}$

b) $\left|\overrightarrow{AD}\right| = \sqrt{74}$ units

8. a) $\begin{pmatrix} -1 \\ 17 \end{pmatrix}$

b) $p = 4$ and $q = \frac{9}{2}$

9. a) unit vector in the direction of $\overrightarrow{AB} = \frac{1}{5}\begin{pmatrix} 4 \\ -3 \end{pmatrix}$

b) $\overrightarrow{CD} = \begin{pmatrix} 12 \\ 9 \end{pmatrix}$

c) B (14 , 3)

d) C (-11 , 13)

10. a) $h = \frac{3}{2}$ and $k = 5$

b) $\left|\overrightarrow{PR}\right| = \sqrt{41}$ unit

Paper 2 (Section B)

1. a) i) $\overrightarrow{PQ} = -8\underline{p} + 6\underline{q}$

ii) $\overrightarrow{OS} = 4\underline{p} + \frac{3}{2}\underline{q}$

iii) $\overrightarrow{PT} = -8\underline{p} + 3\underline{q}$

b) i) $\overrightarrow{PU} = -8h\underline{p} + 3h\underline{q}$

ii) $\overrightarrow{OU} = 4k\underline{p} + \frac{3}{2}k\underline{q}$

c) $h = \frac{1}{2}$ and $k = -1$

2. a) i) $\overrightarrow{OR} = \underline{p} + 2\underline{q}$

ii) $\overrightarrow{QR} = \underline{q} + \underline{p}$

iii) $\overrightarrow{QU} = \frac{1}{3}\underline{q} + \frac{1}{3}\underline{p}$

b) i) $\overrightarrow{OT} = k\underline{p} + 2k\underline{q}$

ii) $\overrightarrow{OT} = \left(\frac{1}{2} - \frac{1}{6}h\right)\underline{p} + \frac{4}{3}h\underline{q}$

c) $h = \frac{3}{5}$ and $k = \frac{2}{5}$

3. a) i) $\overrightarrow{AC} = 2\underline{x} + 3\underline{y}$

   ii) $\overrightarrow{BD} = -2\underline{x} + \underline{y}$

   b) i) $\overrightarrow{AP} = 2m\underline{x} + 3m\underline{y}$

   ii) $\overrightarrow{AP} = (2-2n)\underline{x} + n\underline{y}$

   Show $m + n = 1$

   c) Prove, $\lambda = 3$

4. a) i) $\overrightarrow{OS} = 8\underline{p} + 4\underline{q}$

   ii) $\overrightarrow{QP} = -10\underline{q} + 8\underline{p}$

   b) i) $\overrightarrow{OT} = 8a\underline{p} + 4a\underline{q}$

   ii) $\overrightarrow{OT} = (10-10b)\underline{q} + 8b\underline{p}$

   c) $a = \frac{5}{7}$ and $b = \frac{5}{7}$

5. a) i) $\overrightarrow{RP} = -7\underline{a} + 7\underline{b}$

   ii) $\overrightarrow{PO} = \frac{7}{2}\underline{a} - \frac{7}{2}\underline{b}$

   iii) $\overrightarrow{OS} = -\frac{9}{2}\underline{a} - \frac{1}{2}\underline{b}$

   b) $\overrightarrow{SQ} = (8-2k)\underline{a} - 4\underline{b}$

   c) $k = 22$

6. a) $\overrightarrow{PY} = \frac{3}{4}\underline{q} - \underline{p}$

   $\overrightarrow{QX} = \frac{2}{3}\underline{p} - \underline{q}$

   b) i) $\overrightarrow{OC} = (1-m)\underline{q} + \frac{2}{3}m\underline{p}$

   ii) $\overrightarrow{OC} = (1-n)\underline{p} + \frac{3}{4}n\underline{q}$

   c) $m = \frac{7}{6}$ and $n = \frac{2}{9}$

7. a) $\overrightarrow{OP} = \frac{1}{3}\underline{a} + \frac{2}{3}\underline{b}$

   b) i) $\overrightarrow{OQ} = \frac{1}{3}h\underline{a} + \frac{2}{3}h\underline{b}$

   ii) $\overrightarrow{OQ} = 4k\underline{a} + (1-k)\underline{b}$

   c) $BQ : QC = 1 : 8$

8. a) i) $\overrightarrow{MN} = 5\underline{q} - 2\underline{p}$

   ii) $\overrightarrow{OB} = 8p + 10q$

   b) $h = \frac{2}{3}$ and $k = \frac{5}{6}$

9. a) $\overrightarrow{OP} = \frac{2}{3}\underline{a} + \frac{1}{3}\underline{b}$

   b) i) $\overrightarrow{OQ} = \frac{2}{3}h\underline{a} + \frac{1}{3}h\underline{b}$

   ii) $\overrightarrow{BQ} = 3k\underline{a} - k\underline{b}$

   $h = \frac{9}{5}$ and $k = \frac{2}{5}$

   c) 10 units

10. a) i) $\overrightarrow{QS} = -15\underline{x} + 24\underline{y}$

   ii) $\overrightarrow{TR} = 5\underline{y} + 25\underline{x}$

   b) Show, $\lambda = 3$

   c) $\left|\overrightarrow{QS}\right| = 78$ units