1. [Edexcel, 2015] Column Vectors **[5 Marks]**

$\mathbf{a} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 1 \\ 7 \end{pmatrix}$ $\mathbf{c} = \begin{pmatrix} -7 \\ 0 \end{pmatrix}$

(a) Write, as a column vector, $2\mathbf{a}$

$$2\underline{a} = 2 \times \begin{pmatrix} 5 \\ -2 \end{pmatrix}$$

A1

$\begin{pmatrix} 10 \\ -4 \end{pmatrix}$

(1)

(b) Write, as a column vector, $3\mathbf{b} - \mathbf{c}$

$$3 \times \begin{pmatrix} 1 \\ 7 \end{pmatrix} - \begin{pmatrix} -7 \\ 0 \end{pmatrix} = \begin{pmatrix} 3 \\ 21 \end{pmatrix} - \begin{pmatrix} -7 \\ 0 \end{pmatrix}$$

3 - -7

21 - 0

M1

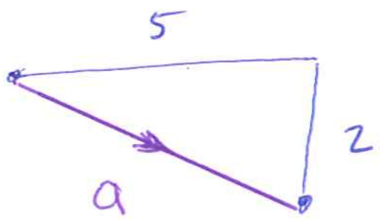
A1

$\begin{pmatrix} 10 \\ 21 \end{pmatrix}$

(2)

(c) Work out the magnitude of **a**
Give your answer as a surd.

USE PYTHAGORAS



M1

$$a^2 = 5^2 + 2^2$$
$$= 25 + 4$$
$$= 29$$

$$\Rightarrow a = \underline{\underline{\sqrt{29}}}$$

A1

MAGNITUDE MEANS 'SIZE'

2. [Edexcel, 2015] Column Vectors **[2 Marks]**

ABCD is a parallelogram.

$\overrightarrow{BC} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$ $\overrightarrow{DC} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$

Find $\overrightarrow{BD}$ as a column vector.

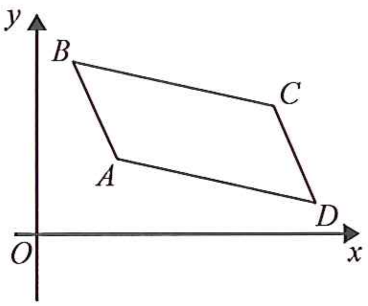


Diagram **NOT** accurately drawn

$\overrightarrow{BD} = \overrightarrow{BC} + \overrightarrow{CD}$

$= \begin{pmatrix} 5 \\ -1 \end{pmatrix} + \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

$\begin{pmatrix} 7 \\ -4 \end{pmatrix}$ A1 A1

3. [Edexcel, 2005] Column Vectors **[2 Marks]**

A is the point with coordinates (2, 3).

$\overrightarrow{AB} = \begin{pmatrix} 5 \\ -4 \end{pmatrix}$.

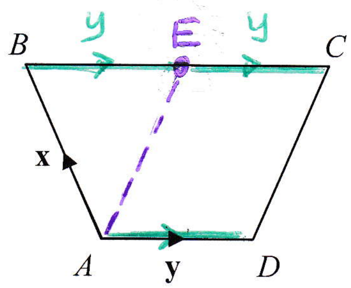
$(2+5, 3-4)$

Find the coordinates of B.

(7, -1)

B1 B1

The diagram shows a trapezium *ABCD*.



$\overrightarrow{BC} = 2\overrightarrow{AD}$. [= 2y]
$\overrightarrow{AB} = \mathbf{x}$. $\overrightarrow{AD} = \mathbf{y}$.

(a) Find, in terms of **x** and **y**,

(i) $\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$

$= x + 2y$

$x + 2y$ B1

(ii) $\overrightarrow{DC} = \overrightarrow{DA} + \overrightarrow{AC}$

$= -y + (x + 2y)$

$x + y$ B1

(2)

(b) The point *E* is such that $\boxed{\overrightarrow{AE} = \mathbf{x} + \mathbf{y}}$.
Use your answer to part (a)(ii) to explain why *AECD* is a parallelogram.

$\overrightarrow{AE} = \overrightarrow{DC}$, SO AE AND DC ARE PARALLEL B1

(2)

$\overrightarrow{EC} = \frac{1}{2}\overrightarrow{BC}$

$= \frac{1}{2} \times 2y$

$= y$

$= \overrightarrow{AD}$, SO EC AND AD ARE PARALLEL

A1 [OTHER METHODS MIGHT ALSO SHOW PARALLELNESS]

5. [Edexcel, 2013] Vector Diagrams **[3 Marks]**

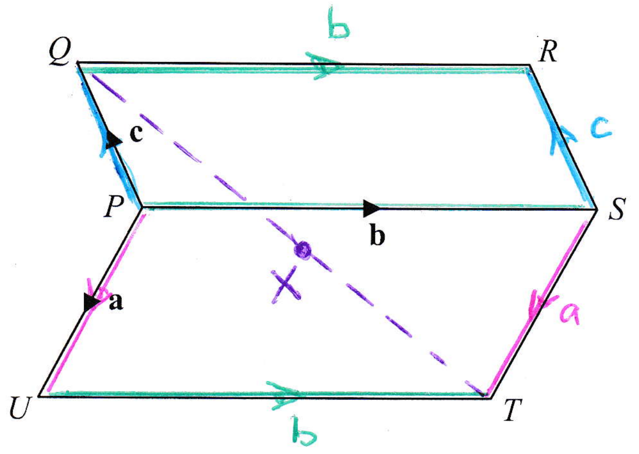


Diagram **NOT** accurately drawn

PQRS and *PSTU* are parallelograms.

$\overrightarrow{PU} = \mathbf{a}$ $\quad \overrightarrow{PS} = \mathbf{b}$ $\quad \overrightarrow{PQ} = \mathbf{c}$

Find, in terms of **a**, **b** and **c**

(i) $\overrightarrow{TQ}$ $= \overrightarrow{TU} + \overrightarrow{UP} + \overrightarrow{PQ}$

$= -b - a + c$

$c - a - b$

B1

(ii) $\overrightarrow{PX}$ where $\boxed{X \text{ is the midpoint of } TQ.}$

Simplify your answer as much as possible.

$\overrightarrow{PX} = \overrightarrow{PU} + \overrightarrow{UT} + \frac{1}{2}\overrightarrow{TQ}$

$= a + b + \frac{1}{2}(c - a - b)$ M1

$= a + b + \frac{1}{2}c - \frac{1}{2}a - \frac{1}{2}b$

$= \frac{1}{2}a + \frac{1}{2}b + \frac{1}{2}c$

A1

$\frac{1}{2}(a + b + c)$

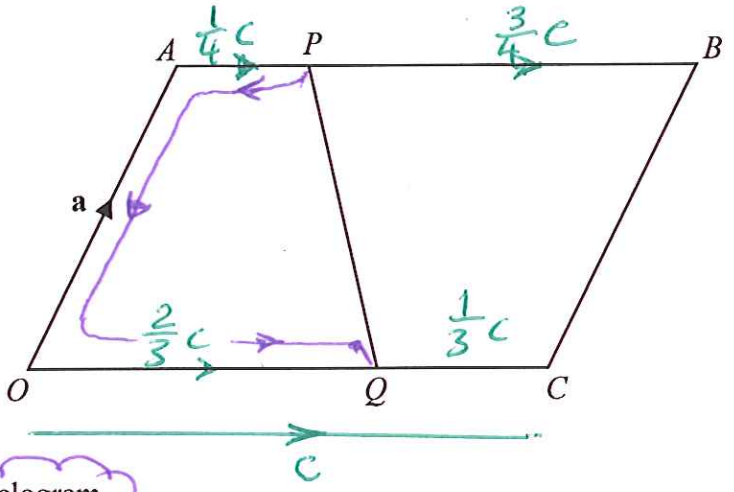


Diagram **NOT** accurately drawn

OABC is a parallelogram.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$

P is the point on *AB* such that $AP = \frac{1}{4}AB$.

Q is the point on *OC* such that $OQ = \frac{2}{3}OC$.

Find, in terms of **a** and **c**, $\overrightarrow{PQ}$.
Give your answer in its simplest form.

$$\overrightarrow{PQ} = \overrightarrow{PA} + \overrightarrow{AO} + \overrightarrow{OQ}$$

$$= -\frac{1}{4}c - a + \frac{2}{3}c \quad \text{M1}$$

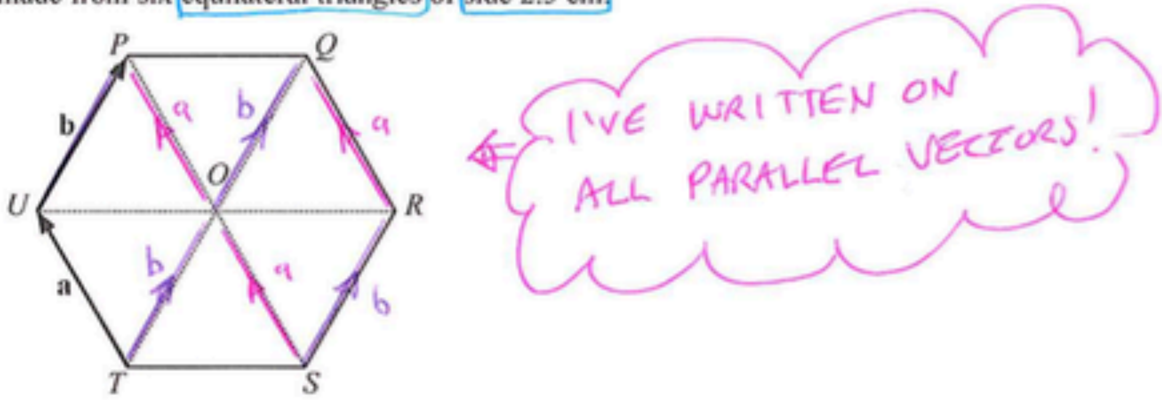
$$= \left(\frac{2}{3} - \frac{1}{4}\right)c - a$$

$$= \frac{5}{12}c - a \quad \text{A1}$$

A1

7. [Edexcel, 2008] Vector Diagrams **[4 Marks]**

PQRSTU is a regular hexagon, centre *O*.
The hexagon is made from six equilateral triangles of side 2.5 cm.



$\overrightarrow{TU} = \mathbf{a}$. $\overrightarrow{UP} = \mathbf{b}$.

(a) Find, in terms of **a** and/or **b**, the vectors

(i) $\overrightarrow{TP}$ $= \overrightarrow{TU} + \overrightarrow{UP}$

$= a + b$

$a + b$ (A1)
(1)

(ii) $\overrightarrow{PO}$

$-a$ (A1)
(1)

(iii) $\overrightarrow{UO}$ $= \overrightarrow{UP} + \overrightarrow{PO}$

$= b - a$

$b - a$ (A1)
(1)

(b) Find the modulus (magnitude) of $\overrightarrow{UR}$.

$2 \times 2 \cdot 5$

5 cm (A1)
(1)

8. [Edexcel, 2015] Vector Diagrams **[4 Marks]**

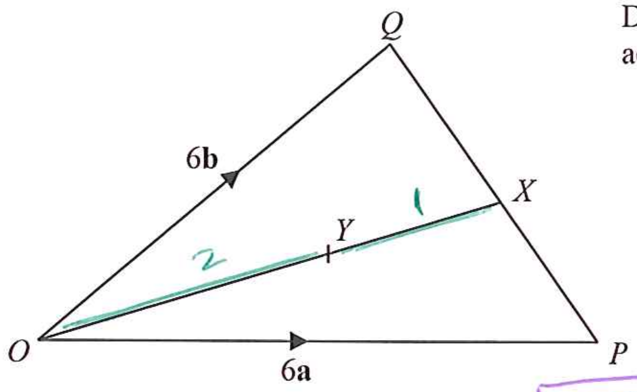


Diagram **NOT** accurately drawn

In triangle OPQ, $\overrightarrow{OP} = 6\mathbf{a}$ and $\overrightarrow{OQ} = 6\mathbf{b}$

X is the $\boxed{\text{midpoint}}$ of PQ.

(a) Find, in terms of **a** and **b**, the vector $\overrightarrow{OX}$
Give your answer in its simplest form.

$\boxed{\text{1ST}}$

$\overrightarrow{QP} = \overrightarrow{QO} + \overrightarrow{OP}$

$= -6b + 6a$

$$\left.\begin{aligned}\overrightarrow{OX} &= \overrightarrow{OQ} + \tfrac{1}{2}\overrightarrow{QP} \\ &= 6b + \tfrac{1}{2}(-6b + 6a)\end{aligned}\right\} \text{M1 [EITHER]}$$

$= 6b - 3b + 3a$

$3a + 3b$ A1 ....
(2)

Y is the point on OX such that $OY : YX = 2 : 1$

(b) Find, in terms of **a** and **b**, the vector $\overrightarrow{QY}$
Give your answer in its simplest form.

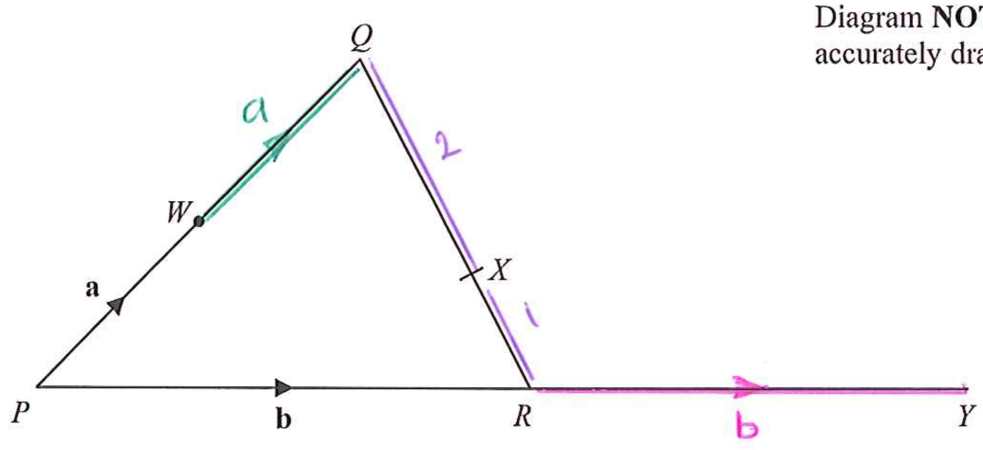
$\overrightarrow{QY} = \overrightarrow{QO} + \overrightarrow{OY}$

$$\left.\begin{aligned}&= \overrightarrow{QO} + \tfrac{2}{3}\overrightarrow{OX} \\ &= -6b + \tfrac{2}{3}(3a + 3b)\end{aligned}\right\} \text{M1 [EITHER]}$$

$= -6b + 2a + 2b$

$2a - 4b$ A1 ....
(2)

Diagram **NOT** accurately drawn



PQR is a triangle.
The midpoint of *PQ* is *W*.
X is the point on *QR* such that $QX : XR = 2 : 1$
PRY is a straight line.

$\overrightarrow{PW} = \mathbf{a}$ $\overrightarrow{PR} = \mathbf{b}$

(a) Find, in terms of **a** and **b**,

(i) $\overrightarrow{QR}$

$= \overrightarrow{QP} + \overrightarrow{PR} \quad = -2a + b$

$b - 2a$ (A1)

(ii) $\overrightarrow{QX}$

$= \frac{2}{3}\overrightarrow{QR} \quad = \frac{2}{3}(b - 2a)$

$\frac{2}{3}b - \frac{4}{3}a$ (A1)

(iii) $\overrightarrow{WX}$

$= \overrightarrow{WQ} + \overrightarrow{QX} \quad = a + \left[\frac{2}{3}b - \frac{4}{3}a\right]$

$\frac{2}{3}b - \frac{1}{3}a$ (A1)

(3)

R is the midpoint of the straight line *PRY*.

(b) Use a vector method to show that *WXY* is a straight line.

$\overrightarrow{XY} = \overrightarrow{XR} + \overrightarrow{RY}$

$= \frac{1}{3}\overrightarrow{QR} + \overrightarrow{RY}$

$= \frac{1}{3} \times [b - 2a] + b$

$= \frac{1}{3}b - \frac{2}{3}a + b$ (B1)

$= \frac{4}{3}b - \frac{2}{3}a \quad = \frac{2}{3}(2b - a)$

NOTE THAT

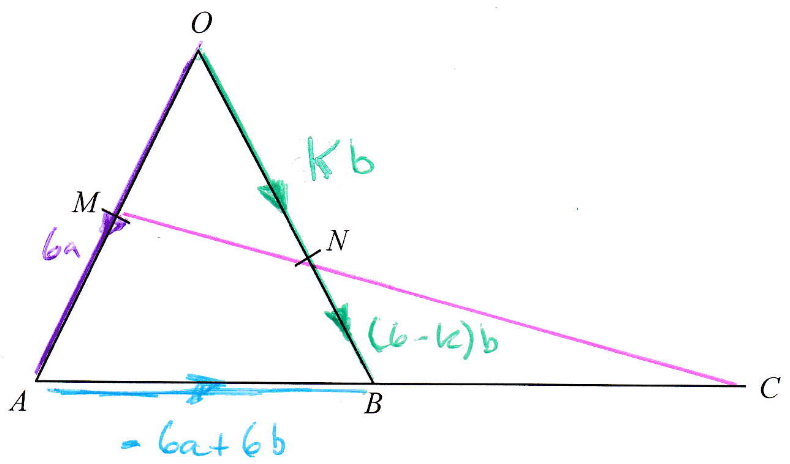
$\overrightarrow{WX} = \frac{1}{3}(2b - a)$ (B1)

BOTH ARE MULTIPLES OF $(2b - a)$ ∴ SAME DIRECTION

ALSO, THEY BOTH GO THROUGH COMMON POINT X

(∴ STRAIGHT LINE)

10. [Edexcel, 2017] Vector Diagrams **[5 Marks]**



OMA, *ONB* and *ABC* are straight lines.
M is the midpoint of *OA*.
B is the midpoint of *AC*.
$\overrightarrow{OA} = \boxed{6\mathbf{a}}$ $\overrightarrow{OB} = \boxed{6\mathbf{b}}$ $\overrightarrow{ON} = k\mathbf{b}$ where k is a scalar quantity.

Given that *MNC* is a straight line, find the value of k.

$\overrightarrow{MN} = -3a + kb$ (M1)

$\overrightarrow{MC} = 3a + 2(-6a + 6b)$

$= -9a + 12b$ (M1)

[NOTE THAT $\overrightarrow{MN}$ MIGHT BE COMPARED WITH $\overrightarrow{NC}$ INSTEAD OF $\overrightarrow{MC}$!]

IF MNC IS A STRAIGHT LINE, THEN

$MC = n \times MN$ [WHERE n IS A SCALAR]

$\Rightarrow -9a + 12b = n(-3a + kb)$ (M1)

$\Rightarrow -9a + 12b = -3na + knb$

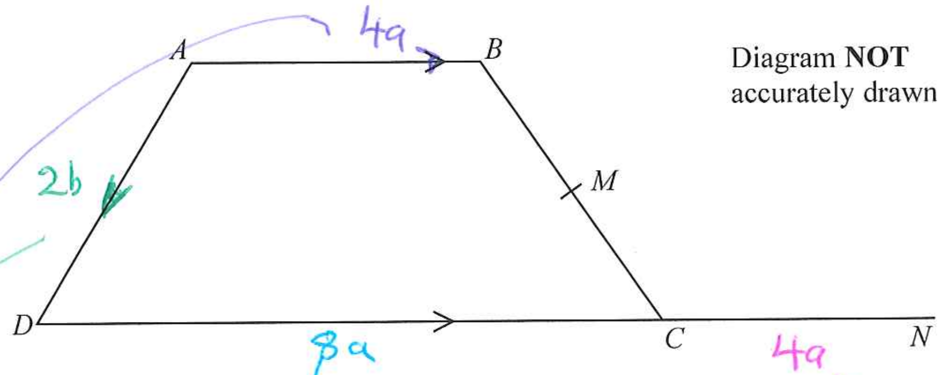
COMPARING THE 'a' COEFFICIENTS...

$-3n = -9$

$\Rightarrow n = \underline{\underline{3}}$ (M1)

COMPARING THE 'b' COEFFICIENTS

$kn = 12 \Rightarrow k \times 3 = 12 \Rightarrow k = \underline{\underline{4}}$ (A1)



AB is parallel to *DC*
$DC = 2AB$ 2ND
M is the midpoint of *BC* $\overrightarrow{BM} = \frac{1}{2}\overrightarrow{BC}$
$\overrightarrow{AD} = 2\mathbf{b}$
$\overrightarrow{AB} = 4\mathbf{a}$ 1ST

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

$\overrightarrow{BC} = -4a + 2b + 8a$ m1 [FOR $\overrightarrow{BC}$]

$= 4a + 2b$

$\Rightarrow \overrightarrow{BM} = \frac{1}{2}(4a + 2b)$

$2a + b$ A1

(2)

N is the point such that *DCN* is a straight line and $DC : CN = 2 : 1$ $\rightarrow \overrightarrow{CN} = 4a$

(b) Show that *AMN* is a straight line.

$\overrightarrow{AM} = \overrightarrow{AB} + \overrightarrow{BM}$

$= 4a + (2a+b) = 6a + b.$

$\overrightarrow{AN} = \overrightarrow{AD} + \overrightarrow{DC} + \overrightarrow{CN}$

$= 2b + 8a + 4a$ m1 [BOTH]

$= 12a + 2b$

$= 2(6a+b)$

$= 2\overrightarrow{AM}$

EXPLANATION

SINCE $\overrightarrow{AM} = k \times \overrightarrow{AN}$ m1 [EXPLANATION]

AM AND AN MUST BE PARALLEL AND SINCE THEY BOTH HAVE POINT A IN COMMON FORM A STRAIGHT LINE

NEEDED!

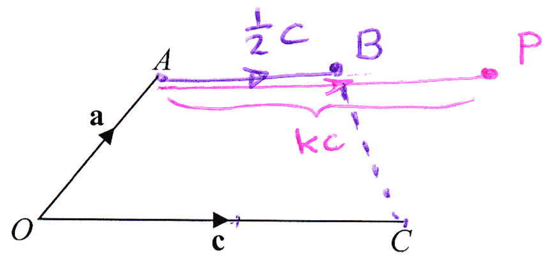


Diagram **NOT** accurately drawn

In the diagram $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$.

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

$\overrightarrow{CA} = \overrightarrow{CO} + \overrightarrow{OA}$

$= -c + a$

$a - c$ (B1)

(1)

(b) The point $\boxed{B}$ is such that $\boxed{\overrightarrow{AB} = \frac{1}{2}\mathbf{c}}$.

Give the mathematical name for the quadrilateral *OABC*.

[AB IS PARALLEL TO OC !]

TRAPEZIUM (B1)

(1)

(c) The point $\boxed{P}$ is such that $\boxed{\overrightarrow{OP} = \mathbf{a} + k\mathbf{c},}$ where $k \geqslant 0$

State the two conditions relating to $\mathbf{a} + k\mathbf{c}$ that must be true for *OAPC* to be a rhombus.

IF A RHOMBUS,

$AP = OC \Rightarrow \underline{\underline{k = 1}}$ (A1)

(2)

ALSO

<u>LENGTH OF a = LENGTH OF c</u> (A1)

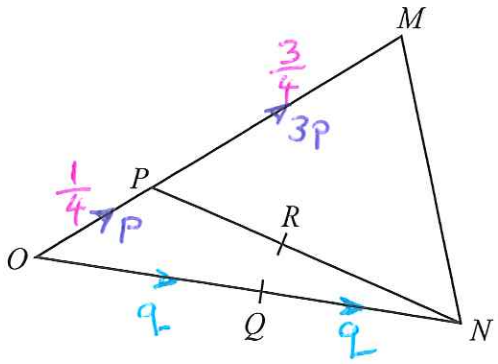


Diagram **NOT** accurately drawn

OMN is a triangle.

P is the point on *OM* such that $OP = \frac{1}{4}OM$

Q is the midpoint of *ON*

R is the midpoint of *PN*

$\overrightarrow{OP} = \mathbf{p}$ $\quad \overrightarrow{OQ} = \mathbf{q}$

(a) Find, in terms of **p** and **q**,

(i) $\overrightarrow{MN}$

$\overrightarrow{MN} = \overrightarrow{MO} + \overrightarrow{ON} = -3p - p + q + q$

$= 2q - 4p$ B1

(ii) $\overrightarrow{PR}$

$= \frac{1}{2}\overrightarrow{PN} = \frac{1}{2}(-p + 2q) \longrightarrow q - \frac{1}{2}p$ B1

(2)

(b) Use a vector method to prove that *QR* is parallel to *OP*

$\overrightarrow{QR} = \overrightarrow{QO} + \overrightarrow{OP} + \overrightarrow{PR}$

$= -q + p + [q - \frac{1}{2}p]$

$= p - \frac{1}{2}p$

$= \frac{1}{2}p$ B1 SINCE $\overrightarrow{QR} = k\overrightarrow{OP}$ B1 [STATEMENT]

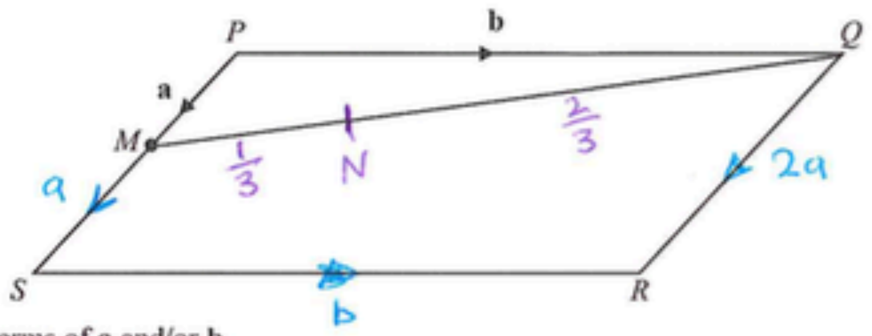
QR IS PARALLEL TO OP.

The diagram shows a parallelogram, $PQRS$.

M is the midpoint of PS.

$\overrightarrow{PM} = \mathbf{a}$ $\quad \overrightarrow{PQ} = \mathbf{b}$

Diagram **NOT** accurately drawn



(a) Find, in terms of **a** and/or **b**,

(i) $\overrightarrow{PS}$

$2a$ (A1)

(ii) $\overrightarrow{PR}$ $= \overrightarrow{PQ} + \overrightarrow{QR}$

$= b + 2a$

$2a + b$ (A1)

(iii) $\overrightarrow{MQ}$ $= \overrightarrow{MP} + \overrightarrow{PQ}$

$= -a + b$

$-a + b$ (A1)

(3)

N is the point on MQ such that $MN = \frac{1}{3}MQ$

(b) Use a vector method to prove that PNR is a straight line.

$\overrightarrow{PN} = \overrightarrow{PM} + \overrightarrow{MN}$

$= \overrightarrow{PM} + \frac{1}{3}\overrightarrow{MQ}$

$= a + \frac{1}{3}(-a + b)$

$= a - \frac{1}{3}a + \frac{1}{3}b$

$= \frac{2}{3}a + \frac{1}{3}b$

(M1) [ANY]

$= \frac{1}{3}(2a + b)$ (B1)

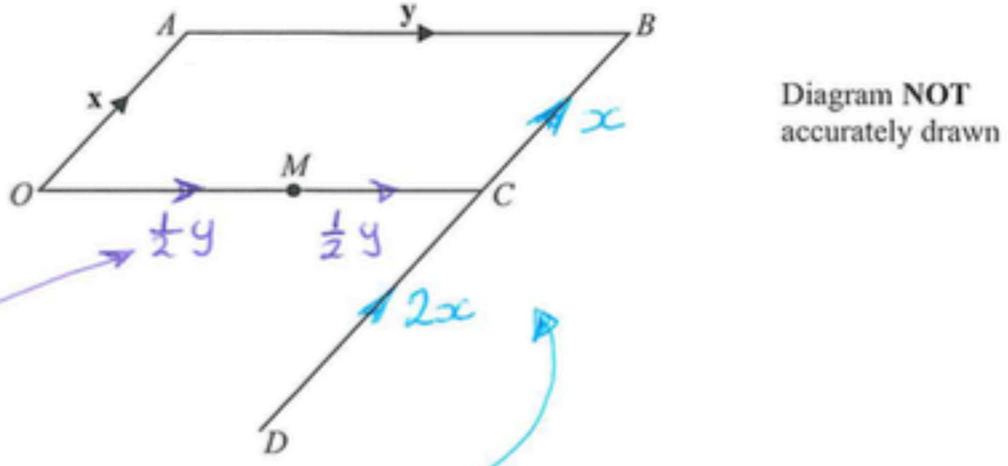
$= \frac{1}{3}\overrightarrow{PR}$

SINCE $\overrightarrow{PN} = k\overrightarrow{PR}$

PN AND PR ARE PARALLEL.

THEY ALSO SHARE A COMMON POINT, AND SO

PNR IS A STRAIGHT LINE



OABC is a parallelogram.
BCD is a straight line.
BD = 3*BC*.
M is the midpoint of *OC*.

$\overrightarrow{OA} = \mathbf{x}$ $\quad \overrightarrow{AB} = \mathbf{y}$

(a) Find, in terms of **x** and **y**,

(i) $\overrightarrow{AM}$

$= \overrightarrow{AO} + \overrightarrow{OM}$

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

A1

$-x + \frac{1}{2}y$

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

(ii) $\overrightarrow{OD}$

$= \overrightarrow{OC} + \overrightarrow{CD}$

$= y - 2x$

A1

$-2x + y$

(2)

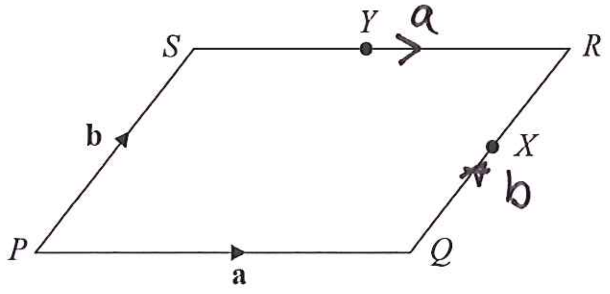
(b) Use your answers to (a)(i) and (ii) to write down two different geometric facts about the lines *AM* and *OD*.

SINCE $\overrightarrow{AM} = \frac{1}{2}\overrightarrow{OD}$, AM AND OD ARE PARALLEL

AM IS HALF THE LENGTH OF OD A1

A1

(2)



PQRS is a parallelogram.
X is the midpoint of *QR* and *Y* is the midpoint of *SR*.
$\overrightarrow{PQ} = \mathbf{a}$ and $\overrightarrow{PS} = \mathbf{b}$.

(a) Write down, in terms of **a** and **b**, expressions for

(i) $\overrightarrow{PX} = \overrightarrow{PQ} + \overrightarrow{QX}$

$= a + \frac{1}{2}b$

$a + \frac{1}{2}b$ A1

(ii) $\overrightarrow{PY} = \overrightarrow{PS} + \overrightarrow{SY}$

$= b + \frac{1}{2}a$

$b + \frac{1}{2}a$ A1

(iii) $\overrightarrow{QS} = \overrightarrow{QP} + \overrightarrow{PS}$

$= -a + b$

$b - a$ A1

(3)

(b) Use a vector method to show that *XY* is parallel to *QS* and that $XY = \frac{1}{2}QS$.

$\overrightarrow{XY} = \overrightarrow{XP} + \overrightarrow{PY}$

$= \left(-a - \frac{1}{2}b\right) + \left(b + \frac{1}{2}a\right)$ M1

$= -\frac{1}{2}a + \frac{1}{2}b$

(2)

$= \frac{1}{2}(b - a)$ A1

$= \frac{1}{2}\overrightarrow{QS}$ (SINCE $\overrightarrow{XY} = k\overrightarrow{QS}$,

XY and QS ARE PARALLEL)

17. [Edexcel, 2016] Vector Diagrams **[5 Marks]**

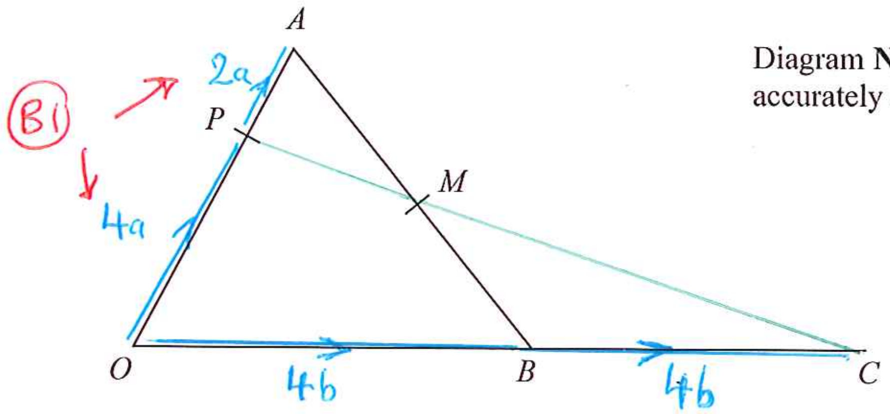


Diagram **NOT** accurately drawn

OAB is a triangle.
P is the point on *OA* such that $\boxed{OP : PA = 2 : 1}$ $= 4a : 2a$

C is the point such that B is the midpoint of *OC*.
M is the midpoint of *AB*.

$\overrightarrow{OA} = 6\mathbf{a}$ $\overrightarrow{OB} = 4\mathbf{b}$

Show that *PMC* is a straight line.

MUST SHOW THAT
$\overrightarrow{PM} = k \times MC$
OR $PM = k \times PC$
OR $MC = k \times PC$

$\overrightarrow{AB} = -6a + 4b$

$\therefore \overrightarrow{AM} = \frac{1}{2}(-6a + 4b)$

$= -3a + 2b$ A1 [FOR $\overrightarrow{AM}$ OR $\overrightarrow{BM}$]

$\overrightarrow{PM} = \overrightarrow{PA} + \overrightarrow{AM}$

$= 2a + (-3a + 2b)$

$= -a + 2b$ M1

$\overrightarrow{PC} = -4a + 8b$

$= 4(-a + 2b)$ M1

$= 4\overrightarrow{PM}$

SINCE $\overrightarrow{PC} = k\overrightarrow{PM}$ THEY ARE PARALLEL

SINCE THEY ALSO BOTH GO THROUGH POINT P THEY MUST FORM A STRAIGHT LINE. A1

OABC is a parallelogram.

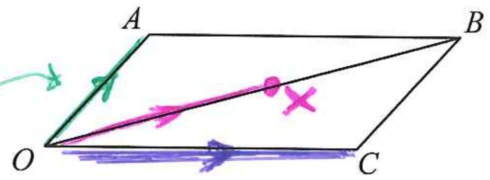


Diagram **NOT** accurately drawn

$\overrightarrow{OA} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$, $\overrightarrow{OC} = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$.

(a) Find the vector $\overrightarrow{OB}$ as a column vector.

$\overrightarrow{OB} = \overrightarrow{OA} + \overrightarrow{AB} = \begin{pmatrix} 1 \\ 2 \end{pmatrix} + \begin{pmatrix} 4 \\ 0 \end{pmatrix}$

$\begin{pmatrix} 5 \\ 2 \end{pmatrix}$ A1

(1)

X is the point on *OB* such that $OX = kOB$, where $0 < k < 1$

(b) Find, in terms of *k*, the vectors

(i) $\overrightarrow{OX}$, $= k \times \overrightarrow{OB} = k\begin{pmatrix} 5 \\ 2 \end{pmatrix} = \begin{pmatrix} 5k \\ 2k \end{pmatrix}$ A1

(ii) $\overrightarrow{AX}$, $= \overrightarrow{AO} + \overrightarrow{OX} = -\begin{pmatrix} 1 \\ 2 \end{pmatrix} + \begin{pmatrix} 5k \\ 2k \end{pmatrix} = \begin{pmatrix} 5k-1 \\ 2k-2 \end{pmatrix}$ A1

(iii) $\overrightarrow{XC}$. $= \overrightarrow{XO} + \overrightarrow{OC}$

$= -\begin{pmatrix} 5k \\ 2k \end{pmatrix} + \begin{pmatrix} 4 \\ 0 \end{pmatrix} = \begin{pmatrix} 4-5k \\ -2k \end{pmatrix}$ A1

(3)

(c) Find the value of *k* for which $\overrightarrow{AX} = \overrightarrow{XC}$.

$\begin{pmatrix} 5k-1 \\ 2k-2 \end{pmatrix} = \begin{pmatrix} 4-5k \\ -2k \end{pmatrix} \Rightarrow 5k - 1 = 4 - 5k$ M1

$\Rightarrow 10k = 5 \longrightarrow k = \frac{1}{2}$ A1

(2)

(d) Use your answer to part (c) to show that the diagonals of the parallelogram *OABC* bisect one another.

SINCE $k = \frac{1}{2}$, X IS MIDPOINT OF $\overrightarrow{OB}$ M1

$\overrightarrow{AX} = \begin{pmatrix} 5 \times 0.5 - 1 \\ 2 \times 0.5 - 2 \end{pmatrix} = \begin{pmatrix} 1.5 \\ -1 \end{pmatrix}$

$\overrightarrow{XC} = \begin{pmatrix} 4 - 5 \times 0.5 \\ -2 \times 0.5 \end{pmatrix} = \begin{pmatrix} 1.5 \\ -1 \end{pmatrix}$

SAME SO X IS MIDPOINT OF AC M1

Disclaimer

While reasonable endeavours have been used to verify the accuracy of these solutions, these solutions are provided on an “as is” basis and no warranties are made of any kind, whether express or implied, in relation to these solutions.

There is no warranty that these solutions will meet Your requirements or provide the results which You want, or that they are complete, or that they are error-free. If You find anything confusing within these solutions then it is Your responsibility to seek clarification from Your teacher, tutor or mentor.

Please report any errors or omissions that You find*. These solutions will be updated to correct errors that are discovered. It is recommended that You always check that You have the most up-to-date version of these solutions.

The methods used in these solutions, where relevant, are methods which have been successfully used with students. The method shown for a particular question is not always the only method and there is no claim that the method that is used is necessarily the most efficient or ‘best’ method. From time to time, a solution to a question might be updated to show a different method if it is judged that it is a good idea to do so.

Sometimes a method used in these solutions might be unfamiliar to You. If You are able to use a different method to obtain the correct answer then You should consider to keep using your existing method and not change to the method that is used here. However, the choice of method is always up to You and it is often useful if You know more than one method to solve a particular type of problem.

Within these solutions there is an indication of where marks **might** be awarded for each question. B marks, M marks and A marks have been used in a similar, but **not identical**, way that an exam board uses these marks within their mark schemes. This slight difference in the use of these marking symbols has been done for simplicity and convenience. Sometimes B marks, M marks and A marks have been interchanged, when compared to an examiners’ mark scheme and sometimes the marks have been awarded for different aspects of a solution when compared to an examiners’ mark scheme.

B1 – This is an unconditional accuracy mark (the specific number, word or phrase must be seen. This type of mark cannot be given as a result of ‘follow through’).

M1 – This is a method mark. Method marks have been shown in places where they might be awarded for the method that is shown. If You use a different method to get a correct answer, then the same number of method marks would be awarded but it is not practical to show all possible methods, and the way in which marks might be awarded for their use, within these particular solutions. When appropriate, You should seek clarity and download the relevant examiner mark scheme from the exam board’s web site.

A1 – These are accuracy marks. Accuracy marks are typically awarded after method marks. If the correct answer is obtained, then You should normally (but not always) expect to be awarded all of the method marks (provided that You have shown a method) and all of the accuracy marks.

Note that some questions contain the words ‘show that’, ‘show your working out’, or similar. These questions require working out to be shown. Failure to show sufficient working out is likely to result in no marks being awarded, even if the final answer is correct.

* The best way to inform of errors or omissions is a direct Twitter message to @Maths4Everyone

Note: “You/Your” means the person who is using these solutions.