Edexcel GCSE

Mathematics (Linear) – 1MA0

VECTORS

Materials required for examination
Ruler graduated in centimetres and millimetres, protractor, compasses, pen, HB pencil, eraser.
Tracing paper may be used.

Items included with question papers
Nil

Instructions

Use black ink or ball-point pen.
Fill in the boxes at the top of this page with your name, centre number and candidate number.
Answer all questions.
Answer the questions in the spaces provided – there may be more space than you need.
Calculators may be used.

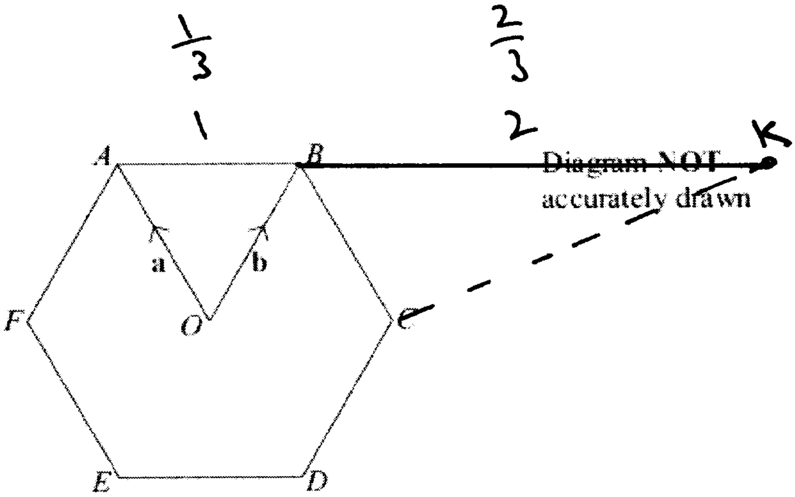
Information

The marks for each question are shown in brackets – use this as a guide as to how much time to spend on **each** question.
Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed – you should take particular care on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.

Advice

Read each question carefully before you start to answer it.
Keep an eye on the time.
Try to answer every question.
Check your answers if you have time at the end.

1.



ABCDEF is a regular hexagon, with centre *O*.

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

(a) Write the vector $\overrightarrow{AB}$ in terms of **a** and **b**.

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$

$= -a + b$.

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

(1)

The line *AB* is extended to the point *K* so that *AB* : *BK* = 1 : 2

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

$\overrightarrow{CK} = \overrightarrow{CB} + \overrightarrow{BK}$

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

$= a - 2a + 2b$.

$= -a + 2b$.

$\overrightarrow{CK} = -a + 2b$.

(3)

(4 marks)

2.

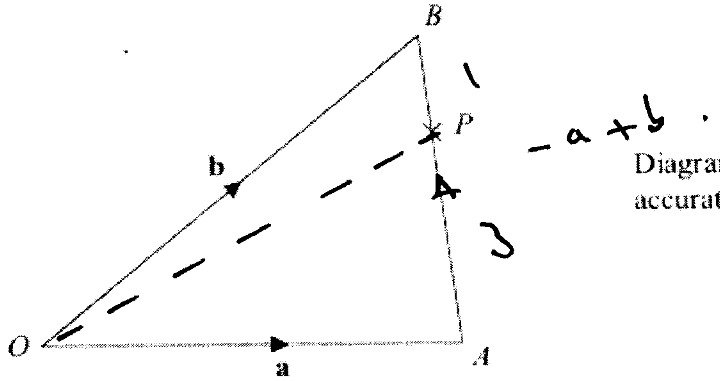


Diagram **NOT** accurately drawn

OAB is a triangle.

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

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

$$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$$
$$= -a + b$$

$\overrightarrow{AB} = -a + b$ ....

(1)

P is the point on *AB* such that *AP* : *PB* = 3 : 1

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

$$\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AP}$$
$$= a + \frac{3}{4}(\overrightarrow{AB})$$
$$= a + \frac{3}{4}(-a + b)$$
$$= \frac{1}{4}a + \frac{3}{4}b .$$

$\overrightarrow{OP} = \frac{1}{4}a + \frac{3}{4}b .$ ....

(3)

(4 marks)

3.

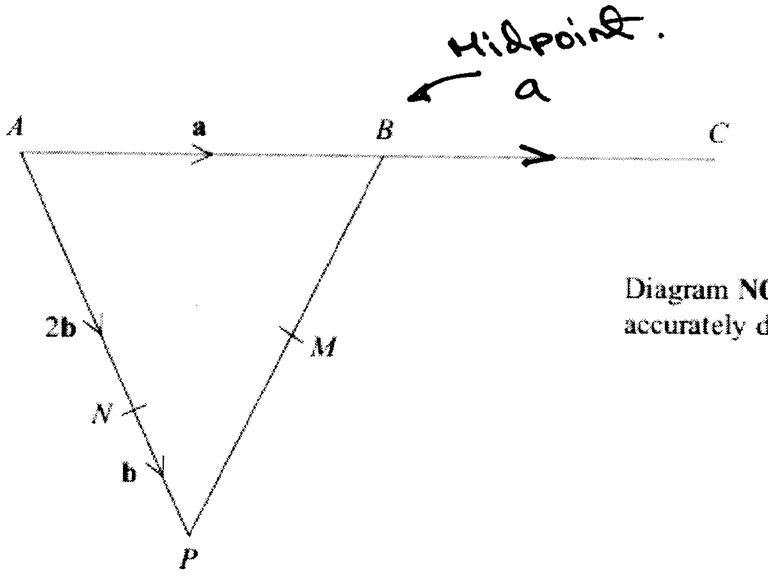


Diagram **NOT** accurately drawn

APB is a triangle.
N is a point on *AP*.

$\overrightarrow{AB} = \mathbf{a}$ $\qquad \overrightarrow{AN} = 2\mathbf{b}$ $\qquad \overrightarrow{NP} = \mathbf{b}$

(a) Find the vector $\overrightarrow{PB}$, in terms of **a** and **b**.

$\overrightarrow{PB} = \overrightarrow{PA} + \overrightarrow{AB}$

$= -3b + a$

$\overrightarrow{PB} = a - 3b$.

(1)

B is the midpoint of *AC*.
M is the midpoint of *PB*.

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

$\overrightarrow{NM} = \overrightarrow{MC}$ (or a multiple of)

$\boxed{\overrightarrow{NM}} = \overrightarrow{NP} + \overrightarrow{PM}$.

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

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

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

$\therefore \overrightarrow{NM} = \frac{1}{2}a - \frac{1}{2}b$

$\boxed{\overrightarrow{MC}} = \overrightarrow{MB} + \overrightarrow{BC}$

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

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

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

$\overrightarrow{MC} = \frac{3}{2}a - \frac{3}{2}b$

(4)

(5 marks)

NMC is a straight line as $\overrightarrow{NM}$ & $\overrightarrow{MC}$ are both multiples of $a - b$.

4.

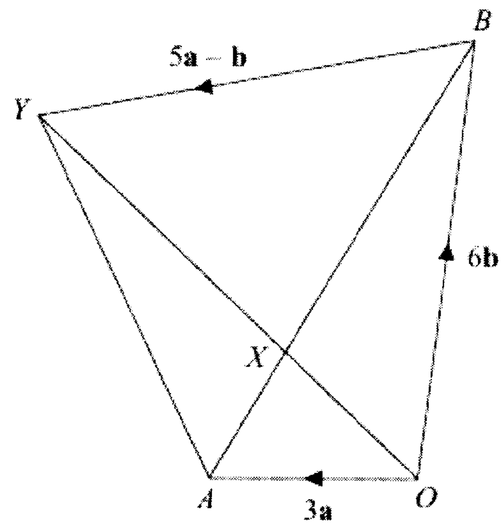


Diagram **NOT** accurately drawn

$OAYB$ is a quadrilateral.

$\overrightarrow{OA} = 3\mathbf{a}$

$\overrightarrow{OB} = 6\mathbf{b}$

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

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$
$= -3a + 6b$

$\overrightarrow{AB} = -3a + 6b$

(1)

X is the point on AB such that $AX : XB = 1 : 2$

and $\overrightarrow{BY} = 5\mathbf{a} - \mathbf{b}$

* (b) Prove that $\overrightarrow{OX} = \frac{2}{5}\overrightarrow{OY}$

$\overrightarrow{OY} = \overrightarrow{OB} + \overrightarrow{BY}$
$= 6b + 5a - b$

$\overrightarrow{OY} = 5a + 5b$

$\overrightarrow{OX} = \overrightarrow{OA} + \overrightarrow{AX}$
$= 3a + \frac{1}{3}(-3a + 6b)$
$= 3a - a + 2b$

$\overrightarrow{OX} = 2a + 2b$

$\overrightarrow{OX} = \frac{2}{5}\overrightarrow{OY}$

$2a + 2b = \frac{2}{5}(5a + 5b)$

$2a + 2b = 2a + 2b$

(4)

(5 marks)

5.

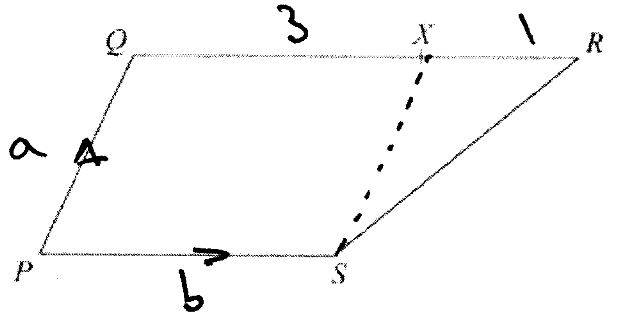


Diagram **NOT** accurately drawn

PQRS is a trapezium.
PS is parallel to *QR*.
QR = 2*PS*

$\overrightarrow{PQ} = \mathbf{a}$ $\qquad \overrightarrow{PS} = \mathbf{b}$

X is the point on *QR* such that *QX* : *XR* = 3 : 1

Express in terms of **a** and **b**.

(i) $\overrightarrow{PR}$

$$\overrightarrow{PR} = \overrightarrow{PQ} + \overrightarrow{QR}$$
$$= a + 2b$$

(2)

$\overrightarrow{PR} = a + 2b$ ....

(ii) $\overrightarrow{SX}$

$$\overrightarrow{SX} = \overrightarrow{SP} + \overrightarrow{PQ} + \overrightarrow{QX}$$
$$= -b + a + \frac{3}{4}(2b)$$
$$= -b + a + \frac{6}{4}b$$
$$= a + 2b$$

(3)

$\overrightarrow{SX} = a + 2b$ ....

(5 marks)

6.

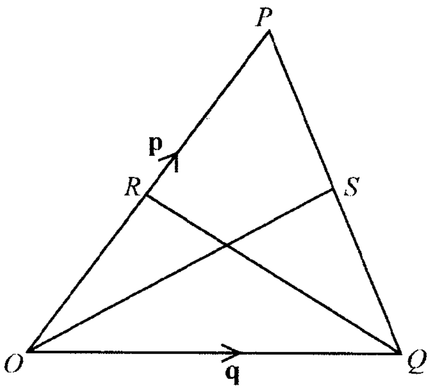


Diagram **NOT** accurately drawn

OPQ is a triangle.

R is the midpoint of OP.

S is the midpoint of PQ.

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

(i) Find $\overrightarrow{OS}$ in terms of p and q.

$$\overrightarrow{OS} = \overrightarrow{OP} + \overrightarrow{PS}$$
$$= p + \tfrac{1}{2}(PQ)$$
$$= p + \tfrac{1}{2}(-p + q)$$
$$= p - \tfrac{1}{2}p + \tfrac{1}{2}q$$
$$\overrightarrow{OS} = \tfrac{1}{2}(p+q)$$

$\overrightarrow{OS}$ = ...

(ii)Show that RS is parallel to OQ.

$\overrightarrow{RS}$ is parallel to OQ if same or a multiple of q.

$$\overrightarrow{RS} = \overrightarrow{RO} + \overrightarrow{OS}$$
$$= -\tfrac{1}{2}p + \tfrac{1}{2}(p+q)$$
$$= -\tfrac{1}{2}p + \tfrac{1}{2}p + \tfrac{1}{2}q$$

$\overrightarrow{RS} = \frac{1}{2}q$ which is parallel as a multiple of q.

(5 marks)

6.

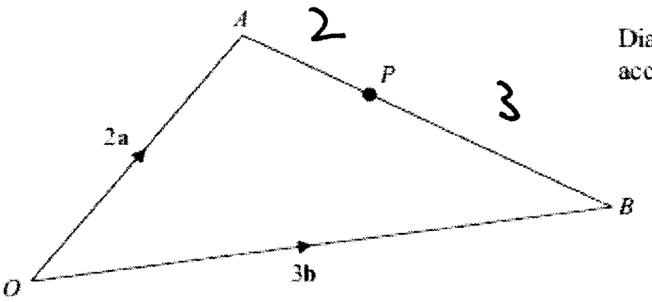


Diagram NOT accurately drawn

OAB is a triangle.

$\overrightarrow{OA} = 2\mathbf{a}$

$\overrightarrow{OB} = 3\mathbf{b}$

(a) Find AB in terms of $\mathbf{a}$ and $\mathbf{b}$.

$$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$$
$$= -2a + 3b$$

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

(1)

P is the point on AB such that $AP : PB = 2 : 3$

(b) Show that $\overrightarrow{OP}$ is parallel to the vector $\mathbf{a} + \mathbf{b}$.

$\overrightarrow{OP}$ is parallel if same or a multiple of $a+b$

$$\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AP}$$
$$= 2a + \frac{2}{5}\left(\overrightarrow{AB}\right)$$
$$= 2a + \frac{2}{5}(-2a + 3b)$$
$$= 2a - \frac{4}{5}a^{*} + \frac{6}{5}b$$

$$* \; 2a - \frac{4}{5}a$$
$$= \frac{2}{1}a - \frac{4}{5}a$$
$$= \frac{10}{5}a - \frac{4}{5}a$$
$$= \frac{6}{5}a.$$

(3)

(4 marks)

$$\overrightarrow{OP} = \frac{6}{5}a + \frac{6}{5}b \quad \text{or} \quad \frac{6}{5}(a+b)$$

$\therefore$ $\overrightarrow{OP}$ is parallel as a multiple of $a+b$.