

Edexcel GCSE

Mathematics (Linear) – 1MA0

VECTORS

SOLUTIONS. 108

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

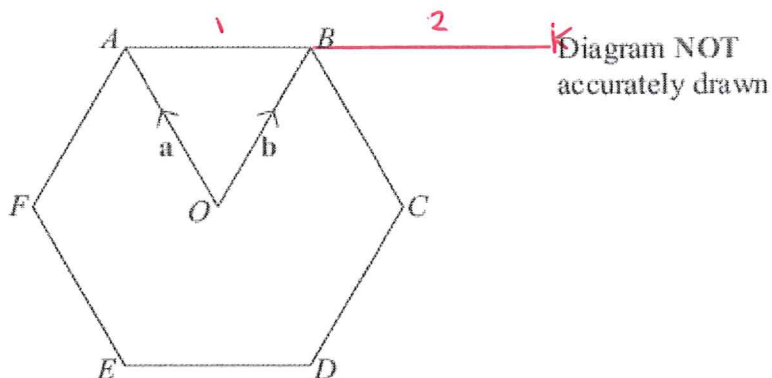
Read each question carefully before you start to answer it.

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 .

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

(a) Write the vector \vec{AB} in terms of \mathbf{a} and \mathbf{b} .

$$\underline{-\mathbf{a} + \mathbf{b}} \quad (1)$$

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

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

$$\vec{AB} = -\mathbf{a} + \mathbf{b}$$

$$\vec{BK} = -2\mathbf{a} + 2\mathbf{b}$$

$$\vec{CK} = -\mathbf{a} + 2\mathbf{b}$$

$$\underline{-\mathbf{a} + 2\mathbf{b}} \quad (3)$$

(4 marks)

2.

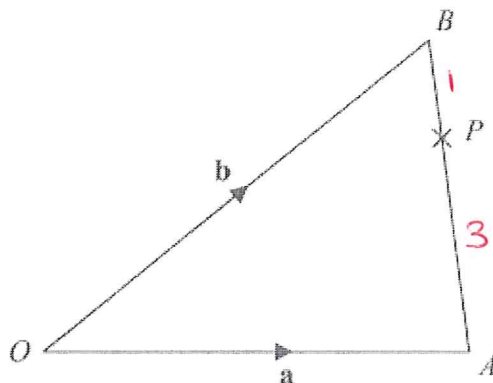


Diagram NOT
accurately drawn

OAB is a triangle.

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

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

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

$$-\mathbf{a} + \mathbf{b}$$

(1)

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

(b) Find \overrightarrow{OP} in terms of \mathbf{a} and \mathbf{b} .

Give your answer in its simplest form.

$$\overrightarrow{AP} = \frac{3}{4}(-\mathbf{a} + \mathbf{b})$$

$$\overrightarrow{AP} = -\frac{3}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$$

$$\overrightarrow{OP} = \mathbf{a} - \frac{3}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$$

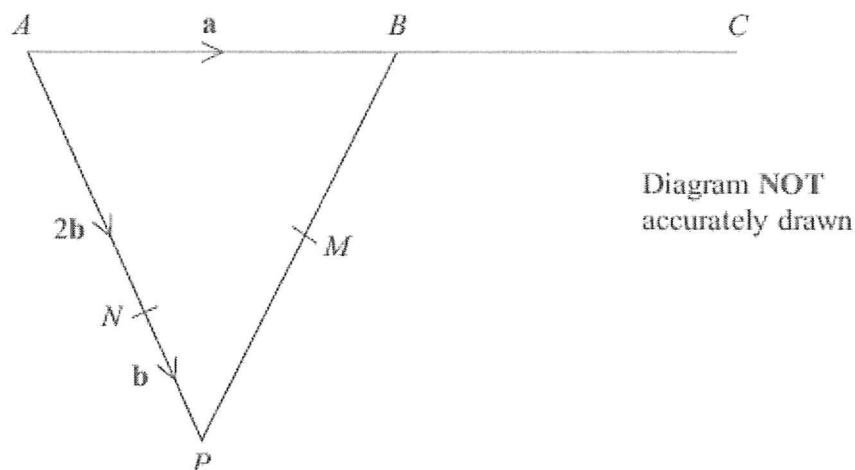
$$= \frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$$

$$\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$$

(3)

(4 marks)

3.



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

$$\overrightarrow{AB} = \mathbf{a}$$

$$\overrightarrow{AN} = 2\mathbf{b}$$

$$\overrightarrow{NP} = \mathbf{b}$$

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

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

$$\overrightarrow{PB} = -3\mathbf{b} + \mathbf{a}$$

$$-3\mathbf{b} + \mathbf{a}$$

(1)

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

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

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

$$\overrightarrow{NM} = \mathbf{b} + \left(-\frac{3}{2}\mathbf{b} + \frac{1}{2}\mathbf{a}\right)$$

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

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

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

(4)

Therefore NMC is a straight line

(5 marks)

$$\text{as } \overrightarrow{MC} = 3\overrightarrow{NM}$$

4.

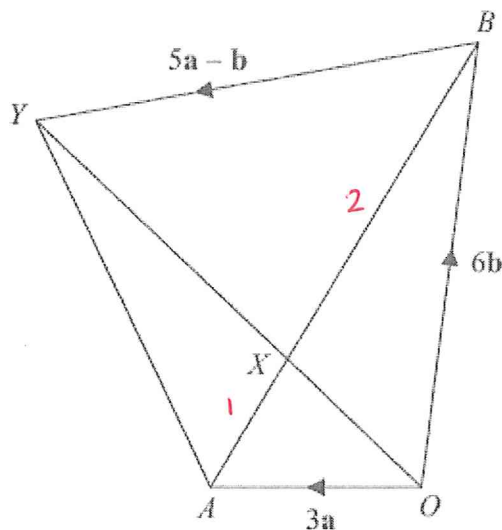


Diagram NOT
accurately drawn

$OAYB$ is a quadrilateral.

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

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

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

$$\underline{\underline{-3\mathbf{a} + 6\mathbf{b}}} \quad (1)$$

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

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

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

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

$$\overrightarrow{OX} = 3\mathbf{a} + (-\mathbf{a} + 2\mathbf{b}) = 2\mathbf{a} + 2\mathbf{b}$$

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

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

(4)
(5 marks)

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

5.

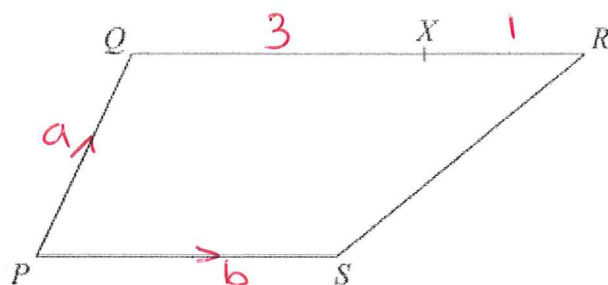


Diagram **NOT**
accurately drawn

$PQRS$ is a trapezium.

PS is parallel to QR .

$QR = 2PS$

$$\vec{QR} = 2\vec{b}$$

$$\vec{PQ} = \mathbf{a}$$

$$\vec{PS} = \mathbf{b}$$

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

Express in terms of \mathbf{a} and \mathbf{b} .

(i) \vec{PR}

$$\vec{PR} = \mathbf{a} + 2\mathbf{b}$$

(2)

$$\underline{\mathbf{a} + 2\mathbf{b}}$$

(ii) \vec{SX}

$$\vec{QX} = \frac{3}{4}(2\mathbf{b}) = \frac{3}{2}\mathbf{b}$$

(3)

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

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

$$\underline{\frac{1}{2}\mathbf{b} + \mathbf{a}}$$

(5 marks)

6.

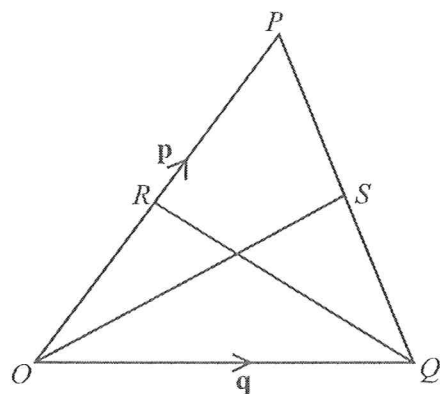


Diagram NOT
accurately drawn

OPQ is a triangle.

R is the midpoint of OP .

S is the midpoint of PQ .

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

$$\begin{aligned}\overrightarrow{PQ} &= -p + q \\ \overrightarrow{PS} &= -\frac{1}{2}p + \frac{1}{2}q\end{aligned}$$

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

$$\begin{aligned}\overrightarrow{OS} &= p - \frac{1}{2}p + \frac{1}{2}q \\ &= \frac{1}{2}p + \frac{1}{2}q\end{aligned}$$

$$\overrightarrow{OS} = \dots\dots\dots \frac{1}{2}(p+q)$$

(ii) Show that RS is parallel to OQ .

$$\overrightarrow{RP} = \frac{1}{2}p$$

$$\begin{aligned}\overrightarrow{RS} &= \frac{1}{2}p - \frac{1}{2}p + \frac{1}{2}q \\ &= \frac{1}{2}q\end{aligned}$$

\therefore As $\overrightarrow{OQ} = q$, \overrightarrow{RS} is parallel

(5 marks)

6.

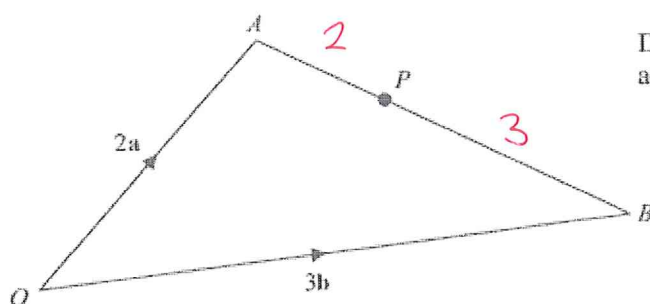


Diagram NOT
accurately drawn

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} .

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

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

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

$$\overrightarrow{AP} = \frac{2}{5}(-2\mathbf{a} + 3\mathbf{b})$$

$$= -\frac{4}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}$$

$$\overrightarrow{OP} = 2\mathbf{a} - \frac{4}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}$$

$$= \frac{6}{5}\mathbf{a} + \frac{6}{5}\mathbf{b}$$

$$= \frac{6}{5}(\mathbf{a} + \mathbf{b})$$

(3)

(4 marks)

Therefore \overrightarrow{OP} is parallel as it has been increased by a scale factor of $\frac{6}{5}$.