

Vectors

Introduction to Column Vectors / Representing Vectors as Diagrams / Magnitude of a Vector / Position & Displacement Vectors / Finding Vector Paths / Problem Solving with Vectors

Medium (9 questions)	/18
Hard (7 questions)	/20
Very Hard (9 questions)	/37
Total Marks	/75

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Medium Questions

1 (a) $\mathbf{u} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$ $\mathbf{v} = \begin{pmatrix} -12 \\ 5 \end{pmatrix}$

Find $\mathbf{u} - 2\mathbf{v}$.

(2 marks)

(b) Find $|\mathbf{v}|$.

(2 marks)

2 Ahmed finds the magnitude of the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.

From this list, select the correct calculation.

A. $\sqrt{2^2 + -3^2}$

B. $2^2 - 3^2$

C. $\sqrt{2^2 - 3^2}$

D. $2^2 + (-3^2)$

E. $\sqrt{2^2 + (-3)^2}$

(1 mark)

3 $\mathbf{m} = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$

Find $3\mathbf{m}$.

$\begin{pmatrix} \\ \end{pmatrix}$

(1 mark)

- 4 Point A has coordinates $(6, 4)$ and point B has coordinates $(2, 7)$. Write $\overrightarrow{AB}$ as a column vector.

$$\overrightarrow{AB} = \begin{pmatrix} \\ \end{pmatrix}$$

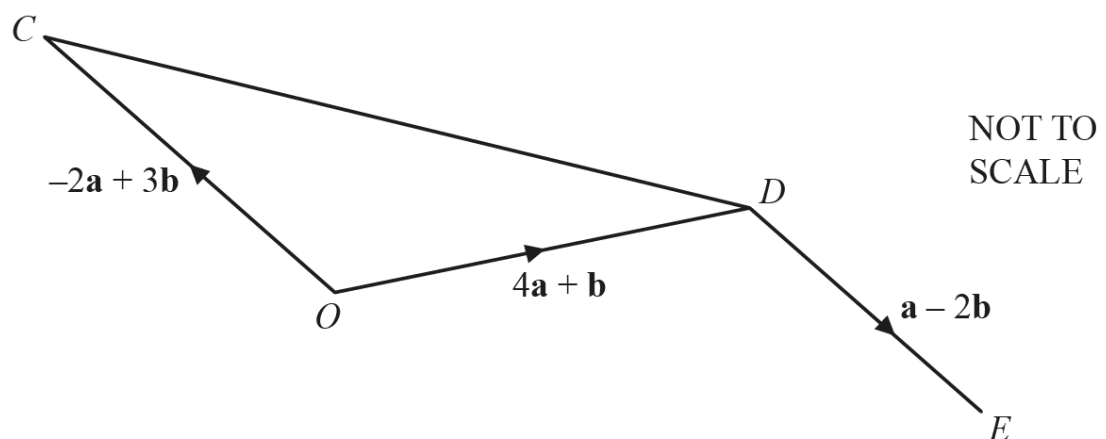
(1 mark)

- 5 O is the origin, $\overrightarrow{OA} = 2\mathbf{x} + 3\mathbf{y}$ and $\overrightarrow{BA} = \mathbf{x} - 4\mathbf{y}$.

Find the position vector of B , in terms of $\mathbf{x}$ and $\mathbf{y}$, in its simplest form.

(2 marks)

6 (a)



In the diagram, O is the origin, $\overrightarrow{OC} = -2\mathbf{a} + 3\mathbf{b}$ and $\overrightarrow{OD} = 4\mathbf{a} + \mathbf{b}$.

Find $\overrightarrow{CD}$, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form.

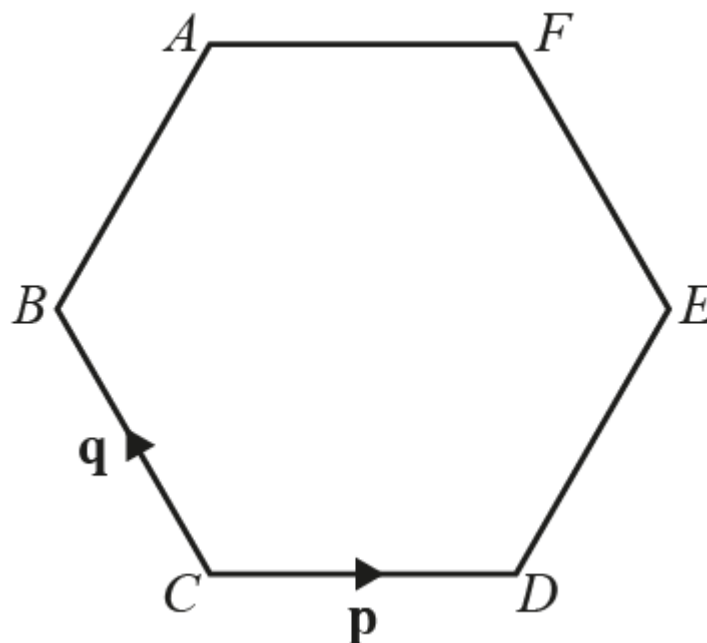
$\overrightarrow{CD}$

(2 marks)

- (b) $\overrightarrow{DE} = \mathbf{a} - 2\mathbf{b}$ Find the position vector of E , in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form.

(2 marks)

7



The diagram shows a regular hexagon $ABCDEF$. $\overrightarrow{CD} = \mathbf{p}$ and $\overrightarrow{CB} = \mathbf{q}$.

Find $\overrightarrow{CA}$, in terms of $\mathbf{p}$ and $\mathbf{q}$, giving your answer in its simplest form.

$\overrightarrow{CA} = \dots\dots\dots$

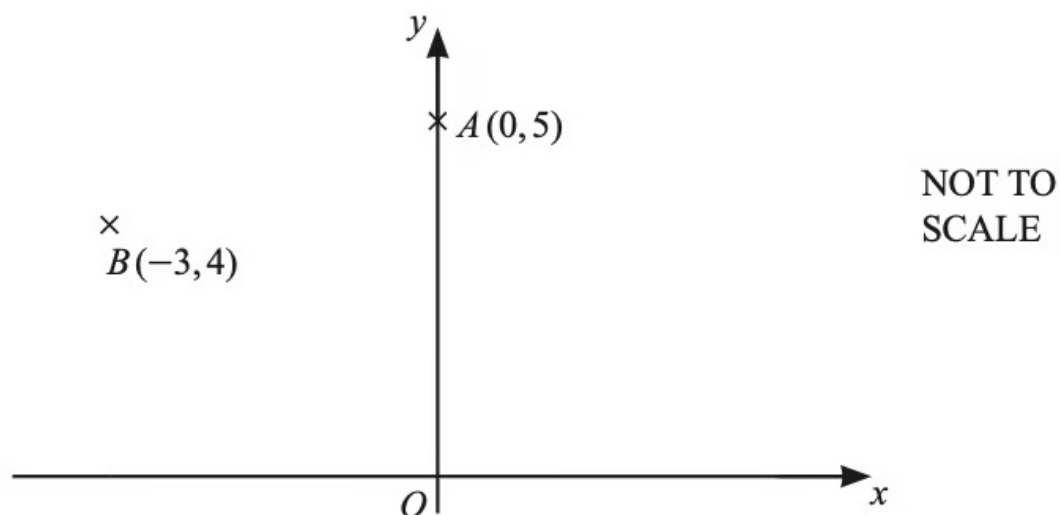
(2 marks)

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

Find the coordinates of B .

(..... ,)

(1 mark)



- i) Write $\vec{OA}$ as a column vector.

$$\vec{OA} = \begin{pmatrix} \quad \\ \quad \end{pmatrix} [1]$$

- ii) Write $\vec{AB}$ as a column vector.

$$\vec{AB} = \begin{pmatrix} \quad \\ \quad \end{pmatrix} [1]$$

(2 marks)

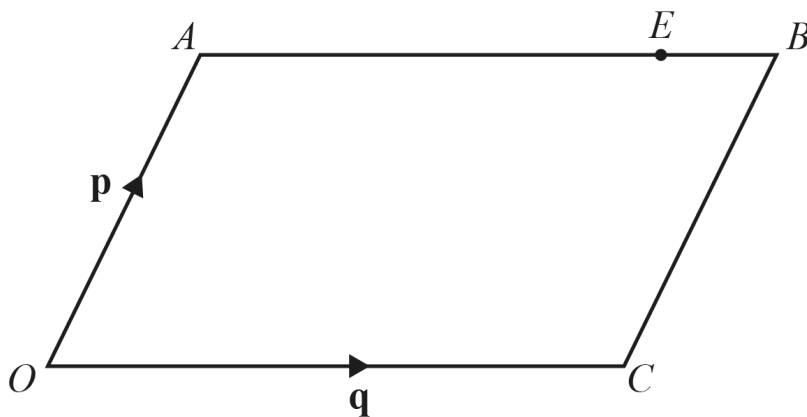
Hard Questions

1 $\vec{GH} = \frac{5}{6}(2\mathbf{p} + \mathbf{q})$ $\vec{JK} = \frac{5}{18}(2\mathbf{p} + \mathbf{q})$

Write down two facts about the geometrical relationship between the vectors $\vec{GH}$ and $\vec{JK}$.

(2 marks)

2



NOT TO
SCALE

a parallelogram.

$\vec{OA} = \mathbf{p}$ and $\vec{OC} = \mathbf{q}$.

E is the point on AB such that $AE : EB = 3 : 1$.

Find $\vec{OE}$, in terms of $\mathbf{p}$ and $\mathbf{q}$, in its simplest form.

$\vec{OE} = \dots\dots\dots$

(2 marks)

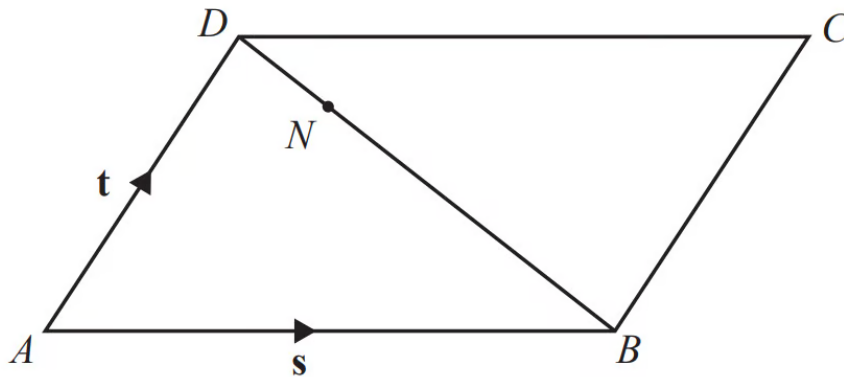
3 $\vec{XY} = 3\mathbf{a} + 2\mathbf{b}$ and $\vec{ZY} = 6\mathbf{a} + 4\mathbf{b}$.

Write down two statements about the relationship between the points X , Y and Z .

- 1
2

(2 marks)

4 (a)



NOT TO
SCALE

$ABCD$ is a parallelogram.

N is the point on BD such that $BN:ND = 4:1$.

$\vec{AB} = \mathbf{s}$ and $\vec{AD} = \mathbf{t}$.

Find, in terms of $\mathbf{s}$ and $\mathbf{t}$, an expression in its simplest form for $\vec{BD}$.

$$\vec{BD} = \dots\dots\dots$$

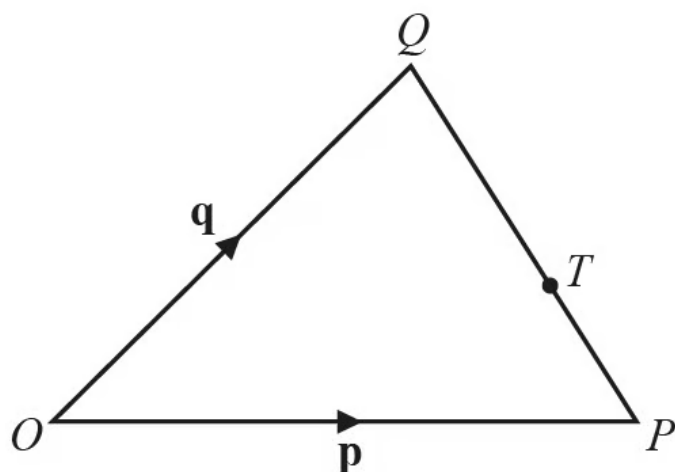
(1 mark)

(b) Find, in terms of $\mathbf{s}$ and $\mathbf{t}$, an expression in its simplest form for $\vec{CN}$.

$$\vec{CN} = \dots\dots\dots$$

(3 marks)

5

NOT TO
SCALE

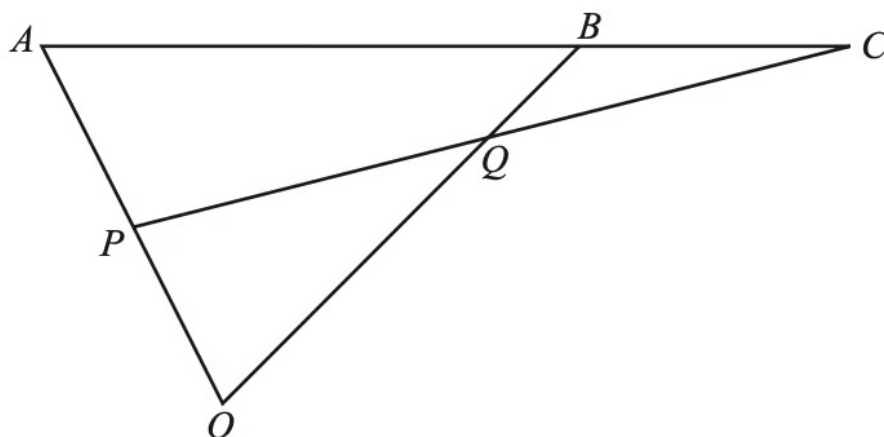
O is the origin, $\vec{OP} = \mathbf{p}$ and $\vec{OQ} = \mathbf{q}$.
 $QT : TP = 2 : 1$

Find the position vector of T .

Give your answer in terms of $\mathbf{p}$ and $\mathbf{q}$, in its simplest form.

(2 marks)

6 (a)

NOT TO
SCALE

OAB is a triangle and ABC and PQC are straight lines.

P is the midpoint of OA , Q is the midpoint of PC and $OQ : QB = 3 : 1$.

$\vec{OA} = 4\mathbf{a}$ and $\vec{OB} = 8\mathbf{b}$.

Find, in terms of **a** and/or **b**, in its simplest form

i) $\overrightarrow{AB}$,

$$\overrightarrow{AB} = \dots\dots\dots [1]$$

ii) $\overrightarrow{OQ}$,

$$\overrightarrow{OQ} = \dots\dots\dots [1]$$

iii) $\overrightarrow{PQ}$,

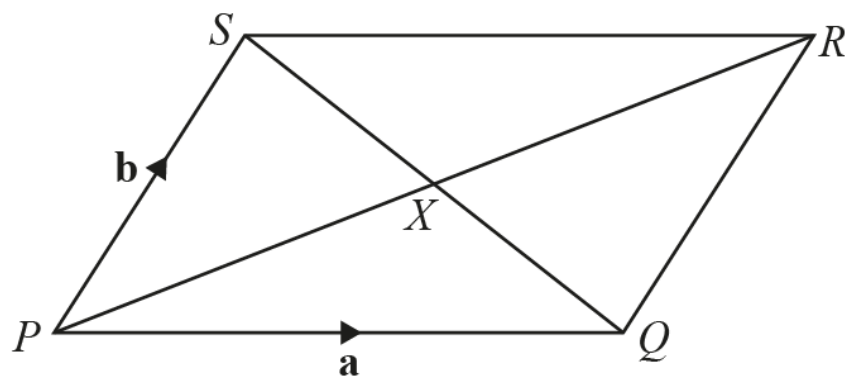
$$\overrightarrow{PQ} = \dots\dots\dots [1]$$

(3 marks)

(b) By using vectors, find the ratio $AB : BC$.

..... :

(3 marks)



NOT TO
SCALE

$PQRS$ is a parallelogram with diagonals PR and QS intersecting at X . $\vec{PQ} = \mathbf{a}$ and $\vec{PS} = \mathbf{b}$.

Find $\vec{QX}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

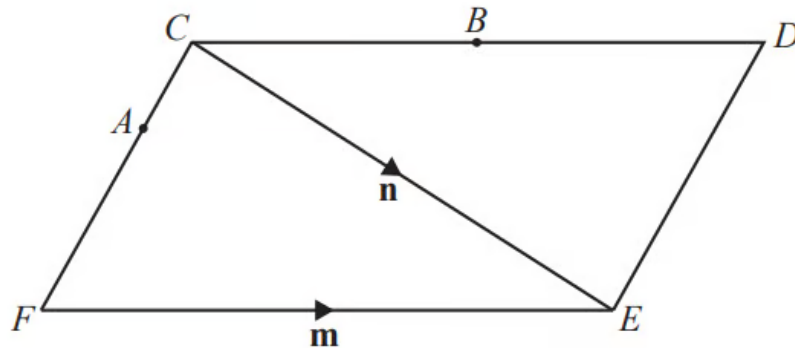
Give your answer in its simplest form.

$\vec{QX} = \dots\dots\dots$

(2 marks)

Very Hard Questions

1



NOT TO
SCALE

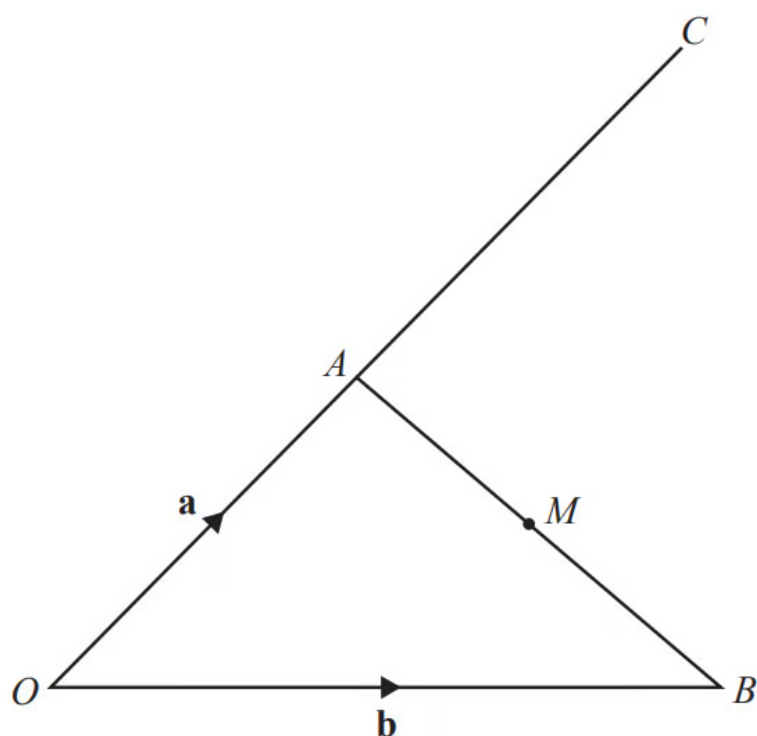
The diagram shows a parallelogram $CDEF$. $\overrightarrow{FE} = \mathbf{m}$ and $\overrightarrow{CE} = \mathbf{n}$. B is the midpoint of CD . $FA = 2AC$

Find an expression, in terms of $\mathbf{m}$ and $\mathbf{n}$, for $\overrightarrow{AB}$.
Give your answer in its simplest form.

$\overrightarrow{AB} = \dots\dots\dots$

(3 marks)

2 (a)



NOT TO
SCALE

The diagram shows a triangle OAB and a straight line OAC .

$OA : OC = 2 : 5$ and M is the midpoint of AB .

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

Find $\vec{AB}$, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form.

$\vec{AB} = \dots\dots\dots$

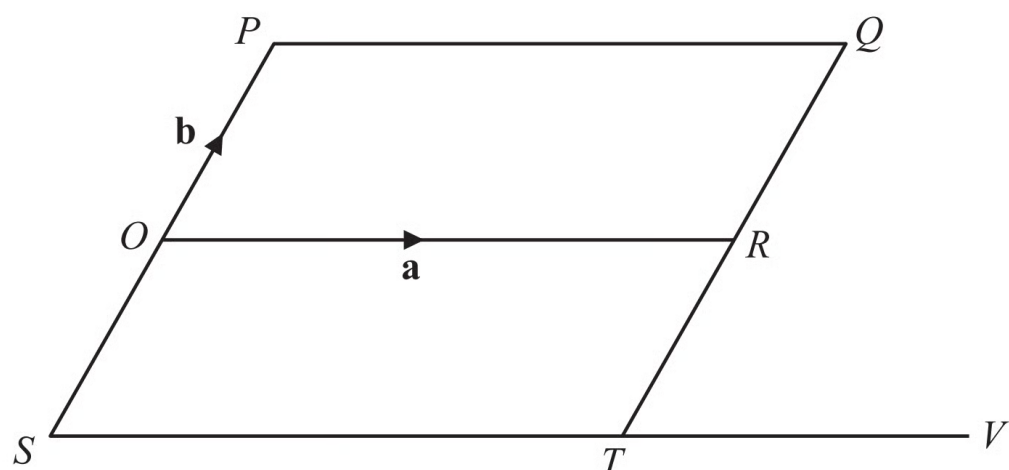
(1 mark)

(b) Find $\vec{MC}$, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form.

$\vec{MC} = \dots\dots\dots$

(3 marks)

3 (a)



NOT TO
SCALE

O is the origin and $OPQR$ is a parallelogram.

SOP is a straight line with $SO = OP$.

TRQ is a straight line with $TR = RQ$.

STV is a straight line and $ST : TV = 2 : 1$.

$\vec{OR} = \mathbf{a}$ and $\vec{OP} = \mathbf{b}$.

Find, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form,

i) the position vector of T ,

[2]

ii) $\vec{RV}$.

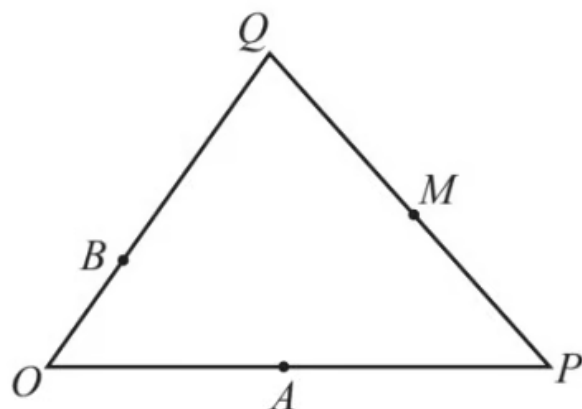
$\vec{RV} = \dots\dots\dots$ [1]

(3 marks)

(b) Show that PT is parallel to RV .

(2 marks)

4 (a)



NOT TO
SCALE

O is the origin, $\vec{OP} = 2\vec{OA}$, $\vec{OQ} = 3\vec{OB}$ and $\vec{PM} = \vec{MQ}$.

$\vec{OP} = \mathbf{p}$ and $\vec{OQ} = \mathbf{q}$.

Find, in terms of $\mathbf{p}$ and $\mathbf{q}$, in its simplest form .

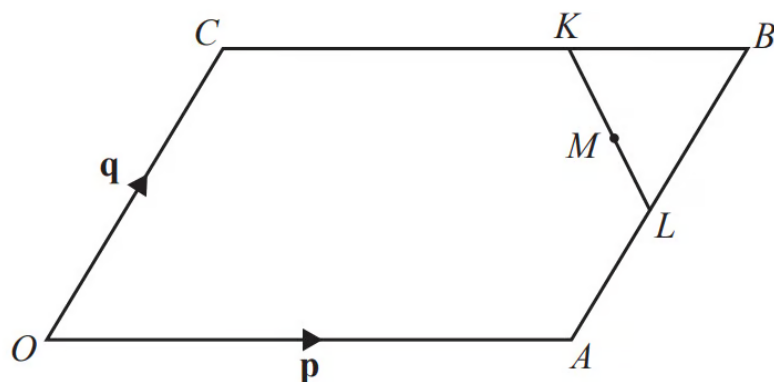
$\vec{BA} = \dots\dots\dots$

(2 marks)

(b) Find, in terms of $\mathbf{p}$ and $\mathbf{q}$, in its simplest form the position vector of M .

(2 marks)

5 (a)



NOT TO
SCALE

$OABC$ is a parallelogram and O is the origin. $CK = 2KB$ and $AL = LB$. M is the midpoint of KL . $\vec{OA} = \mathbf{p}$ and $\vec{OC} = \mathbf{q}$. Find $\vec{KL}$ in terms of $\mathbf{p}$ and $\mathbf{q}$, giving your answer in its simplest form.

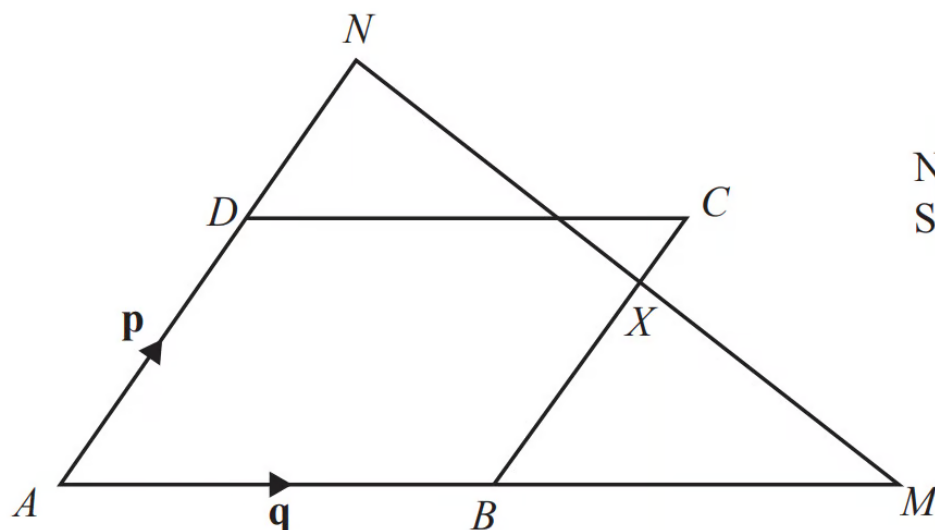
$\vec{KL} = \dots\dots\dots$

(2 marks)

(b) Find the position vector of M in terms of $\mathbf{p}$ and $\mathbf{q}$, giving your answer in its simplest form.

(2 marks)

6 (a)



NOT TO
SCALE

$ABCD$ is a parallelogram with $\vec{AB} = \mathbf{q}$ and $\vec{AD} = \mathbf{p}$.

ABM is a straight line with $AB:BM = 1:1$.

ADN is a straight line with $AD:DN = 3:2$.

Write $\vec{MN}$, in terms of $\mathbf{p}$ and $\mathbf{q}$, in its simplest form.

$\vec{MN} = \dots\dots\dots$

(2 marks)

(b) The straight line NM cuts BC at X .

X is the midpoint of MN .

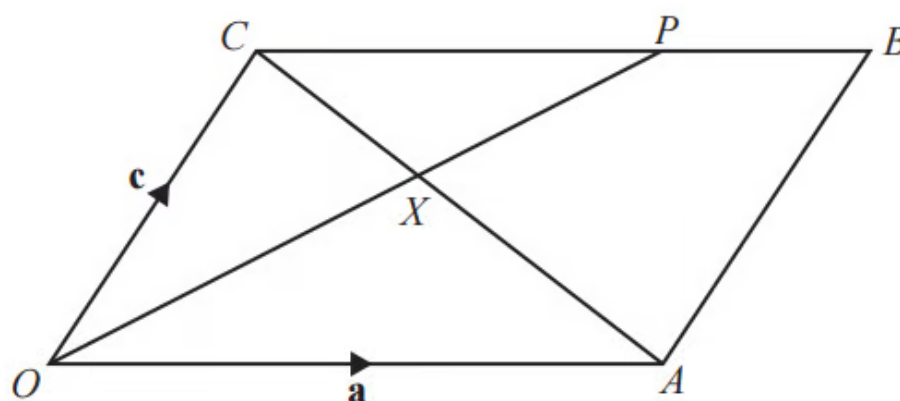
$\vec{BX} = k\mathbf{p}$

Find the value of k .

$k = \dots\dots\dots$

(2 marks)

7 (a)



NOT TO
SCALE

In the diagram, $OABC$ is a parallelogram. OP and CA intersect at X and $CP : PB = 2 : 1$.
 $\vec{OA} = \mathbf{a}$ and $\vec{OC} = \mathbf{c}$.

Find $\vec{OP}$, in terms of $\mathbf{a}$ and $\mathbf{c}$, in its simplest form.

$\vec{OP} = \dots\dots\dots$

(2 marks)

(b) $CX : XA = 2 : 3$

i) Find $\vec{OX}$, in terms of $\mathbf{a}$ and $\mathbf{c}$, in its simplest form.

$\vec{OX} = \dots\dots\dots$ [2]

ii) Find $OX : XP$.

$OX : XP = \dots\dots\dots : \dots\dots\dots$ [2]

(4 marks)

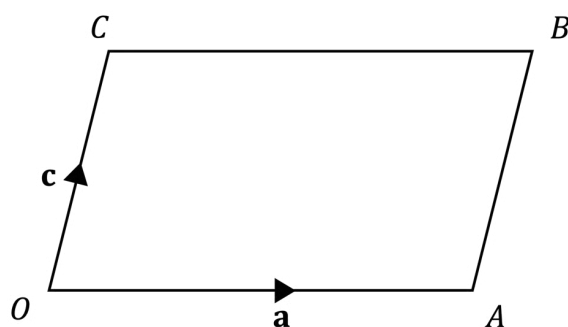
8 $\vec{MT} = \begin{pmatrix} 2k \\ -k \end{pmatrix}$ and $|\vec{MT}| = \sqrt{180}$.

Find the positive value of k .

$k = \dots\dots\dots$

(3 marks)

9



$OABC$ is a parallelogram.

$\vec{OA} = \mathbf{a}$ and $\vec{OC} = \mathbf{c}$.

X is the midpoint of the line OB .

OAD is a straight line such that $OA:AD = k:2$.

Given that $\vec{XD} = 2\mathbf{a} - \frac{1}{2}\mathbf{c}$, find the value of k .

(4 marks)