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GCSE MATHS

Geometry and measures

Edexcel 1MA1 | Subtopic collection Topic 49

Vectors

Higher tier

Past paper question booklet

39	2004-2024	Higher
question groups	available papers	tier

Before you begin

1. Show working and use units where appropriate.
2. Use extra paper if you need more space.
3. Print at actual size (100%) for measurement questions.

Name _____ **Date** _____

Whole questions are retained for context; some parts cover other points. Legacy sources are labelled.

17.

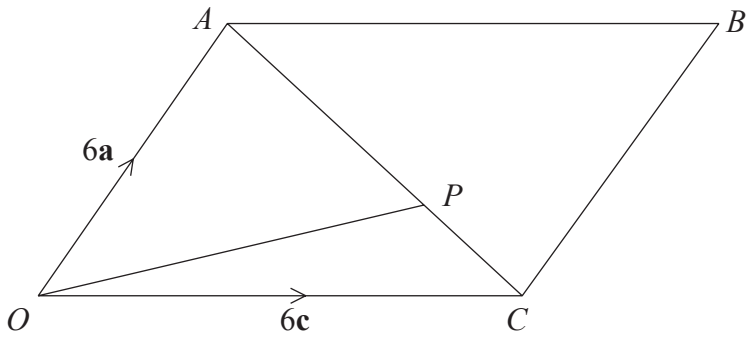


Diagram **NOT** accurately drawn

$OABC$ is a parallelogram.

P is the point on AC such that $AP = \frac{2}{3}AC$.

$\overrightarrow{OA} = 6\mathbf{a}$. $\overrightarrow{OC} = 6\mathbf{c}$.

(a) Find the vector $\overrightarrow{OP}$.
Give your answer in terms of **a** and **c**.

.....

(3)

The midpoint of CB is M.

(b) Prove that OPM is a straight line.

(2)

Page Total

22.

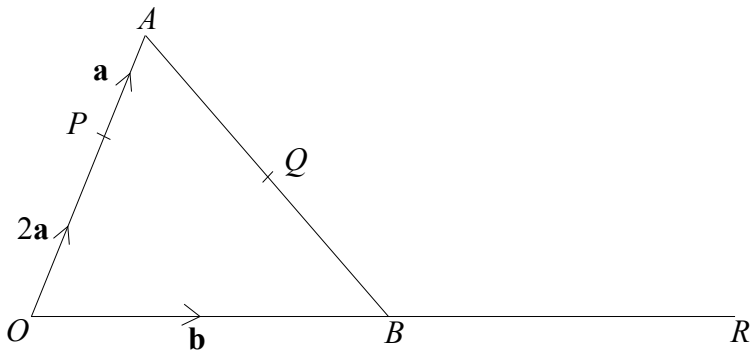


Diagram **NOT** accurately drawn

OAB is a triangle.
B is the midpoint of *OR*.
Q is the midpoint of *AB*.

$\overrightarrow{OP} = 2\mathbf{a}$ $\overrightarrow{PA} = \mathbf{a}$ $\overrightarrow{OB} = \mathbf{b}$

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

(i) $\overrightarrow{AB}$,

.....

(ii) $\overrightarrow{PR}$,

.....

(iii) $\overrightarrow{PQ}$.

.....

(4)

(b) Hence explain why *PQR* is a straight line.

(2)

The length of *PQ* is 3 cm.

(c) Find the length of *PR*.

..... cm

(1)

(Total 7 marks)

Q22

22.

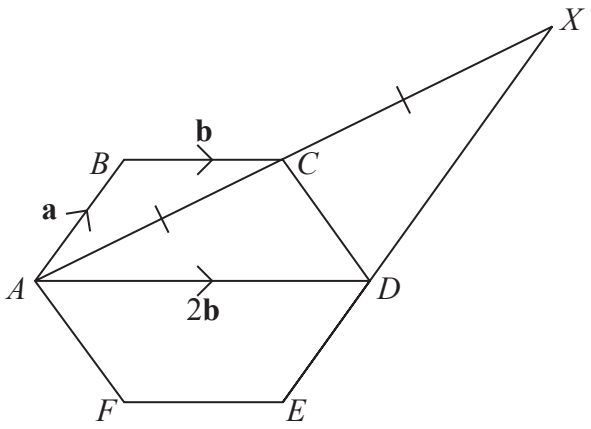


Diagram **NOT** accurately drawn

ABCDEF is a regular hexagon.

$\overrightarrow{AB} = \mathbf{a}$ $\overrightarrow{BC} = \mathbf{b}$ $\overrightarrow{AD} = 2\mathbf{b}$

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

$\overrightarrow{AC}$ = ...

(1)

$\overrightarrow{AC} = \overrightarrow{CX}$

(b) Prove that *AB* is parallel to *DX*.

(3) **Q22**

(Total 4 marks)

20.

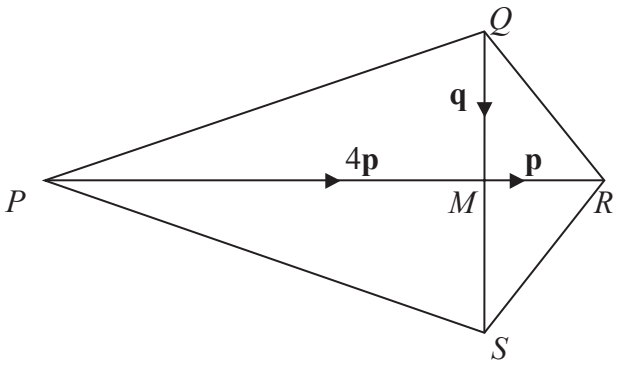


Diagram **NOT** accurately drawn

PQRS is a kite.
The diagonals *PR* and *QS* intersect at *M*.

$\overrightarrow{PM} = 4\mathbf{p}$

$\overrightarrow{QM} = \mathbf{q}$

$\overrightarrow{MR} = \mathbf{p}$

$\overrightarrow{QM} = \overrightarrow{MS}$

(a) Find expressions, in terms of **p** and/or **q** for

(i) $\overrightarrow{PR}$

$\overrightarrow{PR}$ .....

(ii) $\overrightarrow{QS}$

$\overrightarrow{QS}$ .....

(iii) $\overrightarrow{PQ}$

$\overrightarrow{PQ}$ .....

(4)

SR and *PQ* are extended to meet at point *T*.
Q is the midpoint of *PT*.

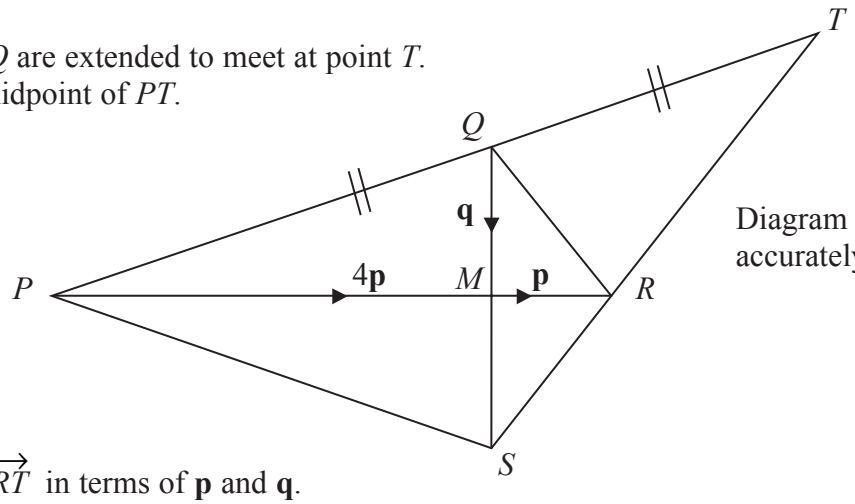


Diagram **NOT** accurately drawn

(b) Find $\overrightarrow{RT}$ in terms of **p** and **q**.

$\overrightarrow{RT}$ .....

(4)

(Total 8 marks)

Q20

23.

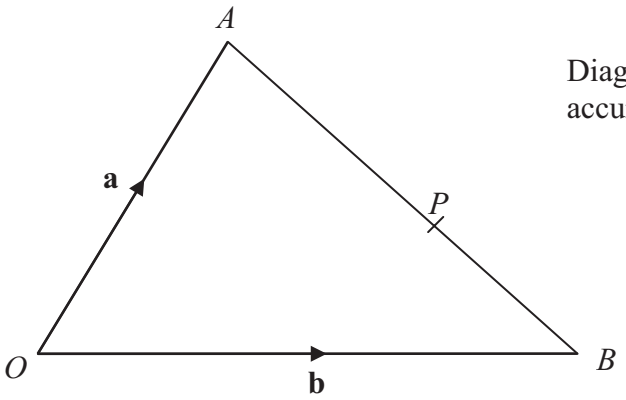


Diagram **NOT** accurately drawn

OAB is a triangle.

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

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

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

$\overrightarrow{AB}$ = ...

(1)

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

(b) Show that $\overrightarrow{OP} = \frac{1}{5}(2\mathbf{a} + 3\mathbf{b})$

(3)

(Total 4 marks)

Q23

22.

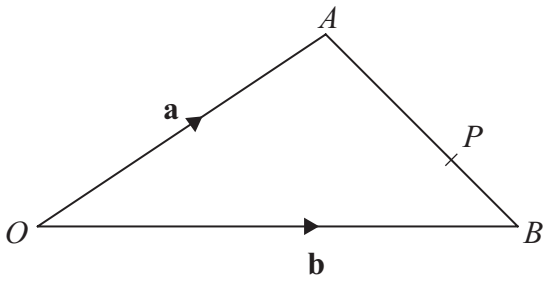


Diagram **NOT** accurately drawn

OAB is a triangle.

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

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

$\overrightarrow{AB}$ = ...

(1)

P is the point on AB so that $AP : PB = 2 : 1$

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

$\overrightarrow{OP}$ = ...

(3)

Q22

(Total 4 marks)

27.

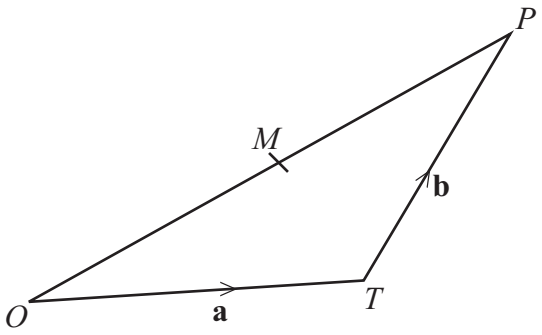


Diagram **NOT** accurately drawn

OPT is a triangle.
M is the midpoint of *OP*.

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

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

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

$\overrightarrow{OM} =$ .....

(2)

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

$\overrightarrow{TM} =$ .....

(2)

Q27

(Total 4 marks)

26.

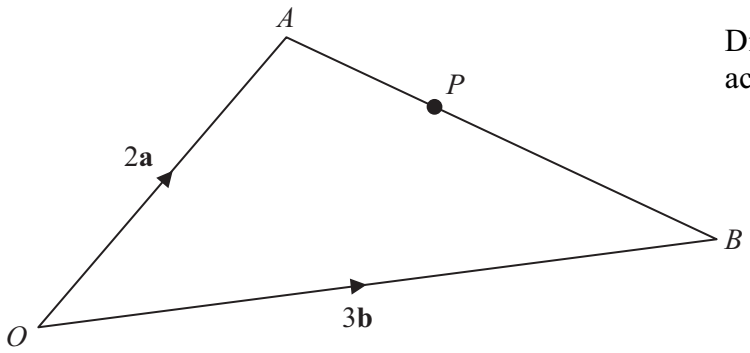


Diagram **NOT** accurately drawn

OAB is a triangle.

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

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

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

$\overrightarrow{AB}$ = ...

(1)

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

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

(3) **Q26**

(Total 4 marks)

26

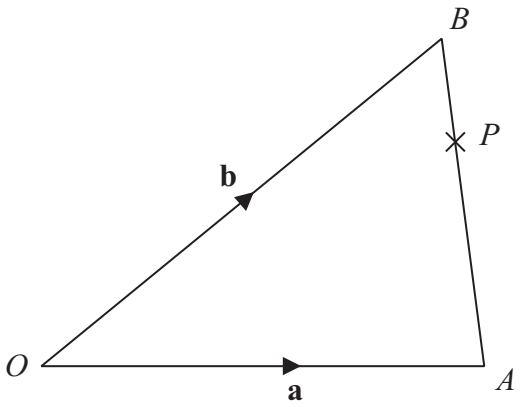


Diagram **NOT** accurately drawn

OAB is a triangle.

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

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

.....

(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.

.....

(3)

(Total for Question 26 is 4 marks)

15

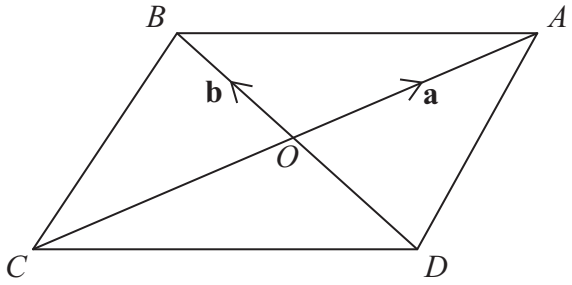


Diagram **NOT** accurately drawn

$ABCD$ is a parallelogram.
The diagonals of the parallelogram intersect at O.

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

(a) Write an expression, in terms of **a** and/or **b**, for

(i) $\overrightarrow{CA}$,

.....

(ii) $\overrightarrow{BA}$,

.....

(iii) $\overrightarrow{BC}$.

.....

(3)

X is the point such that $\overrightarrow{OX} = 2\mathbf{a} - \mathbf{b}$

(b) (i) Find an expression, in terms of **a** and **b**, for $\overrightarrow{AX}$.

.....

(ii) B, A and X lie on the same straight line.

Explain why.

.....

.....

.....

(3)

(Total for Question 15 is 6 marks)

28

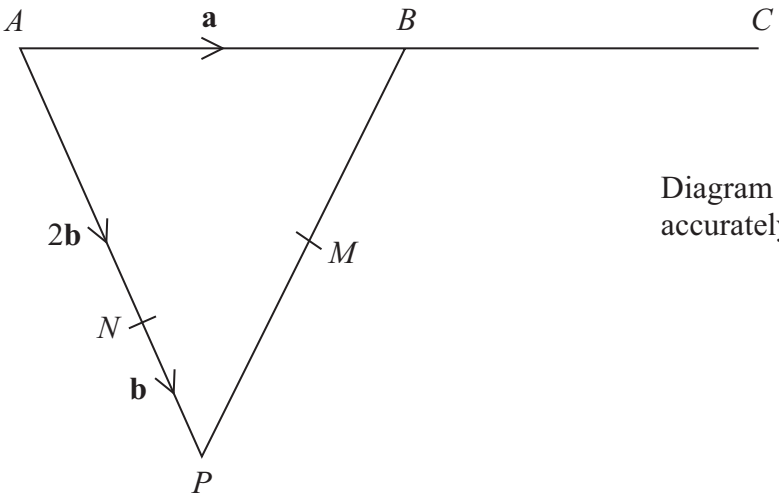


Diagram **NOT** accurately drawn

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

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

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

.....

(1)

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

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

(4)

(Total for Question 28 is 5 marks)

18

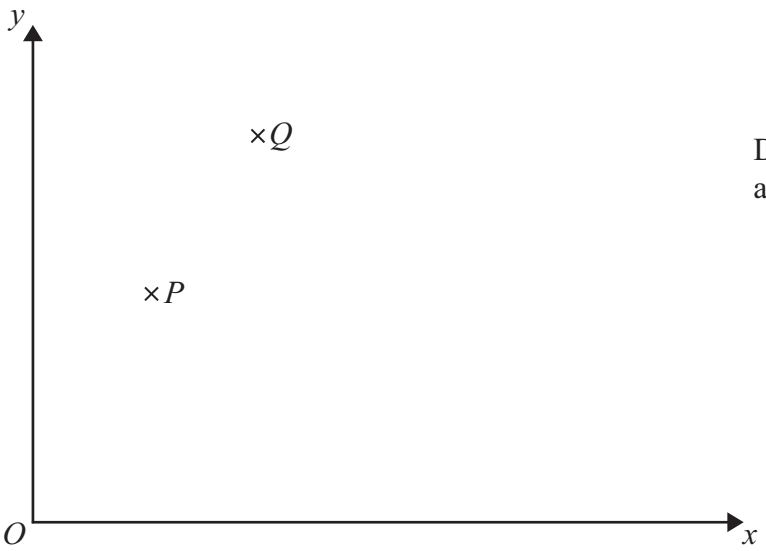


Diagram **NOT** accurately drawn

The diagram is a sketch.

P is the point (2, 4)
Q is the point (4, 8)

(a) Find the vector $\overrightarrow{PQ}$

Give your answer as a column vector $\begin{pmatrix} x \\ y \end{pmatrix}$

.....

(2)

$\overrightarrow{QR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$

M is the midpoint of PQ.
N is the midpoint of QR.

(b) Find the vector $\overrightarrow{MN}$

Give your answer as a column vector $\begin{pmatrix} x \\ y \end{pmatrix}$

.....

(3)

(Total for Question 18 is 5 marks)

26

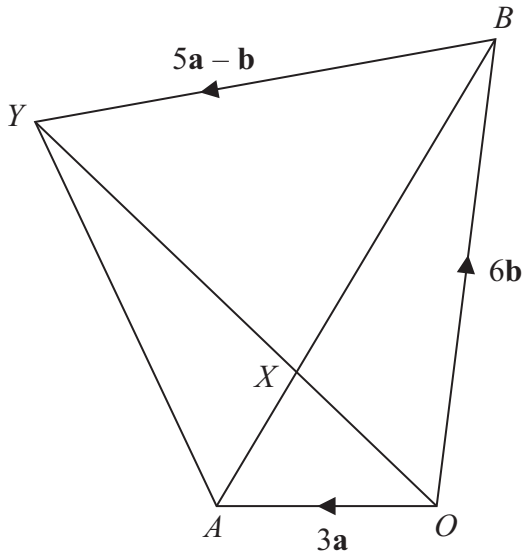


Diagram **NOT** accurately drawn

$OAYB$ is a quadrilateral.

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

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

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

.....

(1)

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

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

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

(4)

(Total for Question 26 is 5 marks)

23

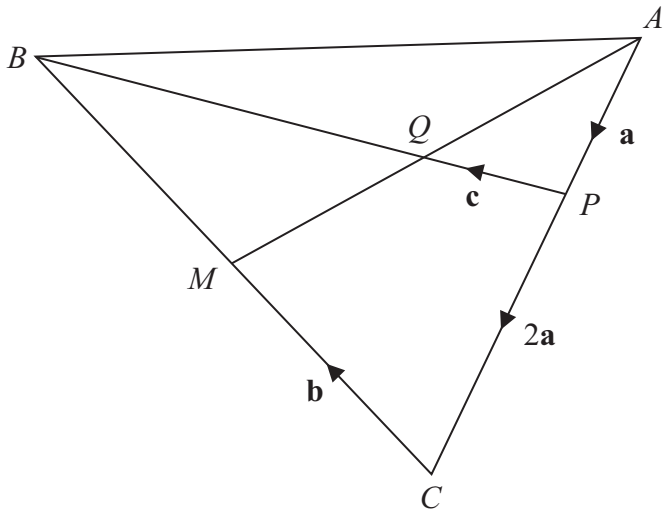


Diagram **NOT** accurately drawn

M is the midpoint of BC.
Q is the midpoint of AM.

$\overrightarrow{AP} = \mathbf{a}$ $\overrightarrow{PC} = 2\mathbf{a}$ $\overrightarrow{CM} = \mathbf{b}$ $\overrightarrow{PQ} = \mathbf{c}$

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

$\overrightarrow{AM} =$ .....

(1)

(b) Find $\overrightarrow{QB}$ in terms of **c**.

$\overrightarrow{QB} =$ .....

(4)

(Total for Question 23 is 5 marks)

27

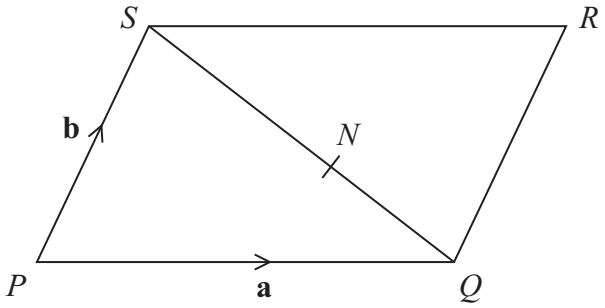


Diagram **NOT** accurately drawn

$PQRS$ is a parallelogram.
N is the point on SQ such that $SN : NQ = 3 : 2$
$\overrightarrow{PQ} = \mathbf{a}$
$\overrightarrow{PS} = \mathbf{b}$

(a) Write down, in terms of **a** and **b**, an expression for $\overrightarrow{SQ}$.

$\overrightarrow{SQ} =$ .....

(1)

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

$\overrightarrow{NR} =$ .....

(3)

(Total for Question 27 is 4 marks)

20 OAB is a triangle.

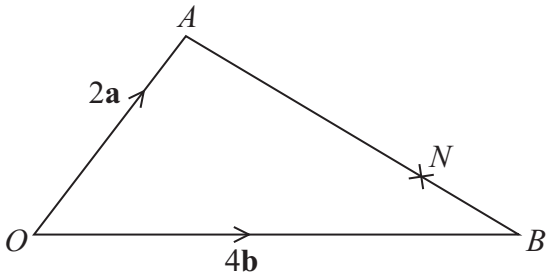


Diagram **NOT** accurately drawn

N is the point on AB such that $AN : NB = 3 : 1$

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

$\overrightarrow{OB} = 4\mathbf{b}$

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

.....

(1)

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

.....

(3)

(Total for Question 20 is 4 marks)

24 $OACB$ is a parallelogram.

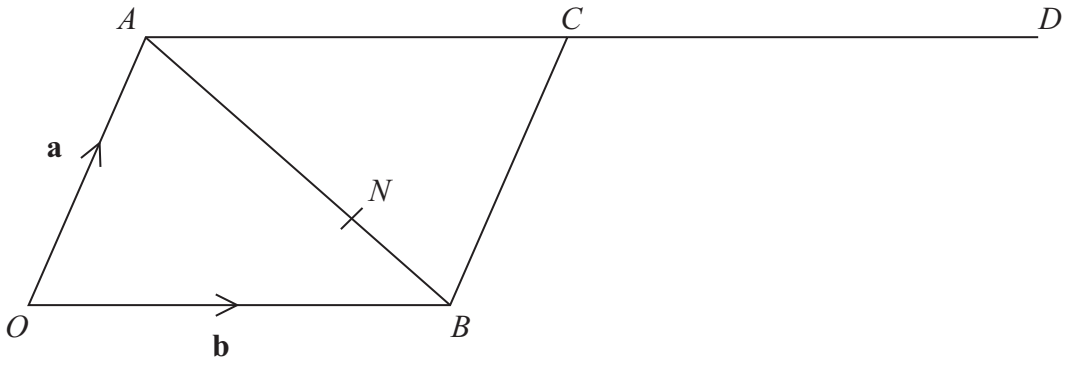


Diagram **NOT** accurately drawn

$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$
D is the point such that $\overrightarrow{AC} = \overrightarrow{CD}$
The point N divides AB in the ratio $2:1$

(a) Write an expression for $\overrightarrow{ON}$ in terms of **a** and **b**.

.....

(3)

*(b) Prove that OND is a straight line.

(3)

(Total for Question 24 is 6 marks)

19

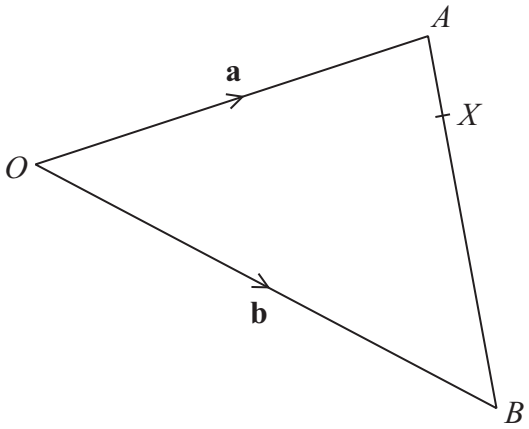


Diagram **NOT** accurately drawn

OAB is a triangle.

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

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

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

.....

(1)

X is the point on AB such that $AX : XB = 1 : 4$

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

$\overrightarrow{OX} =$ .....

(3)

(Total for Question 19 is 4 marks)

19

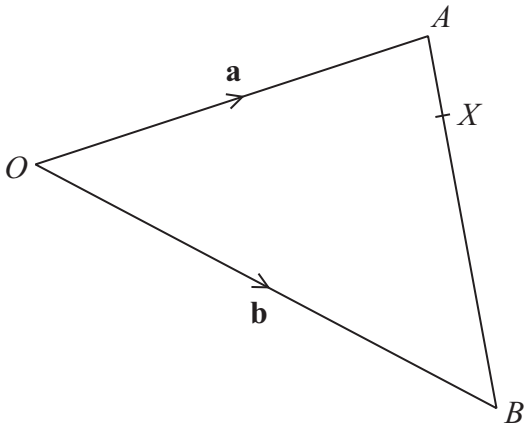


Diagram **NOT** accurately drawn

OAB is a triangle.

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

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

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

.....

(1)

X is the point on AB such that $AX : XB = 1 : 4$

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

$\overrightarrow{OX} =$ .....

(3)

(Total for Question 19 is 4 marks)

***24**

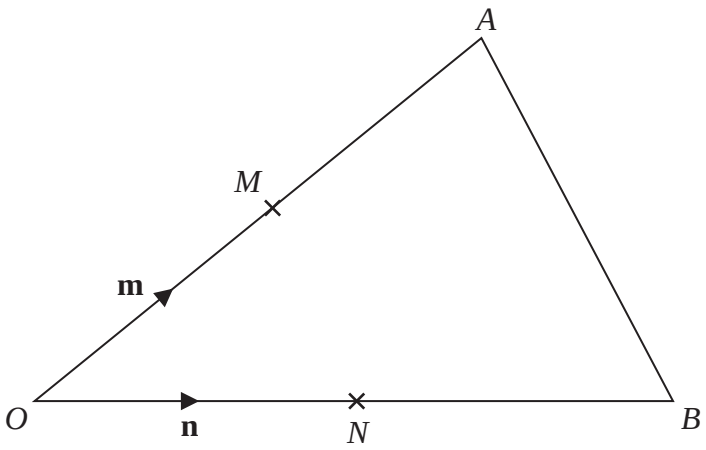


Diagram **NOT** accurately drawn

OAB is a triangle.
M is the midpoint of *OA*.
N is the midpoint of *OB*.

$\overrightarrow{OM}$ = **m**

$\overrightarrow{ON}$ = **n**

Show that *AB* is parallel to *MN*.

(Total for Question 24 is 3 marks)

19

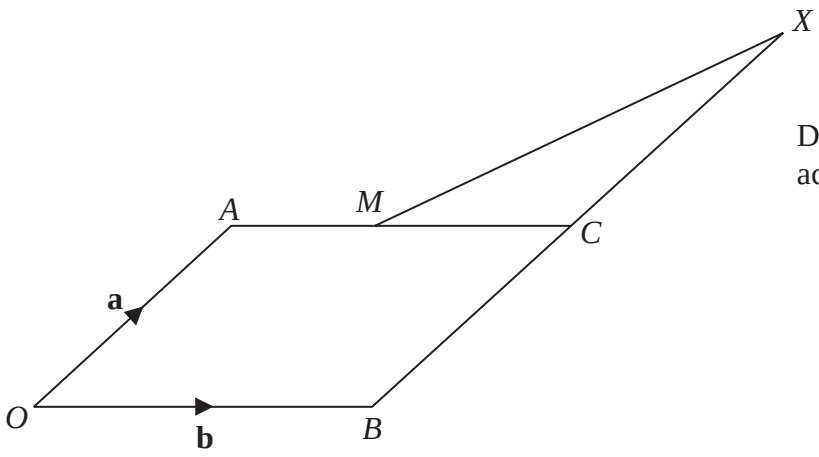


Diagram **NOT** accurately drawn

OACB is a parallelogram.

M is the midpoint of *AC*.
C is the midpoint of the straight line *BCX*.

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

Prove that *OMX* is a straight line.

(Total for Question 19 is 4 marks)

27

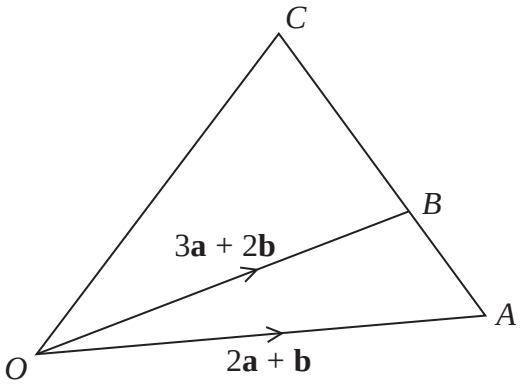


Diagram **NOT** accurately drawn

ABC is a straight line.

$AB : BC = 2 : 5$

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

$\overrightarrow{OB} = 3\mathbf{a} + 2\mathbf{b}$

Express $\overrightarrow{OC}$ in terms of **a** and **b**.
Give your answer in its simplest form.

.....

(Total for Question 27 is 4 marks)

23

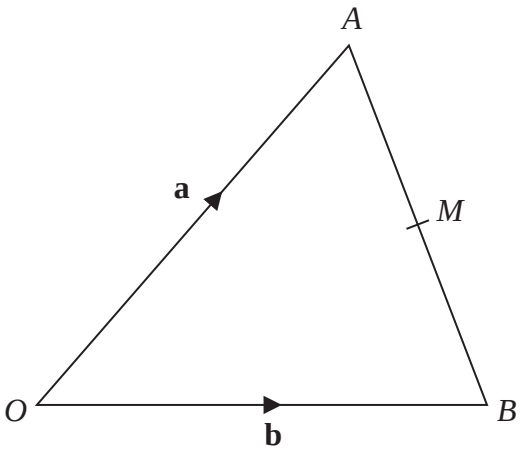


Diagram **NOT** accurately drawn

OAB is a triangle.

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

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

M is the midpoint of *AB*.
OMN is a straight line such that $ON : OM = 3 : 2$

Find, in terms of **a** and **b**, an expression for the vector $\overrightarrow{ON}$.
Write your answer in its simplest form.

.....

(Total for Question 23 is 4 marks)

***20**

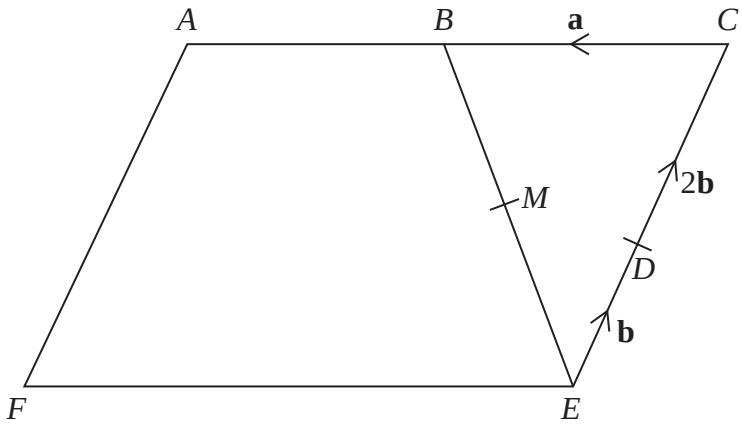


Diagram **NOT** accurately drawn

ACEF is a parallelogram.
B is the midpoint of *AC*.
M is the midpoint of *BE*.

$\overrightarrow{CB}$ = **a**

$\overrightarrow{ED}$ = **b**

$\overrightarrow{DC}$ = 2**b**

Show that *AMD* is a straight line.

(Total for Question 20 is 5 marks)

23

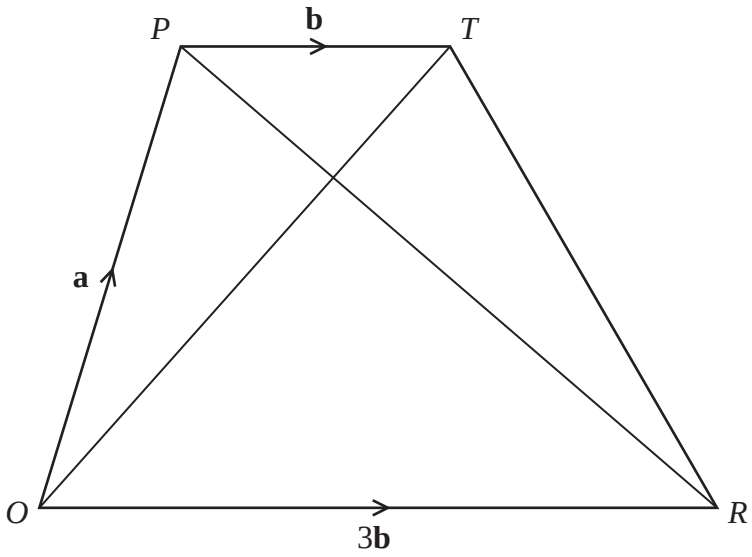


Diagram **NOT** accurately drawn

OPTR is a trapezium.

$\overrightarrow{OP}$ = **a**
$\overrightarrow{PT}$ = **b**
$\overrightarrow{OR}$ = 3**b**

(a) (i) Find $\overrightarrow{OT}$ in terms of **a** and **b**

.....

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

.....

(2)

S is the point on PR such that $PS : SR = 1 : 3$

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

.....

(2)

*(c) What does your answer to part (b) tell you about the position of point S?

.....

.....

.....

.....

(2)

(Total for Question 23 is 6 marks)

***21**

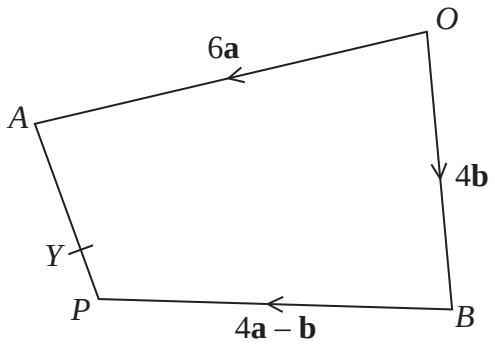


Diagram **NOT** accurately drawn

OBPA is a quadrilateral.

$\overrightarrow{OA} = 6\mathbf{a}$

$\overrightarrow{OB} = 4\mathbf{b}$

$\overrightarrow{BP} = 4\mathbf{a} - \mathbf{b}$

Y is the point on *AP* such that $AY : YP = 2 : 1$

Show that $\overrightarrow{OY}$ is parallel to the vector $7\mathbf{a} + 3\mathbf{b}$

(Total for Question 21 is 4 marks)

23

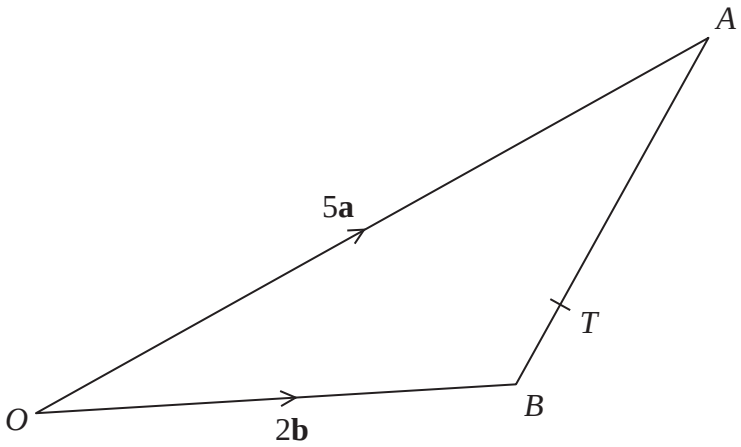


Diagram **NOT** accurately drawn

OAB is a triangle.

$\overrightarrow{OA} = 5\mathbf{a}$

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

T is the point on *AB* such that *AT* : *TB* = 5 : 1

Show that *OT* is parallel to the vector $\mathbf{a} + 2\mathbf{b}$

(Total for Question 23 is 4 marks)

24

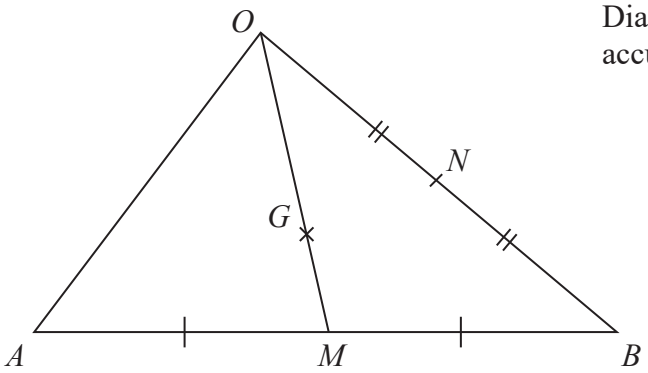


Diagram **NOT** accurately drawn

$\overrightarrow{OA} = 6\mathbf{a}$ and $\overrightarrow{OB} = 6\mathbf{b}$
M is the midpoint of AB.

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

.....

(2)

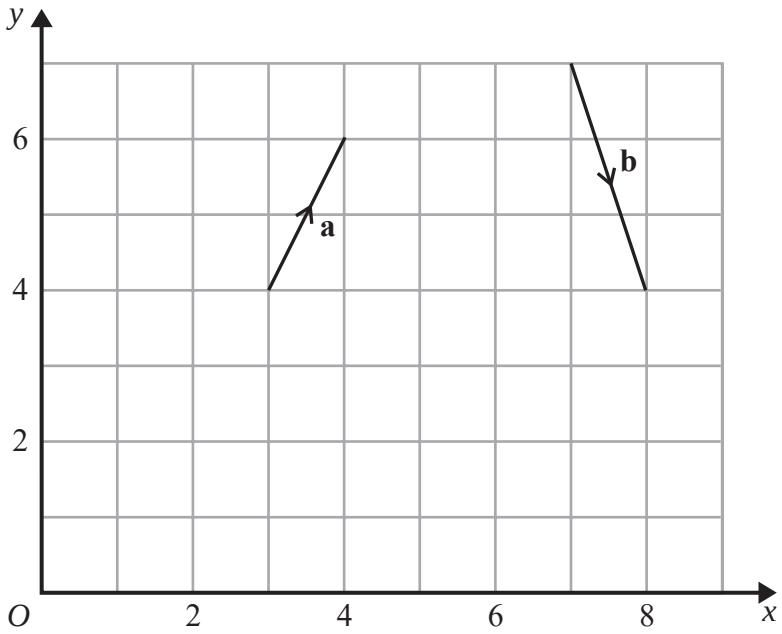
N is the midpoint of OB.
G is the point on OM such that $OG : GM = 2 : 1$

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

(4)

(Total for Question 24 is 6 marks)

10 The vector **a** and the vector **b** are shown on the grid.



(a) On the grid, draw and label vector $-2\mathbf{a}$

(1)

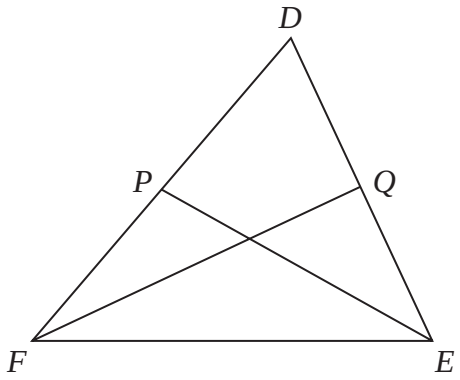
(b) Work out $\mathbf{a} + 2\mathbf{b}$ as a column vector.

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

(2)

(Total for Question 10 is 3 marks)

21 DEF is a triangle.



P is the midpoint of FD.
Q is the midpoint of DE.

$\overrightarrow{FD} = \mathbf{a}$ and $\overrightarrow{FE} = \mathbf{b}$

Use a vector method to prove that PQ is parallel to FE.

(Total for Question 21 is 4 marks)

Question 31

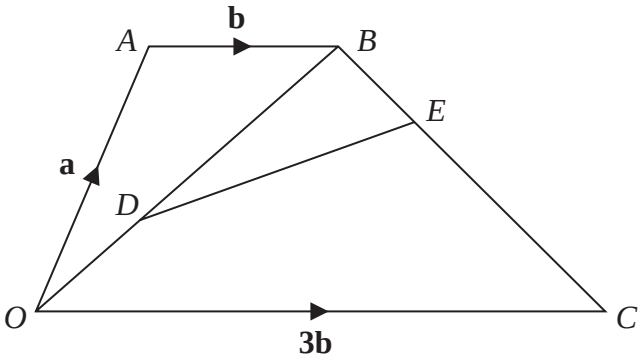
6 $\mathbf{a} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$

Find $2\mathbf{a} - 3\mathbf{b}$ as a column vector.

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

(Total for Question 6 is 2 marks)

18 $OABC$ is a trapezium.



$\overrightarrow{OA} = \mathbf{a}$
$\overrightarrow{AB} = \mathbf{b}$
$\overrightarrow{OC} = \mathbf{3b}$

D is the point on OB such that $OD : DB = 2 : 3$
E is the point on BC such that $BE : EC = 1 : 4$

Work out the vector $\overrightarrow{DE}$ in terms of **a** and **b**.
Give your answer in its simplest form.

.....

(Total for Question 18 is 4 marks)

Question 33

13 **a** and **b** are vectors such that

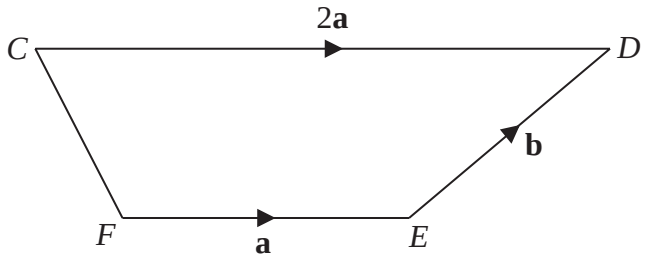
$$\mathbf{a} = \begin{pmatrix} 2 \\ -3 \end{pmatrix} \quad \text{and} \quad 3\mathbf{a} - 2\mathbf{b} = \begin{pmatrix} 8 \\ -17 \end{pmatrix}$$

Find **b** as a column vector.

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

(Total for Question 13 is 3 marks)

24 *CDEF* is a quadrilateral.



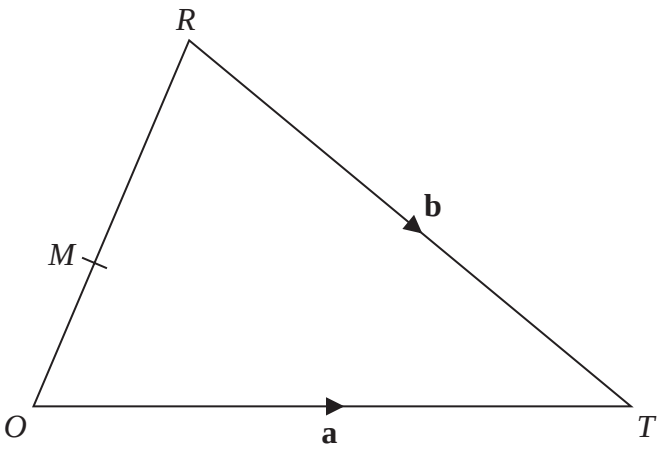
$\overrightarrow{FE} = \mathbf{a}$ $\overrightarrow{ED} = \mathbf{b}$ $\overrightarrow{CD} = 2\mathbf{a}$

The point *P* is such that *CEP* is a straight line and that *CE* = *EP*

Use a vector method to prove that *CF* is parallel to *DP*.

(Total for Question 24 is 4 marks)

20 ORT is a triangle.



$\overrightarrow{OT} = \mathbf{a}$ $\overrightarrow{RT} = \mathbf{b}$

M is the point on OR such that $OM : MR = 2 : 3$

Express $\overrightarrow{MT}$ in terms of **a** and **b**.
Give your answer in its simplest form.

.....

(Total for Question 20 is 4 marks)

Question 36

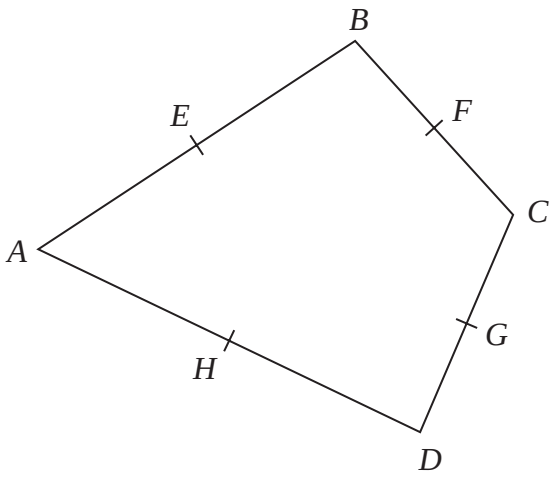
22 Given that the vector $a\begin{pmatrix}2\\6\end{pmatrix}+b\begin{pmatrix}8\\2\end{pmatrix}$ is parallel to the vector $\begin{pmatrix}13\\6\end{pmatrix}$

find an expression for b in terms of a.

.....

(Total for Question 22 is 3 marks)

18



ABCD is a quadrilateral.

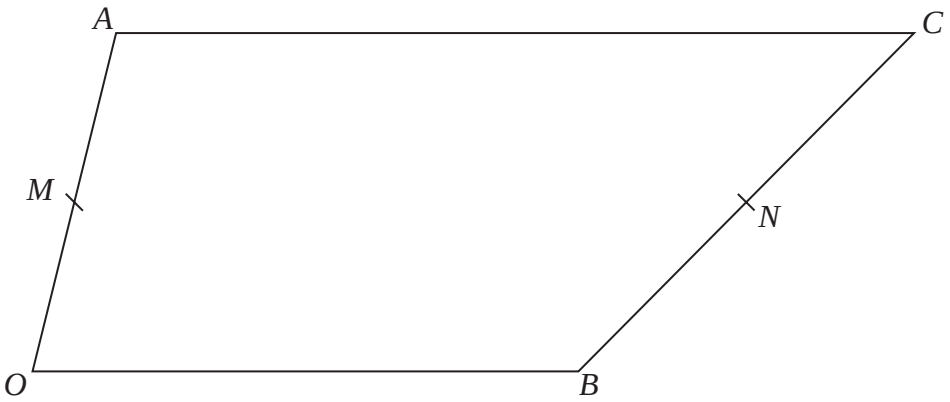
E, *F*, *G* and *H* are the midpoints of *AB*, *BC*, *CD* and *DA*.

$\overrightarrow{AH} = \mathbf{a}$ $\overrightarrow{AE} = \mathbf{b}$ $\overrightarrow{DG} = \mathbf{c}$

Prove, using vectors, that *EFGH* is a parallelogram.

(Total for Question 18 is 4 marks)

19 The diagram shows quadrilateral $OACB$.



M is the midpoint of OA.
N is the point on BC such that $BN : NC = 4 : 5$

$\overrightarrow{OA} = \mathbf{a}$ $\overrightarrow{OB} = \mathbf{b}$ $\overrightarrow{AC} = k\mathbf{b}$ where k is a positive integer.

(a) Express $\overrightarrow{MN}$ in terms of k, $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

.....

(4)

(b) Is MN parallel to OB?
Give a reason for your answer.

.....

.....

.....

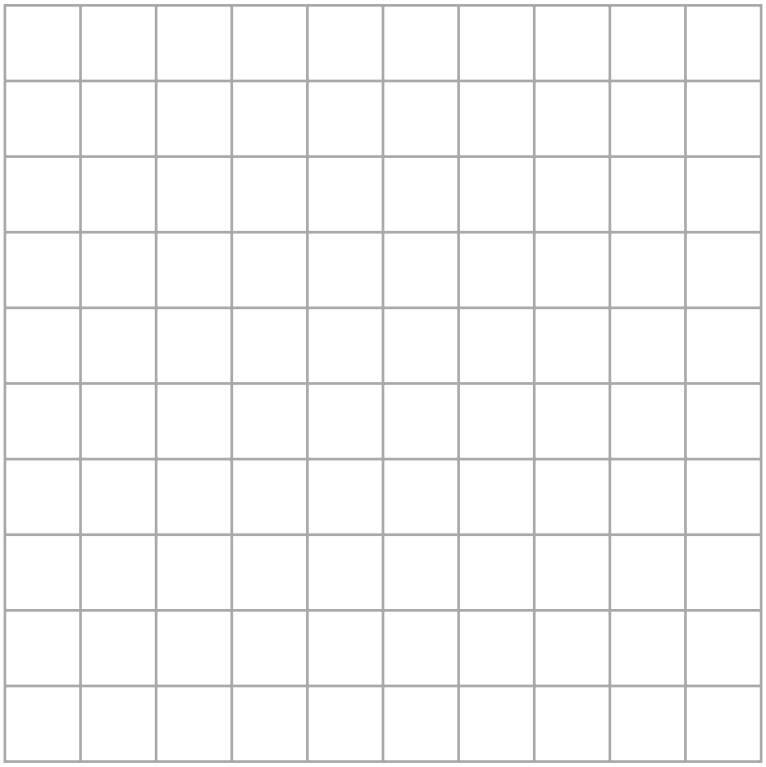
(1)

(Total for Question 19 is 5 marks)

Question 39

8 $\mathbf{a} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$

On the grid below, draw and label the vector $2\mathbf{a} + \mathbf{b}$



(Total for Question 8 is 3 marks)