

13 Here are two vectors.

$$\overrightarrow{AB} = \begin{pmatrix} 5 \\ 3 \end{pmatrix} \quad \overrightarrow{CB} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$$

Find, as a column vector,  $\overrightarrow{AC}$

(Total for Question 13 is 2 marks)



14 Here are two vectors.

$$\vec{AB} = \begin{pmatrix} 6 \\ -9 \end{pmatrix} \quad \vec{CB} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$$

Find the magnitude of  $\vec{AC}$ .

(Total for Question 14 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



16 Here are two vectors.

$$\vec{BA} = \begin{pmatrix} -5 \\ 4 \end{pmatrix} \quad \vec{BC} = \begin{pmatrix} 9 \\ 1 \end{pmatrix}$$

Find  $\vec{AC}$  as a column vector.

$$\vec{AC} = \begin{pmatrix} \dots\dots\dots \\ \dots\dots\dots \\ \dots\dots\dots \end{pmatrix}$$

(Total for Question 16 is 2 marks)



17 Here are two vectors.

$$\vec{FG} = \begin{pmatrix} -5 \\ 2 \end{pmatrix} \quad \vec{HG} = \begin{pmatrix} 4 \\ 14 \end{pmatrix}$$

Calculate the magnitude of the vector  $\vec{HF}$

(Total for Question 17 is 3 marks)



14  $ABCDEF$  and  $GHIJKL$  are regular hexagons each with centre  $O$ .

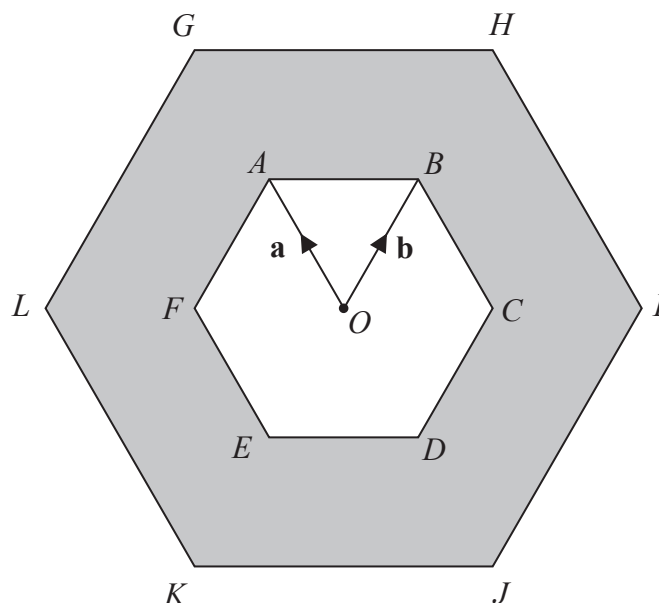


Diagram **NOT**  
accurately drawn

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

$GHIJKL$  is an enlargement of  $ABCDEF$ , with centre  $O$  and scale factor 2

$$\vec{OA} = \mathbf{a} \quad \vec{OB} = \mathbf{b}$$

(a) Write the following vectors, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .  
Simplify your answers.

(i)  $\vec{AB}$

(1)

(ii)  $\vec{KI}$

(2)

(iii)  $\vec{LD}$

(2)



The triangle  $OAB$  has an area of  $5 \text{ cm}^2$

(b) Calculate the area of the shaded region.

.....  $\text{cm}^2$   
(3)

(Total for Question 14 is 8 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- 19 The diagram shows a triangle  $ABC$  where  $A$ ,  $B$  and  $C$  represent the positions of three towns.

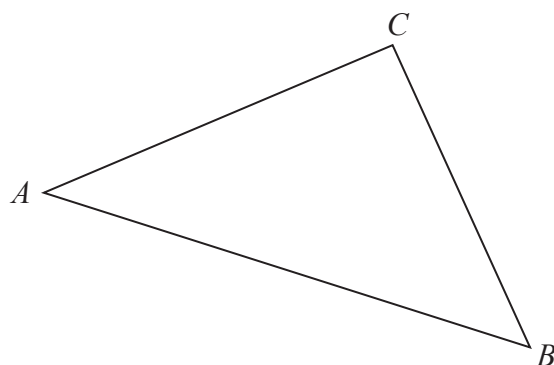


Diagram **NOT**  
accurately drawn

$$\vec{AB} = \begin{pmatrix} 7 \\ -2 \end{pmatrix} \quad \vec{BC} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$$

Pru travels directly from  $A$  to  $B$  and then directly from  $B$  to  $C$

Yang travels directly from  $A$  to  $C$

Given that the values for  $\vec{AB}$  and  $\vec{BC}$  are in kilometres,

work out how much further Pru travels than Yang travels.

Give your answer in km, correct to one decimal place.

..... km

(Total for Question 19 is 5 marks)



19

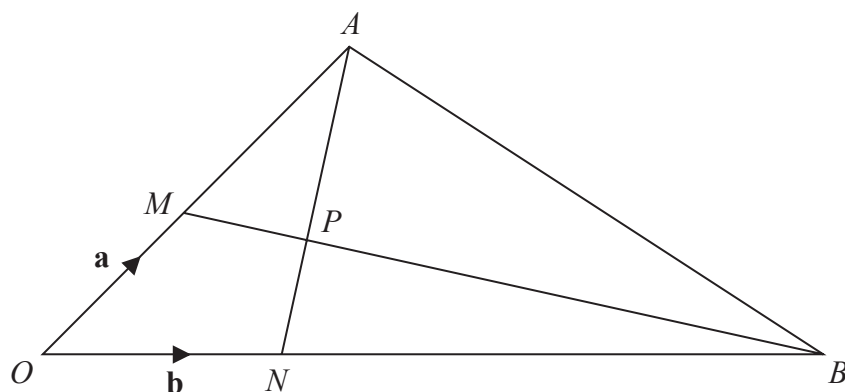


Diagram **NOT**  
accurately drawn

$OMA$ ,  $ONB$ ,  $MPB$  and  $NPA$  are straight lines.

$M$  is the midpoint of  $OA$

$ON:NB = 1:5$

$$\vec{OM} = \mathbf{a} \quad \vec{ON} = \mathbf{b}$$

(a) Find in terms of  $\mathbf{a}$  and  $\mathbf{b}$  the vector  $\vec{AN}$

(1)

(b) Use a vector method to find the ratio  $AP:PN$

$$AP:PN = \dots\dots\dots$$

(4)

(Total for Question 19 is 5 marks)





17 The diagram shows parallelogram  $ABCD$ .

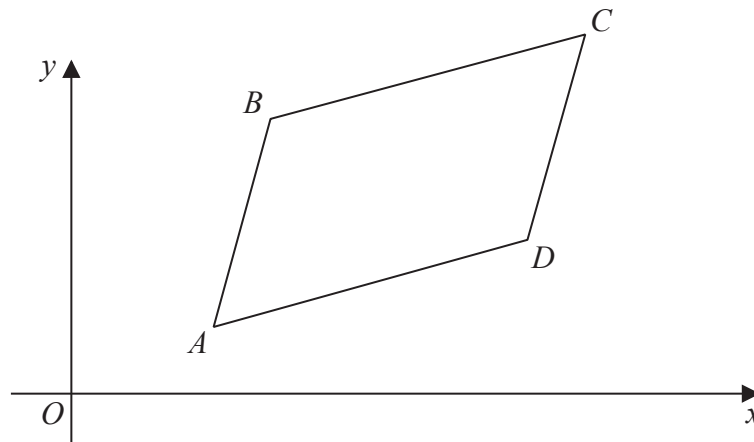


Diagram **NOT** accurately drawn

$$\vec{AB} = \begin{pmatrix} 2 \\ 7 \end{pmatrix} \quad \vec{AC} = \begin{pmatrix} 10 \\ 11 \end{pmatrix}$$

The point  $B$  has coordinates  $(5, 8)$

(a) Work out the coordinates of the point  $C$ .

(....., .....)  
(3)

The point  $E$  has coordinates  $(63, 211)$

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

(2)

(Total for Question 17 is 5 marks)



19  $OAB$  is a triangle.

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

The point  $C$  lies on  $OA$  such that  $OC : CA = 1 : 2$

The point  $D$  lies on  $OB$  such that  $OD : DB = 1 : 2$

Using a vector method, prove that  $ABDC$  is a trapezium.

(Total for Question 19 is 3 marks)



21

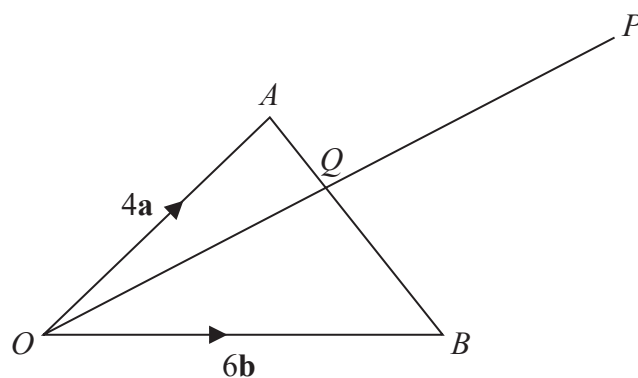


Diagram **NOT**  
accurately drawn

$OAB$  is a triangle.

$Q$  is the point on  $AB$  such that  $OQP$  is a straight line.

$$\vec{OA} = 4\mathbf{a} \quad \vec{OB} = 6\mathbf{b} \quad \vec{AP} = 2\mathbf{a} + 8\mathbf{b}$$

Using a vector method, find the ratio  $AQ:QB$

$$AQ:QB = \dots\dots\dots$$

(Total for Question 21 is 5 marks)



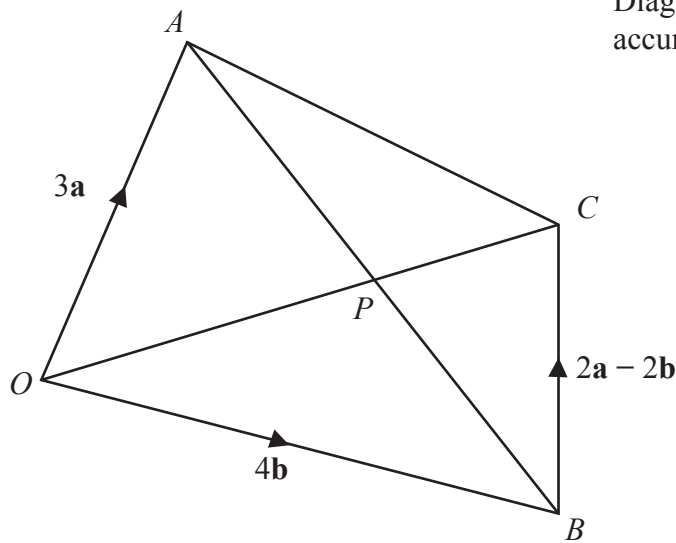


Diagram **NOT**  
accurately drawn

$OACB$  is a quadrilateral.

$$\vec{OA} = 3\mathbf{a} \quad \vec{OB} = 4\mathbf{b} \quad \vec{BC} = 2\mathbf{a} - 2\mathbf{b}$$

- (a) (i) Find the vector  $\vec{OC}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$   
Simplify your answer.

$$\vec{OC} = \dots\dots\dots (1)$$

- (ii) Find the vector  $\vec{AB}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$

$$\vec{AB} = \dots\dots\dots (1)$$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



The point  $P$  lies on  $AB$  and on  $OC$

- (b) Using a vector method, find the ratio  $AP : PB$   
Show your working clearly.

.....  
(3)

(Total for Question 22 is 5 marks)



P 7 3 4 6 9 A 0 2 1 2 4

22  $ABCDEF$  is a regular hexagon.

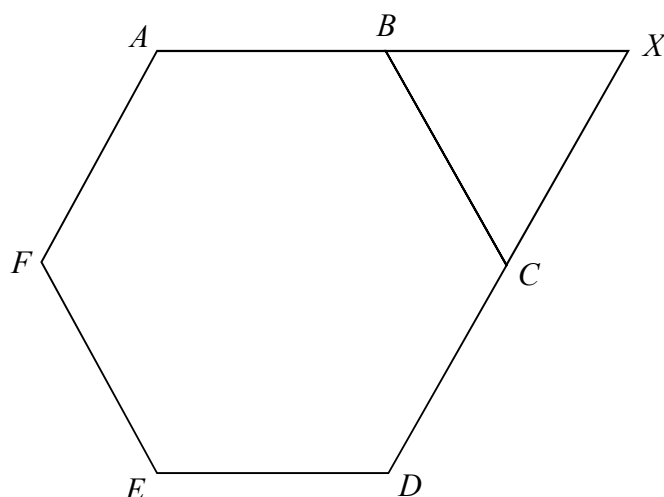


Diagram **NOT**  
accurately drawn

$ABX$  and  $DCX$  are straight lines.

$$\vec{AB} = \mathbf{a} \quad \vec{BC} = \mathbf{b}$$

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

Give your answer in its simplest form.

(Total for Question 22 is 4 marks)



22 The diagram shows triangle  $OAB$

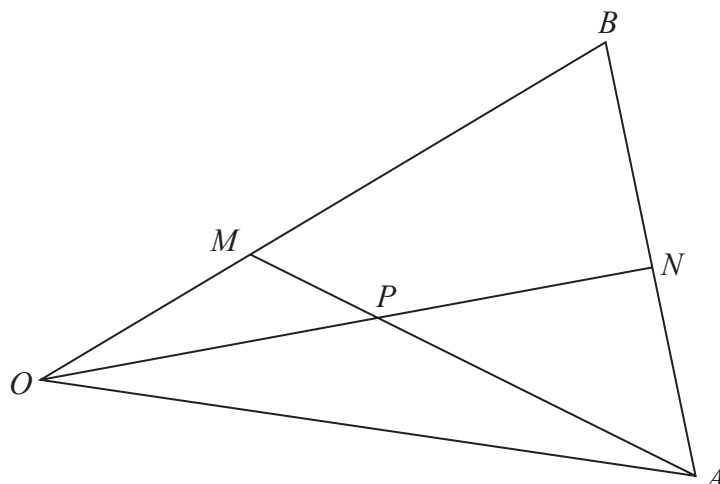


Diagram **NOT**  
accurately drawn

$$\vec{OA} = 8\mathbf{a} \quad \vec{OB} = 6\mathbf{b}$$

$M$  is the point on  $OB$  such that  $OM:MB = 1:2$

$N$  is the midpoint of  $AB$

$P$  is the point of intersection of  $ON$  and  $AM$

Using a vector method, find  $\vec{OP}$  as a simplified expression in terms of  $\mathbf{a}$  and  $\mathbf{b}$   
Show your working clearly.

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

(Total for Question 22 is 5 marks)



- 22 The diagram shows triangle  $OAB$  with  $OA$  extended to  $E$

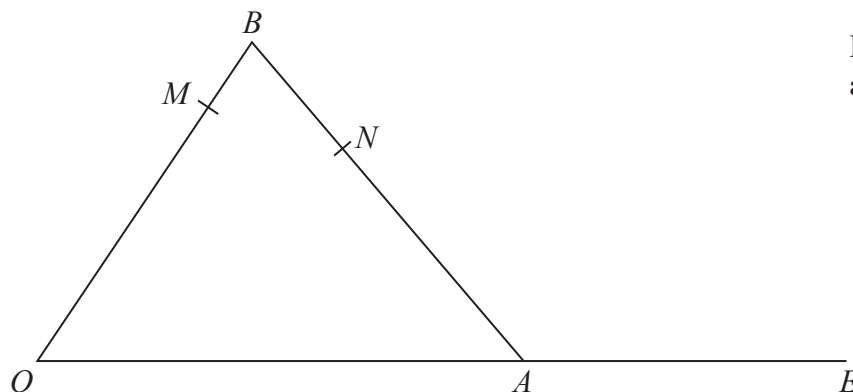


Diagram **NOT**  
accurately drawn

$$\vec{OA} = \mathbf{a} \quad \vec{OB} = \mathbf{b}$$

$M$  is the point on  $OB$  such that  $OM:MB = 4:1$

$N$  is the point on  $AB$  such that  $AN:NB = 3:2$

$OA:AE = 5:3$

- (a) Find an expression for  $\vec{ON}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$   
Give your answer in its simplest form.

$$\vec{ON} = \dots\dots\dots (2)$$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA





(b) Use a vector method to show that  $MNE$  is a straight line.

(3)

(Total for Question 22 is 5 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



23  $OAB$  is a triangle.

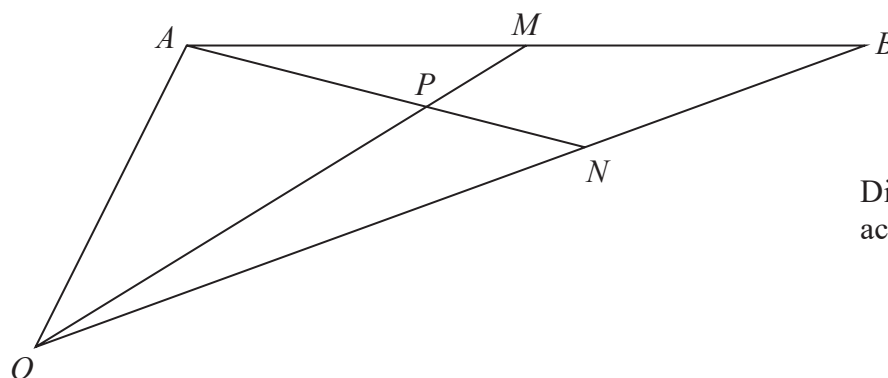


Diagram **NOT**  
accurately drawn

$$\vec{OA} = 2\mathbf{a} \text{ and } \vec{OB} = 2\mathbf{b}$$

$M$  is the midpoint of  $AB$ .

$N$  is the point on  $OB$  such that  $ON:NB = 2:1$

$P$  is the point on  $AN$  such that  $OPM$  is a straight line.

Use a vector method to find  $OP:PM$

Show your working clearly.

(Total for Question 23 is 6 marks)



23  $ABCD$  is a trapezium.

$$\vec{DC} = 3\vec{AB}$$

$$\vec{DA} = \begin{pmatrix} -2 \\ 3 \end{pmatrix} \quad \vec{DB} = \begin{pmatrix} -1 \\ 7 \end{pmatrix}$$

Find the exact magnitude of  $\vec{BC}$

(Total for Question 23 is 5 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



23

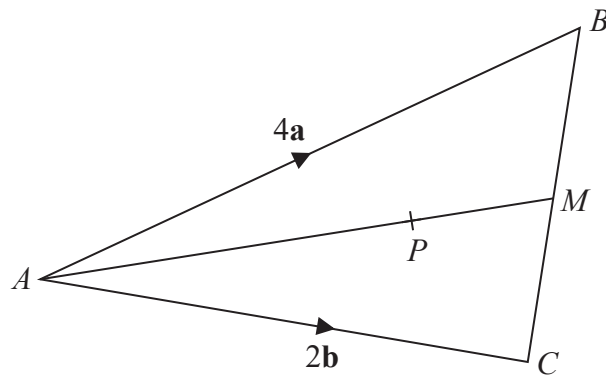


Diagram **NOT**  
accurately drawn

$ABC$  is a triangle.  
The midpoint of  $BC$  is  $M$ .  
 $P$  is a point on  $AM$ .

$$\vec{AB} = 4\mathbf{a}$$

$$\vec{AC} = 2\mathbf{b}$$

$$\vec{AP} = \frac{3}{2}\mathbf{a} + \frac{3}{4}\mathbf{b}$$

Find the ratio  $AP:PM$

(Total for Question 23 is 3 marks)



23  $OAB$  is a triangle.

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

$C$  is the midpoint of  $OA$ .

$D$  is the point on  $AB$  such that  $AD:DB = 3:1$

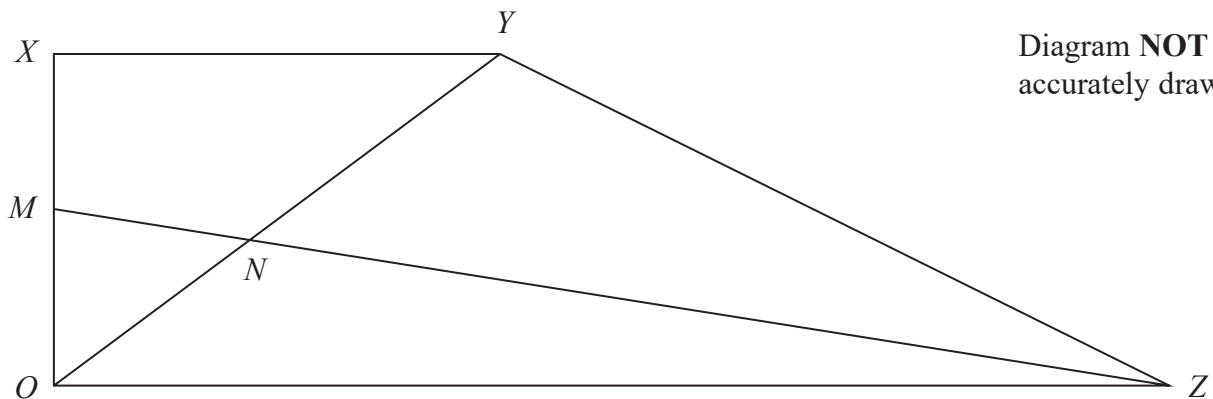
$E$  is the point such that  $\overrightarrow{OE} = 2\overrightarrow{BE}$

Using a vector method, prove that the points  $C$ ,  $D$  and  $E$  lie on the same straight line.

(Total for Question 23 is 5 marks)



24  $OXYZ$  is a trapezium.



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

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

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

$M$  is the midpoint of  $OX$

$N$  is the point such that  $MNZ$  and  $ONY$  are straight lines.

Given that  $ON : OY = \lambda : 1$

use a vector method to find the value of  $\lambda$

$$\lambda = \dots\dots\dots$$

(Total for Question 24 is 5 marks)



24  $OAED$  is a quadrilateral.

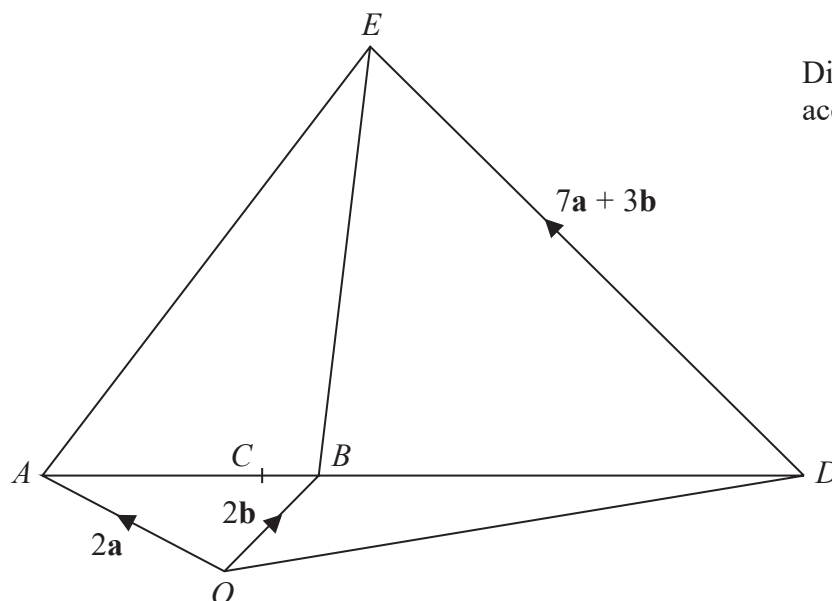


Diagram **NOT**  
accurately drawn

$$\vec{OA} = 2\mathbf{a} \quad \vec{OB} = 2\mathbf{b} \quad \vec{DE} = 7\mathbf{a} + 3\mathbf{b}$$

$$AB:BD = 1:2$$

The point  $C$  on  $AB$  is such that  $OCE$  is a straight line.

Use a vector method to find the ratio of  $OC:CE$

(Total for Question 24 is 5 marks)



24

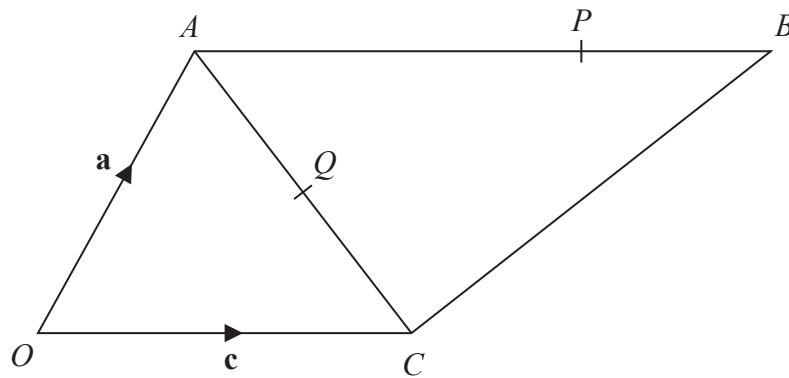


Diagram **NOT**  
accurately drawn

$$\vec{OA} = \mathbf{a} \quad \vec{OC} = \mathbf{c} \quad \vec{AB} = 2\mathbf{c}$$

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

$Q$  is the point on  $AC$  such that  $OQP$  is a straight line.

Use a vector method to find  $AQ : QC$

Show your working clearly.

$$AQ : QC = \dots\dots\dots$$

(Total for Question 24 is 5 marks)





25  $ABCD$  is a parallelogram and  $ADM$  is a straight line.

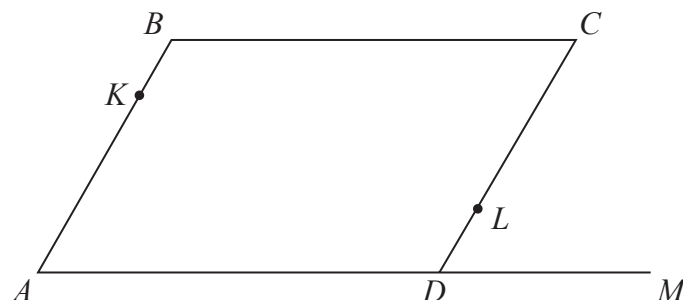


Diagram **NOT**  
accurately drawn

$$\vec{AB} = \mathbf{a} \quad \vec{BC} = \mathbf{b} \quad \vec{DM} = \frac{1}{2} \mathbf{b}$$

$K$  is the point on  $AB$  such that  $AK:AB = \lambda:1$

$L$  is the point on  $CD$  such that  $CL:CD = \mu:1$

$KLM$  is a straight line.

Given that  $\lambda:\mu = 1:2$

use a vector method to find the value of  $\lambda$  and the value of  $\mu$

$$\lambda = \dots\dots\dots$$

$$\mu = \dots\dots\dots$$

(Total for Question 25 is 5 marks)



26 The diagram shows trapezium  $OACB$ .

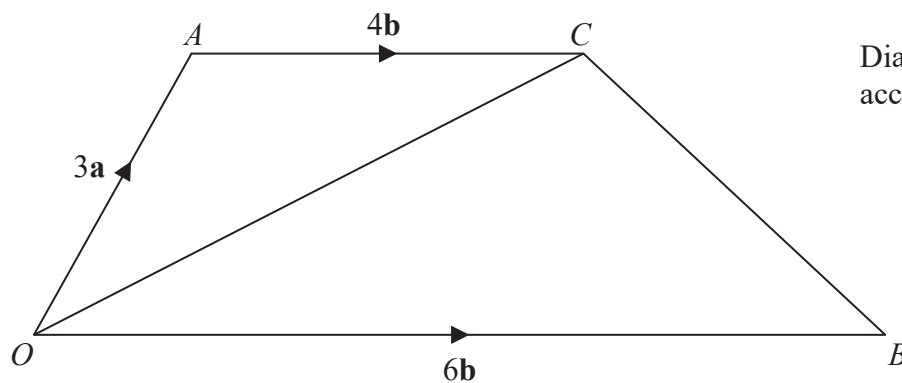


Diagram **NOT**  
accurately drawn

$$\vec{OA} = 3\mathbf{a} \quad \vec{OB} = 6\mathbf{b} \quad \vec{AC} = 4\mathbf{b}$$

$N$  is the point on  $OC$  such that  $ANB$  is a straight line.

Find  $\vec{ON}$  as a simplified expression in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

(Total for Question 26 is 5 marks)



26  $OACB$  is a trapezium.

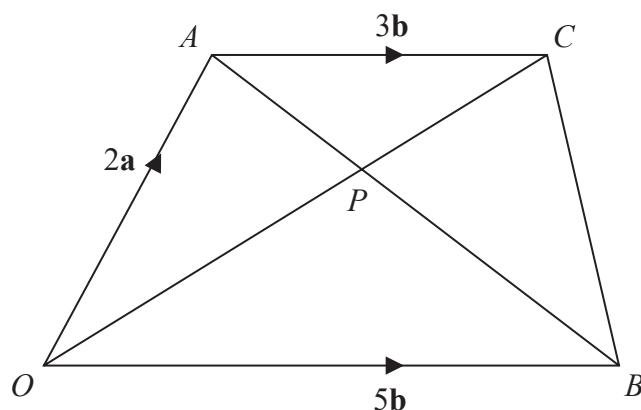


Diagram **NOT**  
accurately drawn

$$\vec{OA} = 2\mathbf{a} \quad \vec{OB} = 5\mathbf{b} \quad \vec{AC} = 3\mathbf{b}$$

The diagonals,  $OC$  and  $AB$ , of the trapezium intersect at the point  $P$ .

Find and simplify an expression, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ , for  $\vec{OP}$   
Show your working clearly.

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

(Total for Question 26 is 5 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



24

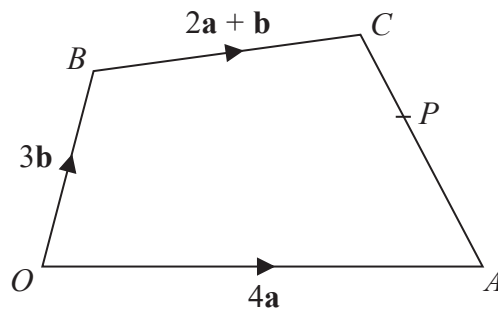


Diagram **NOT**  
accurately drawn

The diagram shows a quadrilateral  $OACB$  in which

$$\overrightarrow{OA} = 4\mathbf{a} \quad \overrightarrow{OB} = 3\mathbf{b} \quad \overrightarrow{BC} = 2\mathbf{a} + \mathbf{b}$$

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

$$\overrightarrow{AC} = \dots\dots\dots (2)$$

The point  $P$  lies on  $AC$  such that  $AP:PC = 3:2$

The point  $Q$  is such that  $OPQ$  and  $BCQ$  are straight lines.

- (b) Using a vector method, find  $\overrightarrow{OQ}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$   
Give your answer in its simplest form.  
Show your working clearly.

$$\overrightarrow{OQ} = \dots\dots\dots (4)$$

(Total for Question 24 is 6 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



24  $OAB$  is a triangle.

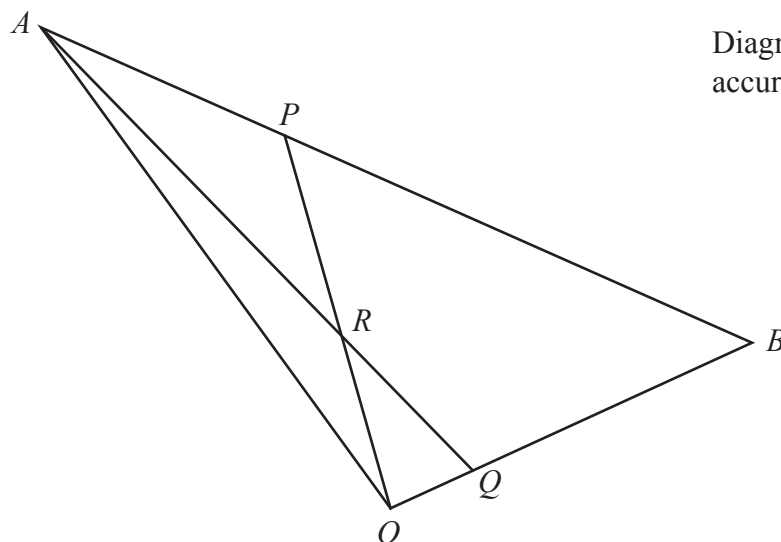


Diagram **NOT**  
accurately drawn

$$\vec{OA} = 10\mathbf{a} \quad \vec{OB} = 10\mathbf{b}$$

$ARQ$  and  $ORP$  are straight lines.

$$\vec{AP} = \frac{1}{4} \vec{AB} \quad \text{and} \quad \vec{OQ} = \frac{1}{5} \vec{OB}$$

Write the following vectors in terms of  $\mathbf{a}$  and  $\mathbf{b}$   
Simplify your answers.

(i)  $\vec{AQ}$

(1)

(ii)  $\vec{OP}$

(1)

(iii)  $\vec{OR}$

(4)

(Total for Question 24 is 6 marks)



25  $OPQR$  is a parallelogram.

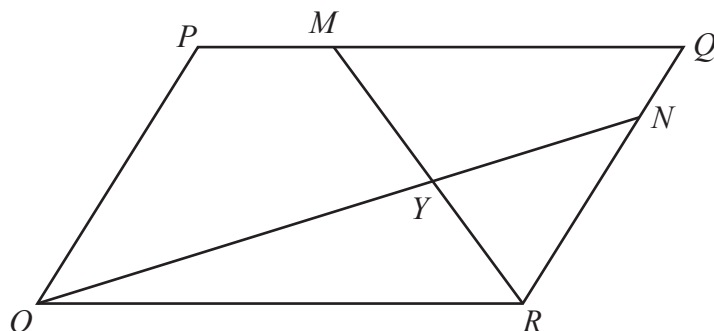


Diagram **NOT** accurately drawn

$$\vec{OP} = 2\mathbf{a} \quad \text{and} \quad \vec{OR} = 3\mathbf{b}$$

The point  $M$  lies on  $PQ$  such that  $PM = \frac{1}{4}PQ$

The point  $N$  lies on  $RQ$  such that  $RN = \frac{4}{5}RQ$

(a) Find, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ , giving your answers in simplest form

(i)  $\vec{ON}$

(1)

(ii)  $\vec{MR}$

(1)

$MR$  and  $ON$  intersect at the point  $Y$

Given that

$$OY = k \times ON$$

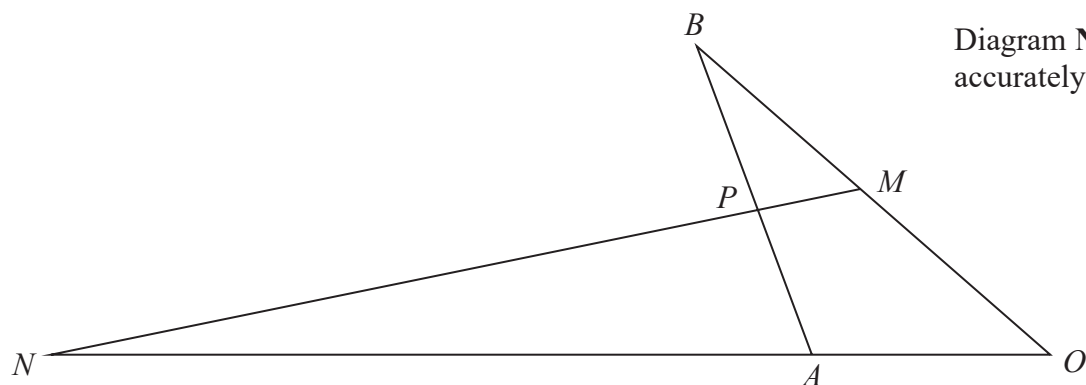
(b) use a vector method to find the value of  $k$

$$k = \dots\dots\dots (4)$$

(Total for Question 25 is 6 marks)



25

Diagram **NOT**  
accurately drawn

$OAN$ ,  $OMB$ ,  $APB$  and  $MPN$  are straight lines.

$$OA:AN = 1:4$$

$$OM:MB = 1:1$$

$$\vec{OA} = 2\mathbf{a} \quad \vec{OB} = 2\mathbf{b}$$

By using a vector method, find the ratio  $AP:PB$   
Give your answer in its simplest form.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Question 25 is 5 marks)

