

**Higher tier unit 18 check in test**

*Non-calculator*

Q1.  $\mathbf{e} = \begin{pmatrix} 4 \\ 1 \end{pmatrix}$        $\mathbf{f} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$

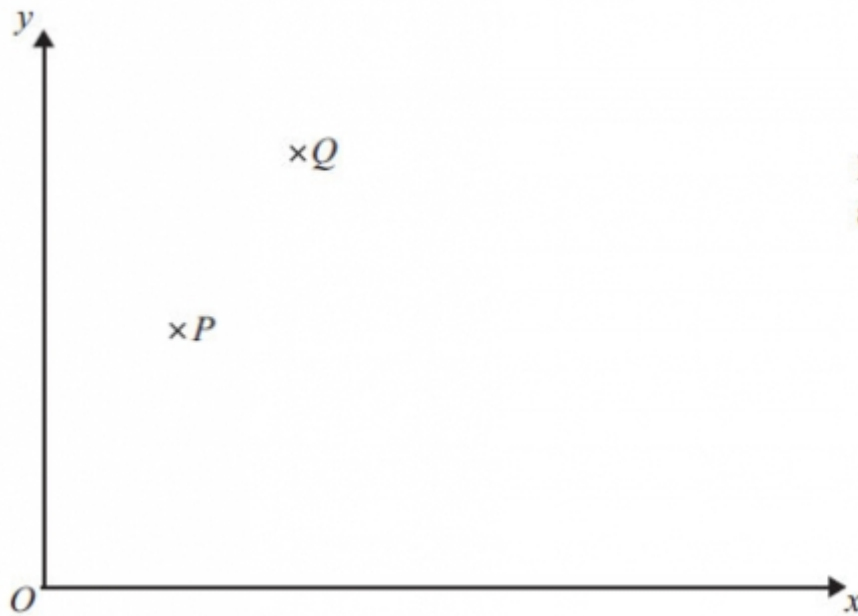
Write  $\mathbf{e} + \mathbf{f}$  as a column vector.

Q2.  $\mathbf{a} = \begin{pmatrix} 2 \\ a \end{pmatrix}$        $\mathbf{b} = \begin{pmatrix} 2b \\ 3 \end{pmatrix}$

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

[Q3–4 linked]

Q3.



The diagram is a sketch.

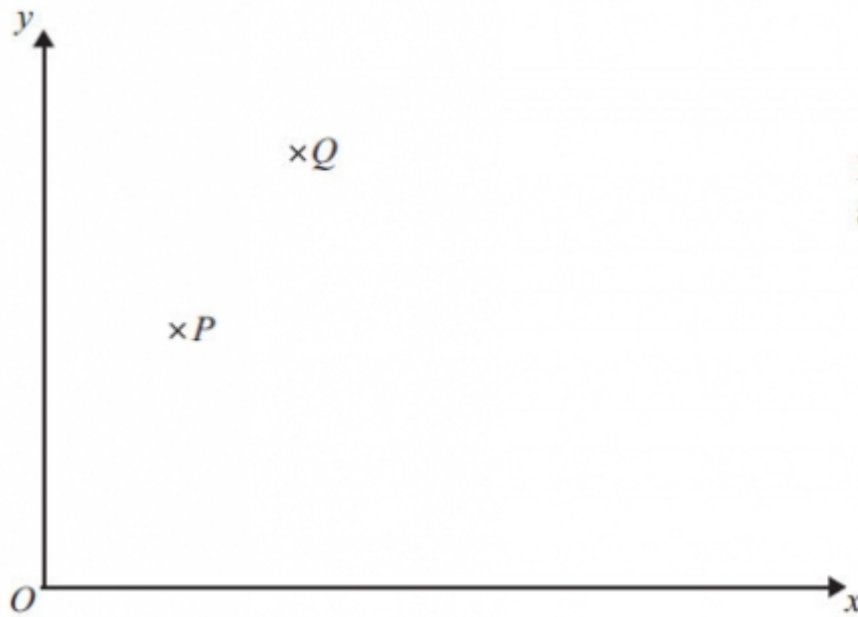
$P$  is the point (2, 4)

$Q$  is the point (4, 8)

Find the vector  $PQ$

Give your answer as a column vector

Q4.



The diagram is a sketch.

$P$  is the point  $(2, 4)$

$Q$  is the point  $(4, 8)$

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

$M$  is the midpoint of  $PQ$ .

$N$  is the midpoint of  $QR$ .

Find the vector  $MN$

Give your answer as a column vector

Q5. Find the length of the vector  $\begin{pmatrix} 4 \\ 6 \end{pmatrix}$ . Give your answer in surd form.

Q6.

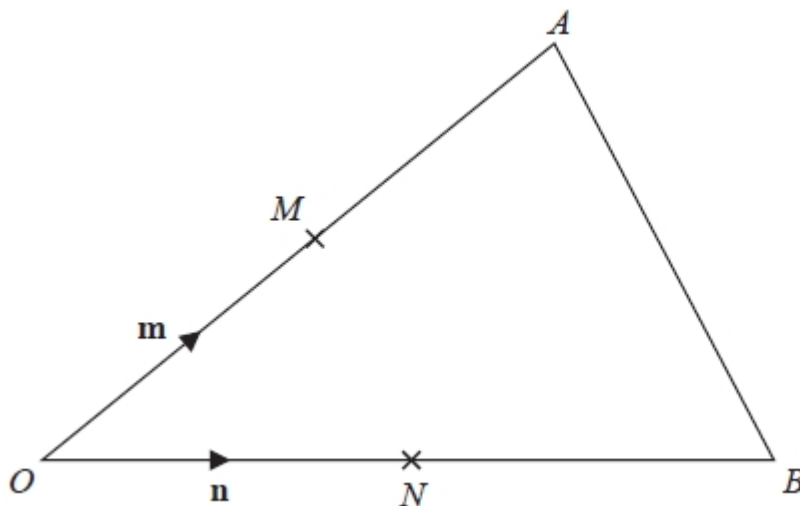


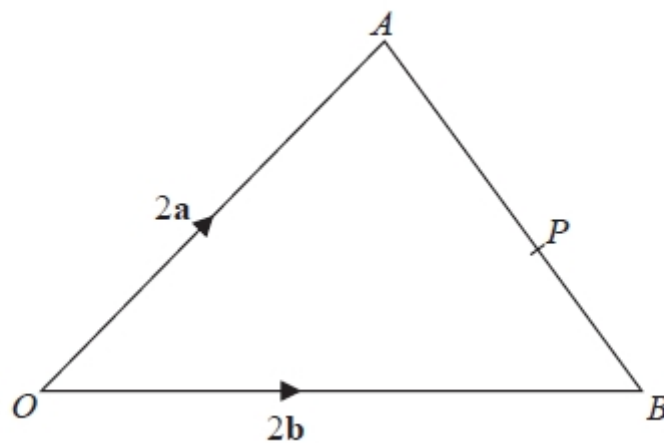
Diagram **NOT** accurately drawn

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

$$\begin{aligned}\vec{OM} &= \mathbf{m} \\ \vec{ON} &= \mathbf{n}\end{aligned}$$

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

Q7.



$OAB$  is a triangle.  
 $P$  is the point on  $AB$  such that  $AP : PB = 5 : 3$

$$\begin{aligned}\vec{OA} &= 2\mathbf{a} \\ \vec{OB} &= 2\mathbf{b} \\ \vec{OP} &= k(3\mathbf{a} + 5\mathbf{b}) \text{ where } k \text{ is a scalar quantity.}\end{aligned}$$

Find the value of  $k$ .

[Q8–9 linked]

Q8.  $OACB$  is a parallelogram.

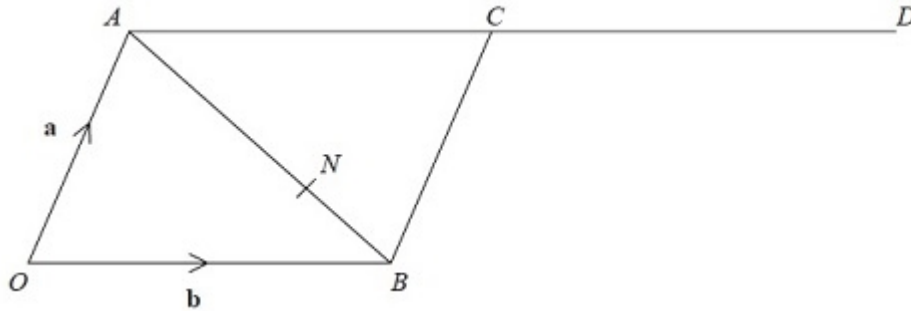


Diagram NOT accurately drawn

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

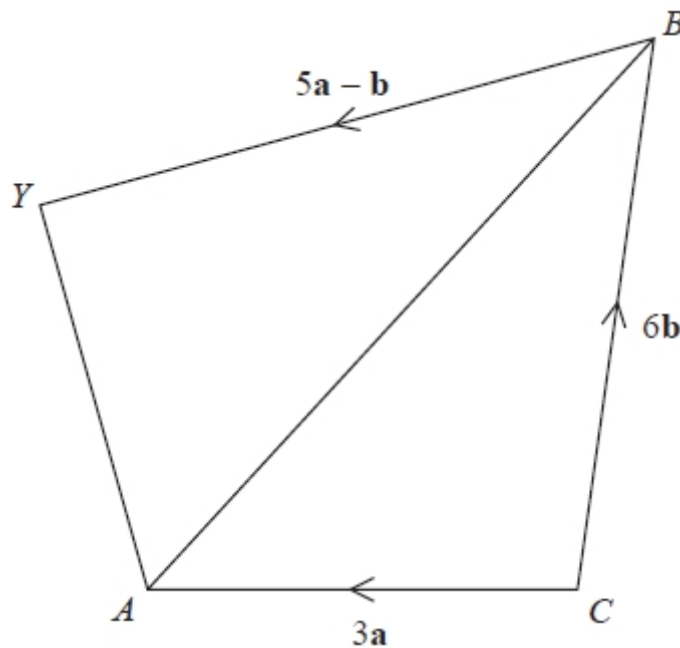
$D$  is the point such that  $AC = CD$

The point  $N$  divides  $AB$  in the ratio  $2 : 1$

Write an expression for  $ON$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

Q9. From the diagram in question 8, prove that  $OND$  is a straight line.

Q10.



$CAYB$  is a quadrilateral.

$CA = 3\mathbf{a}$

$CB = 6\mathbf{a}$

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

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

Prove that  $CX = \frac{2}{5}CY$

*Topics listed in objectives*

- Understand and use vector notation, including column notation, and understand and interpret vectors as displacement in the plane with an associated direction.
- Understand that  $2\mathbf{a}$  is parallel to  $\mathbf{a}$  and twice its length, and that  $\mathbf{a}$  is parallel to  $-\mathbf{a}$  in the opposite direction.
- Represent vectors, combinations of vectors and scalar multiples in the plane pictorially.
- Calculate the sum of two vectors, the difference of two vectors and a scalar multiple of a vector using column vectors (including algebraic terms).
- Find the length of a vector using Pythagoras' Theorem.
- Calculate the resultant of two vectors.
- Solve geometric problems in 2D where vectors are divided in a given ratio.
- Produce geometrical proofs to prove points are collinear and vectors/lines are parallel.

*Answers*

Q1.  $\begin{matrix} 10 \\ 1 \end{matrix}$

Q2.  $\begin{matrix} 6 & 4b \\ 3a+6 \end{matrix}$

Q3.  $\begin{matrix} 2 \\ 4 \end{matrix}$

Q4.  $\begin{matrix} 4 \\ 0 \end{matrix}$

Q5.  $2\sqrt{13}$

Q6.  $MN = \mathbf{n} - \mathbf{m}$  and  $AB = 2\mathbf{n} - 2\mathbf{m}$ , so lines are parallel

Q7.  $k = \frac{1}{4}$

Q8.  $ON = \frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$

Q9.  $OD = 3ON$

Q10.  $CY = 5\mathbf{a} + 5\mathbf{b}$ ,  $CX = 2\mathbf{a} + 2\mathbf{b}$