1. 4024/11/M/J/18 Q21

$$\mathbf{p} = \begin{pmatrix} 3 \\ 4 \end{pmatrix} \qquad \mathbf{q} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$$

(a) Write $3\mathbf{p} - \mathbf{q}$ as a column vector.

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [1]

(b) R is the point $(11, -2)$ and O is the point $(0, 0)$.

The vector $\overrightarrow{OR}$ can be written in the form $\mathbf{p} + n\mathbf{q}$, where n is an integer.

Find the value of n.

Answer $n = $ .... [2]

2. 4024/12/M/J/18 Q23

$$A = \begin{pmatrix} 4 & -1 \\ 2 & 0 \end{pmatrix} \qquad B = \begin{pmatrix} 6 & -3 \\ 0 & -2 \end{pmatrix}$$

(a) Find the matrix **X**, such that $2A + X = B$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Find the matrix **Y**, such that $AY = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$.

Answer [3]

3. 4024/22/M/J/18 Q8b

(b) $\overrightarrow{OA} = 3\mathbf{a}$ and $\overrightarrow{OC} = 6\mathbf{c}$ and $CB : BY = 1 : 2$.

Find, as simply as possible, in terms of **a** and/or **c**

(i) $\overrightarrow{AB}$,

Answer $\overrightarrow{AB} = $ .... [1]

(ii) $\overrightarrow{CY}$.

Answer $\overrightarrow{CY} = $ .... [2]

(c) Find, in its simplest form, the ratio

(i) $OX : XB$,

Answer .... : ....[2]

(ii) area of triangle COX : area of triangle ABX,

Answer .... : ....[1]

(iii) area of triangle AYB : area of trapezium $OABC$.

Answer .... : ....[1]

4. 4024/11/O/N/18 Q20

$$A = \begin{pmatrix} 2 & -1 \\ 0 & 1 \end{pmatrix} \qquad B = \begin{pmatrix} 4 & 3 \\ 6 & -2 \end{pmatrix}$$

(a) Express $2A - B$ as a single matrix.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Find A^{-1}.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

5. 4024/12/O/N/18 Q23

(a) Express $\begin{pmatrix} 2 \\ 1 \end{pmatrix} - 3\begin{pmatrix} -1 \\ 2 \end{pmatrix} + 2\begin{pmatrix} 0 \\ -2 \end{pmatrix}$ as a single vector.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Find $\begin{pmatrix} 2 & -1 \end{pmatrix}\begin{pmatrix} 0 & -1 & 2 \\ 3 & 1 & -3 \end{pmatrix}$.

Answer [2]

6. 4024/21/O/N/18 Q7

The position vector, $\overrightarrow{OA}$, of point A is $\begin{pmatrix} -4 \\ 7 \end{pmatrix}$ and $\overrightarrow{AB} = \begin{pmatrix} 6 \\ -3 \end{pmatrix}$.

(a) Find the position vector, $\overrightarrow{OB}$, of point B.

Answer $\overrightarrow{OB} = \begin{pmatrix} \\ \end{pmatrix}$ [1]

(b) Find $\left| \overrightarrow{AB} \right|$.

Answer .... [2]

(c) Given that $\overrightarrow{AB} = 3\overrightarrow{CB}$, find the coordinates of point C.

Answer (.................. , ...) [2]

7. 4024/11/M/J/19 Q15

$$\mathbf{T} = \begin{pmatrix} 2 & 7 \\ 1 & 5 \end{pmatrix}$$

Find $\mathbf{T}^{-1}$.

$$\begin{pmatrix} & \\ & \end{pmatrix}$$ [2]

8. 4024/12/M/J/19 Q25

(a) $P = \begin{pmatrix} 4 & 0 \\ -2 & 3 \end{pmatrix}$ $Q = \begin{pmatrix} 1 & 2 \\ 0 & -1 \end{pmatrix}$

Evaluate **PQ**.

$\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) $M = \begin{pmatrix} 3 & -1 \\ 2 & k \end{pmatrix}$

The determinant of matrix **M** is −4.

(i)   Find the value of k.

$k = $ .... [1]
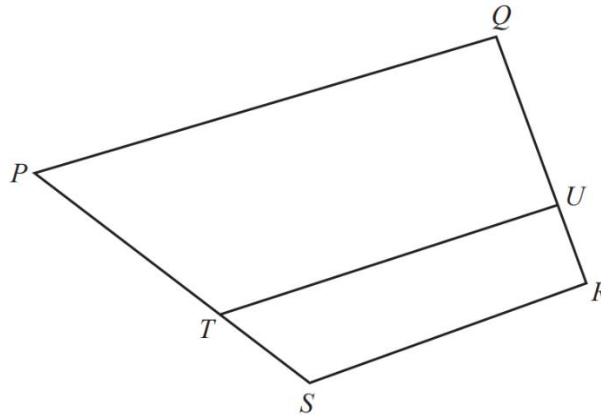
(ii) Find M^{-1}.

$\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

9. 4024/21/M/J/19 Q9

(a)

NOT TO
SCALE

In the diagram, $\overrightarrow{PQ} = 4\mathbf{p}$, $\overrightarrow{QR} = 3\mathbf{q}$ and $\overrightarrow{PT} = \mathbf{p} + 2\mathbf{q}$.

$\overrightarrow{QU} = \frac{2}{3}\overrightarrow{QR}$ and $\overrightarrow{PT} = \frac{2}{3}\overrightarrow{PS}$.

(i) Express, as simply as possible, in terms of $\mathbf{p}$ and/or $\mathbf{q}$,

(a) $\overrightarrow{PS}$,

$\overrightarrow{PS} =$ .... [1]

(b) $\overrightarrow{SR}$.

$\overrightarrow{SR} =$ .... [2]

(ii) State the name of the special quadrilateral *PQRS*.
Using vectors, give a reason for your answer.

.... because ....

.... [2]

(iii) Find, in its simplest form, the ratio $\left|\overrightarrow{PQ}\right| : \left|\overrightarrow{SR}\right|$.

.... : .... [2]

(b) $\overrightarrow{AB} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ $\overrightarrow{BC} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$ $\overrightarrow{CD} = \begin{pmatrix} -7 \\ -3 \end{pmatrix}$

(i)   Find $\overrightarrow{AD}$.

$$\overrightarrow{AD} = \begin{pmatrix} \\ \end{pmatrix} \quad [1]$$

(ii)   Find $\left|\overrightarrow{BC}\right|$.

.... [2]

(iii)   Given that E is the midpoint of BC, find $\overrightarrow{AE}$.

$$\overrightarrow{AE} = \begin{pmatrix} \\ \end{pmatrix} \quad [2]$$

10. 4024/11/O/N/19 Q25

In the diagram, B is the midpoint of OD and $OA : AC = 1 : 3$.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Express, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$

(i) $\overrightarrow{OC}$,

$\overrightarrow{OC} =$ .... [1]

(ii) $\overrightarrow{CD}$.

$\overrightarrow{CD} =$ .... [1]

(b) P is the point on CD where $CP = \frac{3}{4}CD$.

(i) Express $\overrightarrow{AP}$, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$.

$\overrightarrow{AP} =$ .... [2]

(ii) Find $AP : BD$.

.... : .... [1]

(iii) What special type of quadrilateral is $ABDP$?

.... [1]

11. 4024/12/O/N/19 Q21
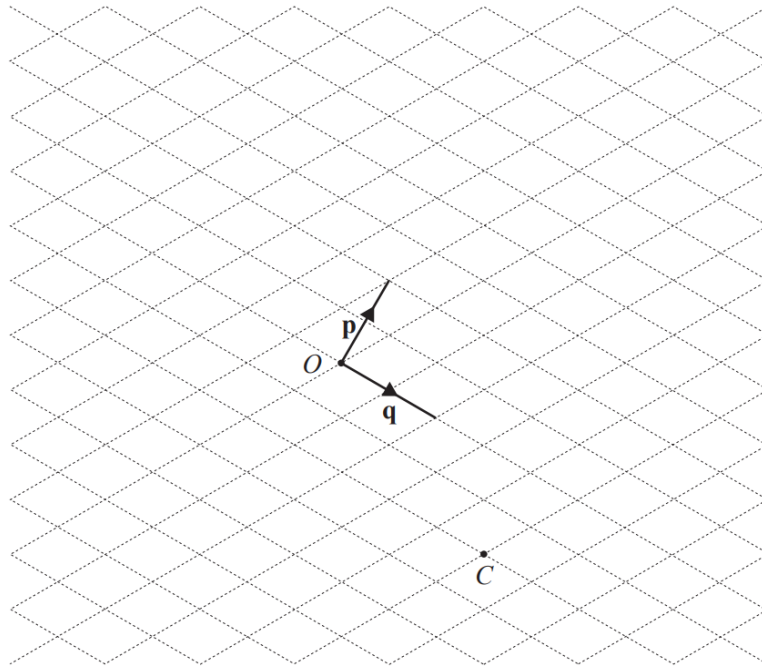
The diagram shows points O and C and the vectors **p** and **q**.

(a) Given that $\overrightarrow{OA} = 2\mathbf{p}$, mark and label the point A on the diagram.   [1]
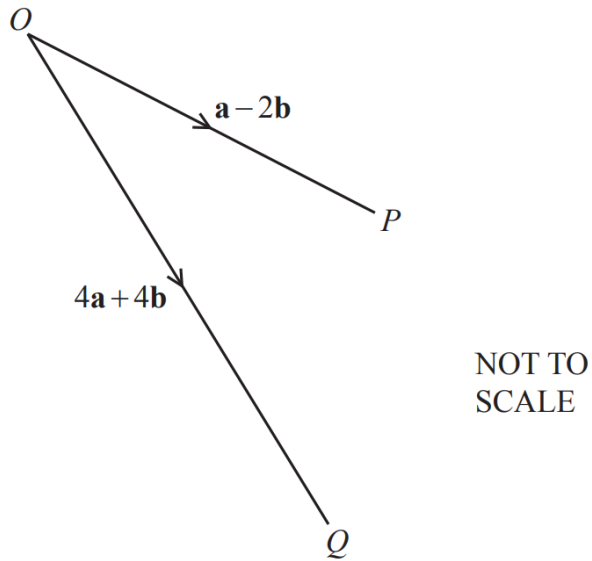
(b) Given that $\overrightarrow{OB} = \mathbf{p} - 2\mathbf{q}$, mark and label the point B on the diagram.   [1]

(c) Express $\overrightarrow{OC}$ in terms of **p** and **q**.

.... [2]

12. 4024/11/M/J/20 Q25

O, P and *Q* are points as shown in the diagram.

$\overrightarrow{OP} = \mathbf{a} - 2\mathbf{b}$ and $\overrightarrow{OQ} = 4\mathbf{a} + 4\mathbf{b}$.

Express $\overrightarrow{PQ}$, as simply as possible, in terms of **a** and **b**.

$\overrightarrow{PQ} =$ .... [2]

13. 4024/12/M/J/20 Q19
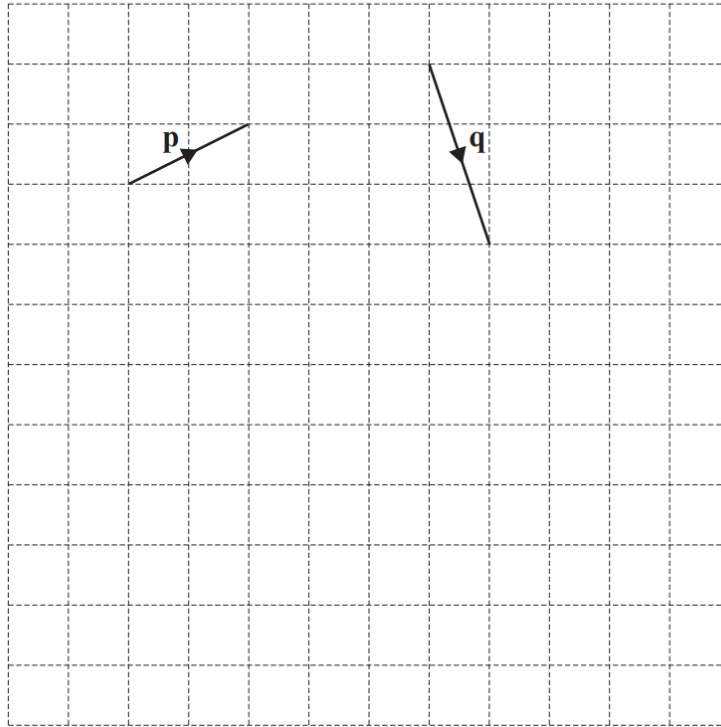
Vectors **p** and **q** are shown on the grid.

On the grid, draw the vector

(a) 3**p**,   [1]

(b) **q** − **p**.   [1]

14. 4024/21/O/N/20 Q9

    (a) H is the point $(5, 2)$ and J is the point $(-3, 6)$.

        (i)   Find $\overrightarrow{HJ}$.

$$\overrightarrow{HJ} = \begin{pmatrix} & \\ & \end{pmatrix} \quad [1]$$

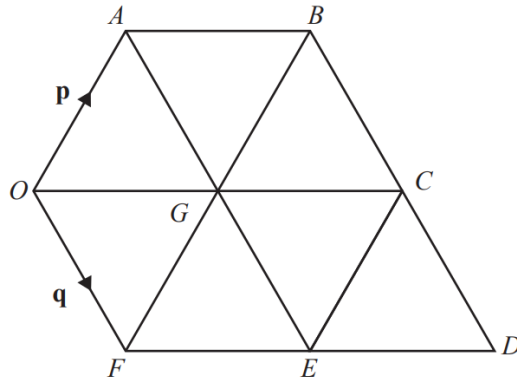   **(ii)**   Calculate the magnitude of $\overrightarrow{HJ}$.

.... [2]

    (iii) M is the midpoint of HJ.

           Find the position vector of M.

$$\begin{pmatrix} & \\ & \end{pmatrix} \quad [2]$$

(b)

The diagram shows a shape made from seven identical equilateral triangles.
$\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{OF} = \mathbf{q}$.

(i) Express, as simply as possible, in terms of $\mathbf{p}$ and/or $\mathbf{q}$

  (a) $\overrightarrow{FB}$,

$$\overrightarrow{FB} = \text{...} \quad [1]$$

  (b) $\overrightarrow{FE}$.

$$\overrightarrow{FE} = \text{...} \quad [1]$$

(ii) X is a point on FB and $FX : XB = 3 : 1$.

  Express $\overrightarrow{OX}$, as simply as possible, in terms of $\mathbf{p}$ and/or $\mathbf{q}$.

$$\overrightarrow{OX} = \text{...} \quad [2]$$

(iii) Y is a point on BD.
  Quadrilateral $OXYF$ is a trapezium.

  Express $\overrightarrow{XY}$, as simply as possible, in terms of $\mathbf{p}$ and/or $\mathbf{q}$.

$$\overrightarrow{XY} = \text{...} \quad [3]$$

Exambuddy

15. 4024/22/O/N/20 Q8

(a) H is the point $(-7, 4)$ and $\overrightarrow{HJ} = \begin{pmatrix} 10 \\ -6 \end{pmatrix}$.

   (i) Calculate the magnitude of $\overrightarrow{HJ}$.

   .... [2]

   (ii) Given that $\overrightarrow{HK} = 3\overrightarrow{HJ}$, find the coordinates of point K.

   (....................... , ...) [2]

Fo (b)
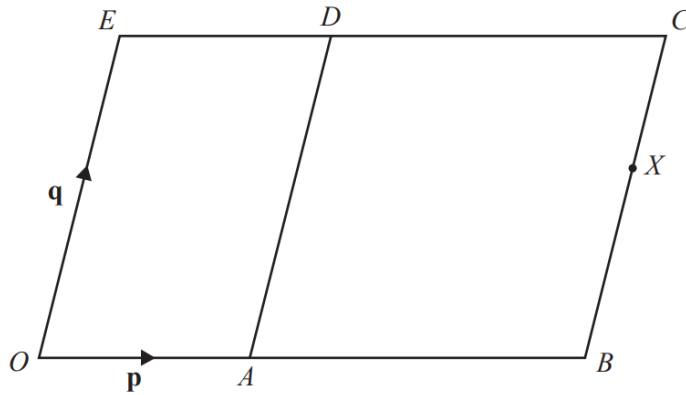
NOT TO SCALE

The diagram shows a parallelogram *OBCE*.
$\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{OE} = \mathbf{q}$.
AD is parallel to *OE* and *OA* : *AB* = 1 : 3.
X is a point on *BC* such that *BX* : *XC* = 3 : 2.

Express, as simply as possible, in terms of **p** and/or **q**

(i) $\overrightarrow{OC}$,

$\overrightarrow{OC} =$ .... [1]

(ii) $\overrightarrow{AX}$,

$\overrightarrow{AX} =$ .... [2]

(iii) $\overrightarrow{EX}$.

$\overrightarrow{EX} =$ .... [2]

16. 4024/21/M/J/21 Q10

(a) $\overrightarrow{AB} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$

(i) Calculate $\left|\overrightarrow{AB}\right|$.

$\left|\overrightarrow{AB}\right| =$ .... [2]

(ii) $\overrightarrow{AC} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$ and C is the point $(10, -1)$.
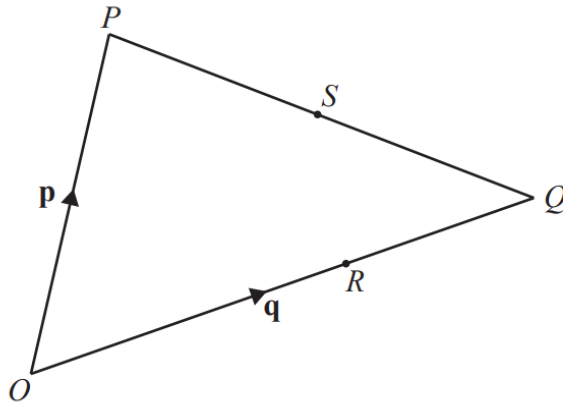
(a) Find the coordinates of the point A.

(.................... , ...) [1]

(b) B is the midpoint of AD.

Find the coordinates of the point D.

(.................... , ...) [2]

(b)

NOT TO
SCALE

The diagram shows triangle *OPQ*.
$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$.
R is the point on *OQ* such that *OR* = 2*RQ*.
S is the midpoint of *PQ*.

Express, as simply as possible, in terms of **p** and/or **q**

(i) $\overrightarrow{PQ}$,

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

(ii) $\overrightarrow{OS}$,

$\overrightarrow{OS} =$ .... [2]

(iii) $\overrightarrow{SR}$.

$\overrightarrow{SR} =$ .... [2]

Exambuddy

17. 4024/22/M/J/21 Q12

    (a)   *A* is the point (2, 3) and *B* is the point (3, −5).

        (i)   Find $\overrightarrow{AB}$.

$$\overrightarrow{AB} = \begin{pmatrix} \\ \end{pmatrix} \quad [2]$$

        (ii) $\overrightarrow{BC} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$
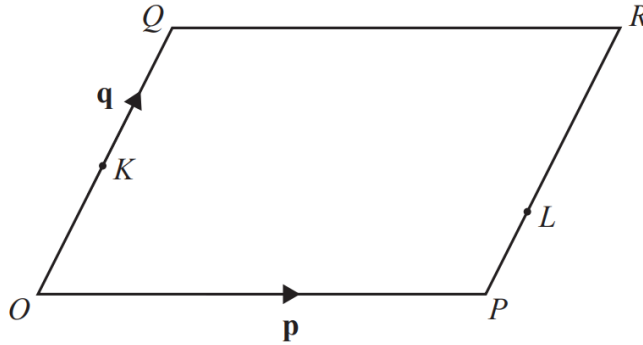
            Find the coordinates of *C*.

(........................ , ...) [1]

        (iii) $\left|\overrightarrow{AD}\right| = \sqrt{74}$ and $D = (-3, n)$.

            Find the possible values of *n*.

$n = $ .... or $n = $ .... [3]

(b)

NOT TO
SCALE

OQRP is a parallelogram.

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

K is the midpoint of *OQ* and *L* is a point on *PR*.

$\overrightarrow{KL} = \mathbf{p} - \dfrac{1}{10}\mathbf{q}$.

Find *PL* : *LR*.

.... : .... [3]

18. 4024/11/O/N/21 Q15

The point A has position vector $\begin{pmatrix} 3 \\ -7 \end{pmatrix}$ and $\overrightarrow{AB} = \begin{pmatrix} -5 \\ 12 \end{pmatrix}$.

(a) Find the coordinates of point B.

(..................... , ...) [2]

(b) Find $\left|\overrightarrow{AB}\right|$.

$\left|\overrightarrow{AB}\right| =$ .... units [2]

19. 4024/22/O/N/21 Q7

(a) *P* is the point $(-5, 2)$, *Q* is the point $(3, 7)$ and $\overrightarrow{QR} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}$.

    (i) Find the coordinates of the midpoint of *PQ*.

(........................ , ...) [1]

    (ii) Find the coordinates of point *R*.

(........................ , ...) [1]

    (iii) Find $\left| \overrightarrow{QR} \right|$.

$\left| \overrightarrow{QR} \right| =$ .... units [2]

(b)
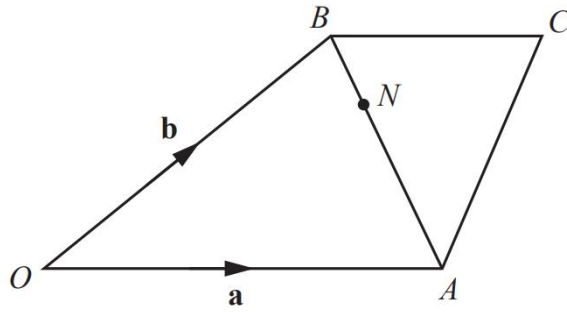
NOT TO
SCALE

OACB is a quadrilateral and *N* is a point on *AB*.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.
$\overrightarrow{OA} = 2\overrightarrow{BC}$ and $BN : NA = 1 : 3$.

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

(i) $\overrightarrow{AB}$,

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

(ii) $\overrightarrow{NC}$.

$\overrightarrow{NC} =$ .... [3]

20. 4024/11/M/J/22 Q16

$$\mathbf{p} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \qquad \mathbf{q} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$$

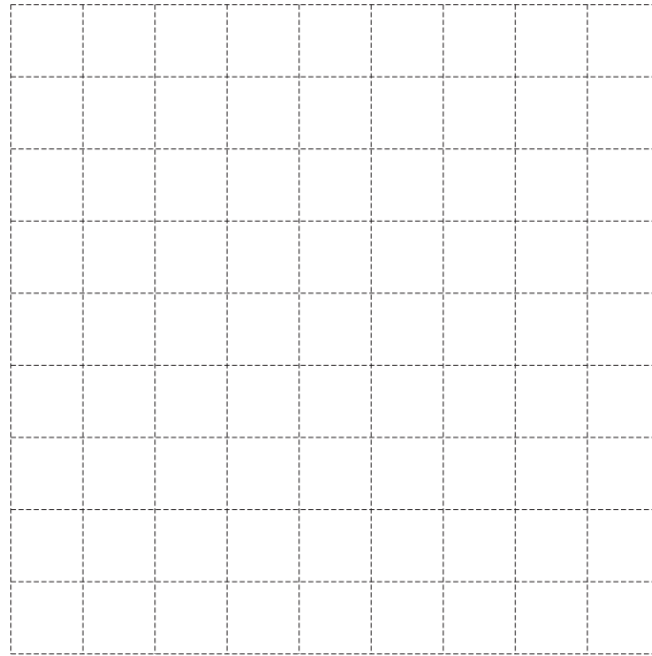   **(a)** On the unit grid below, draw and label vector **p**.
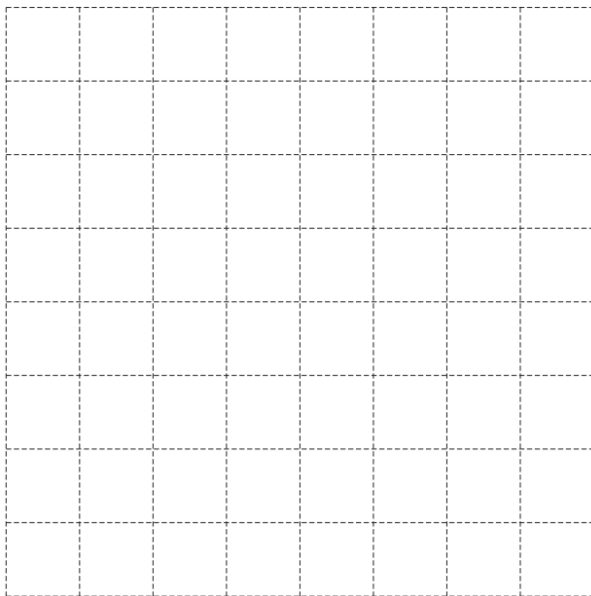
[1]

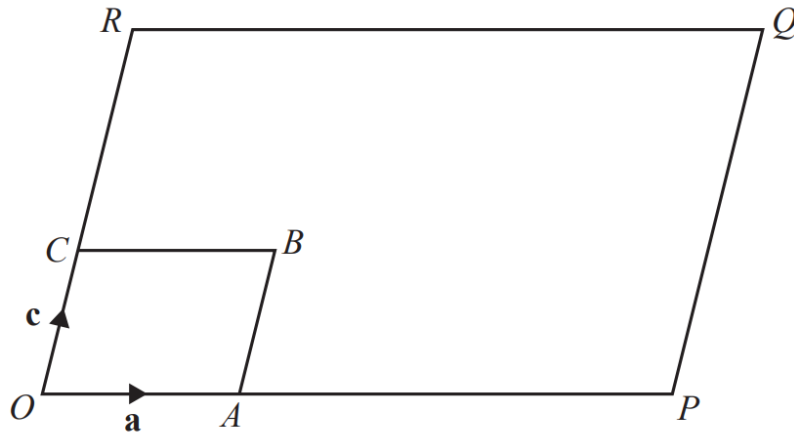   **(b)** On the unit grid below, draw and label vector 2**q**.

[1]

(c) On the unit grid below, draw and label vector $\mathbf{p} - \mathbf{q}$.

[2]

21. 4024/12/M/J/22 Q25

NOT TO SCALE

OABC and *OPQR* are parallelograms.
A is a point on *OP* and *C* is a point on *OR*.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$.
$OA : OP = 1 : 4$ and $OC : CR = 2 : 3$.

(a) Find $\overrightarrow{OR}$ in terms of $\mathbf{c}$.

$\overrightarrow{OR} =$ .... [1]

(b) Find $\overrightarrow{CQ}$, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{c}$.

$\overrightarrow{CQ} =$ .... [2]

(c) Find the ratio area *OABC* : area *OPQR*.

.... : .... [1]

22. 4024/21/O/N/22 Q6

(a) The position vector of point A is $\begin{pmatrix} 4 \\ 7 \end{pmatrix}$ and the position vector of point B is $\begin{pmatrix} 9 \\ 2 \end{pmatrix}$.

    (i) Find the column vector $\overrightarrow{AB}$.

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

    (ii) Find $\left| \overrightarrow{AB} \right|$.

$$\left| \overrightarrow{AB} \right| = \text{...} \quad [2]$$

    (iii) $ABCD$ is a parallelogram with sides AB, BC, CD and DA.

$$\overrightarrow{BC} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}.$$

    Find the coordinates of point C and point D.

$$C = (\text{...................} , \text{...................})$$

$$D = (\text{...................} , \text{...................}) \quad [2]$$

(b) P is the point $(r, 4)$ and Q is the point (t, u).

The midpoint of line PQ is $(1, 3)$.

The gradient of line PQ is $-\dfrac{1}{4}$.
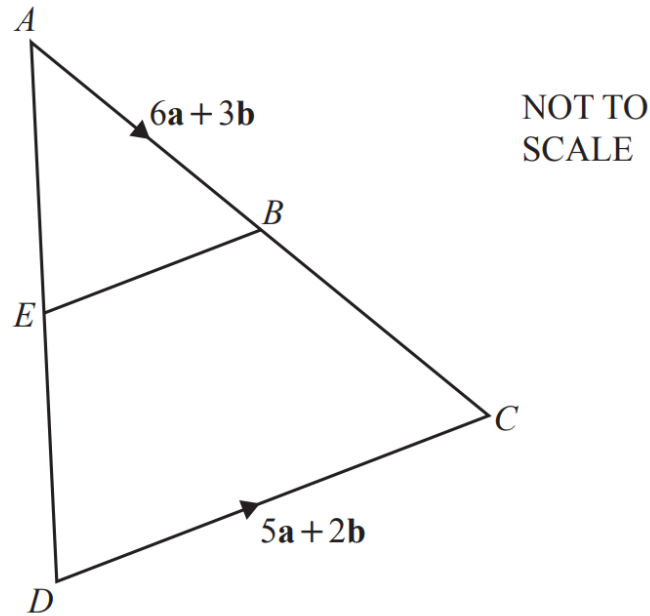
Find the value of each of r, t and u.

$r =$ ....

$t =$ ....

$u =$ .... [4]

23. 4024/11/M/J/22 Q25

In triangle ACD, B is the midpoint of AC and E is the midpoint of AD.
$\overrightarrow{AB} = 6\mathbf{a} + 3\mathbf{b}$ and $\overrightarrow{DC} = 5\mathbf{a} + 2\mathbf{b}$.

(a) Express, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{b}$.

(i) $\overrightarrow{AC}$

$\overrightarrow{AC} =$ .... [1]

(ii) $\overrightarrow{AD}$

$\overrightarrow{AD} =$ .... [2]

(b) Show that $\overrightarrow{EB}$ is parallel to $\overrightarrow{DC}$.

....

....

....

....

....

.... [3]