Vectors and transformations – 2023 O Level Math D 4024

1. Nov/2023/Paper_ 4024/11/No.20

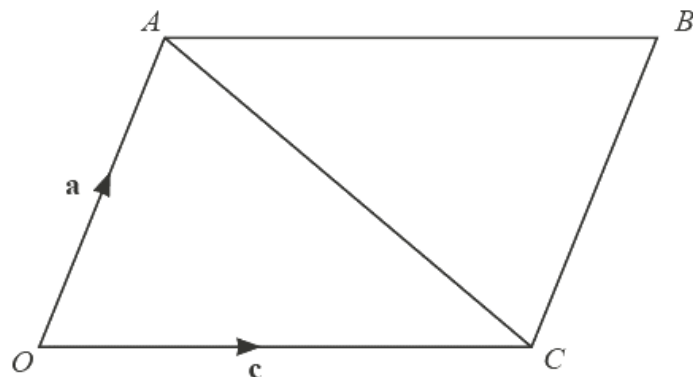$$A = \begin{pmatrix} -2 & 1 \\ 4 & 3 \end{pmatrix} \qquad\qquad B = \begin{pmatrix} 3 & 2 \\ -1 & 1 \end{pmatrix}$$

(a) Find A^{-1}.

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

(b) Find AB.

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

1

2. Nov/2023/Paper_ 4024/11/No.23

NOT TO SCALE

In the diagram, $OABC$ is a parallelogram.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$.

X is the midpoint of AC.
Y is the point on AB where $AY : YB = 2 : 1$.

Express, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{c}$

(a) $\overrightarrow{AC}$

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

(b) the position vector of X

.... [2]

(c) $\overrightarrow{YX}$.

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

2

3. Nov/2023/Paper_ 4024/12/No.7

Shape A and triangles P and Q are drawn on a centimetre square grid.
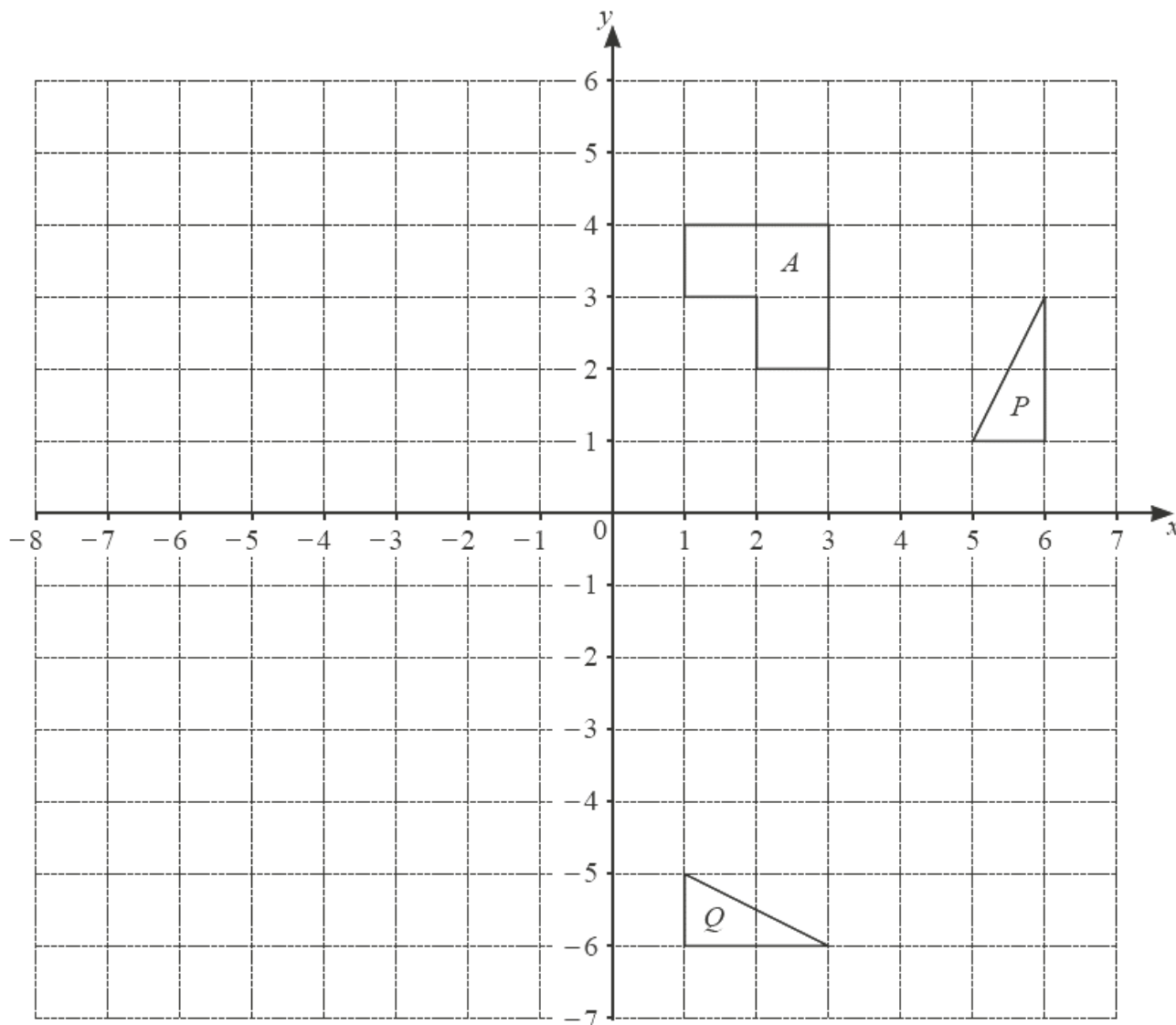
(a) Describe fully the **single** transformation that maps triangle P onto triangle Q.

....

.... [3]

(b) Shape B is an enlargement of shape A.
The centre of enlargement is $(5, 5)$.
The area of shape B is $27 \, \text{cm}^2$.

Draw shape B on the grid.

[3]

3

4. Nov/2023/Paper_ 4024/12/No.22

$$\begin{pmatrix} x & 3 \\ 2 & x+1 \end{pmatrix}\begin{pmatrix} x-1 \\ 2 \end{pmatrix} = \begin{pmatrix} 2x+6 \\ y \end{pmatrix}$$
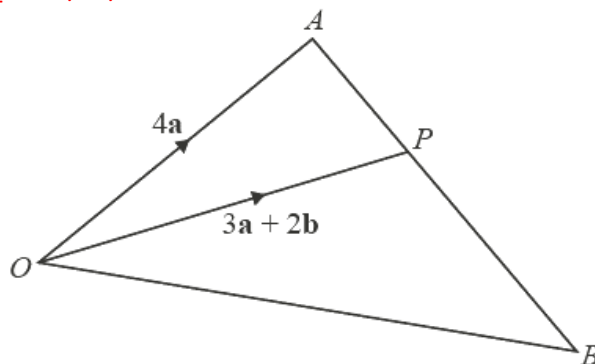
(a) Show that $x^2 - 3x = 0$.

[2]

(b) (i) Solve $x^2 - 3x = 0$.

$x = $ .... or $x = $ .... [2]

(ii) Find the value of y when $x > 0$.

$y =$ .... [2]

5. Nov/2023/Paper_ 4024/12/No.24

NOT TO SCALE

OAB is a triangle.

P lies on AB and $AP : PB = 2 : 3$.

$\overrightarrow{OA} = 4\mathbf{a}$ and $\overrightarrow{OP} = 3\mathbf{a} + 2\mathbf{b}$.

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

    (i) $\overrightarrow{AP}$

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

    (ii) $\overrightarrow{OB}$.

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

(b) Q is a point on OA such that $\overrightarrow{QP}$ is parallel to $\overrightarrow{OB}$.

    Find $\overrightarrow{QP}$.

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

6. Nov/2023/Paper_ 4024/21/No.2
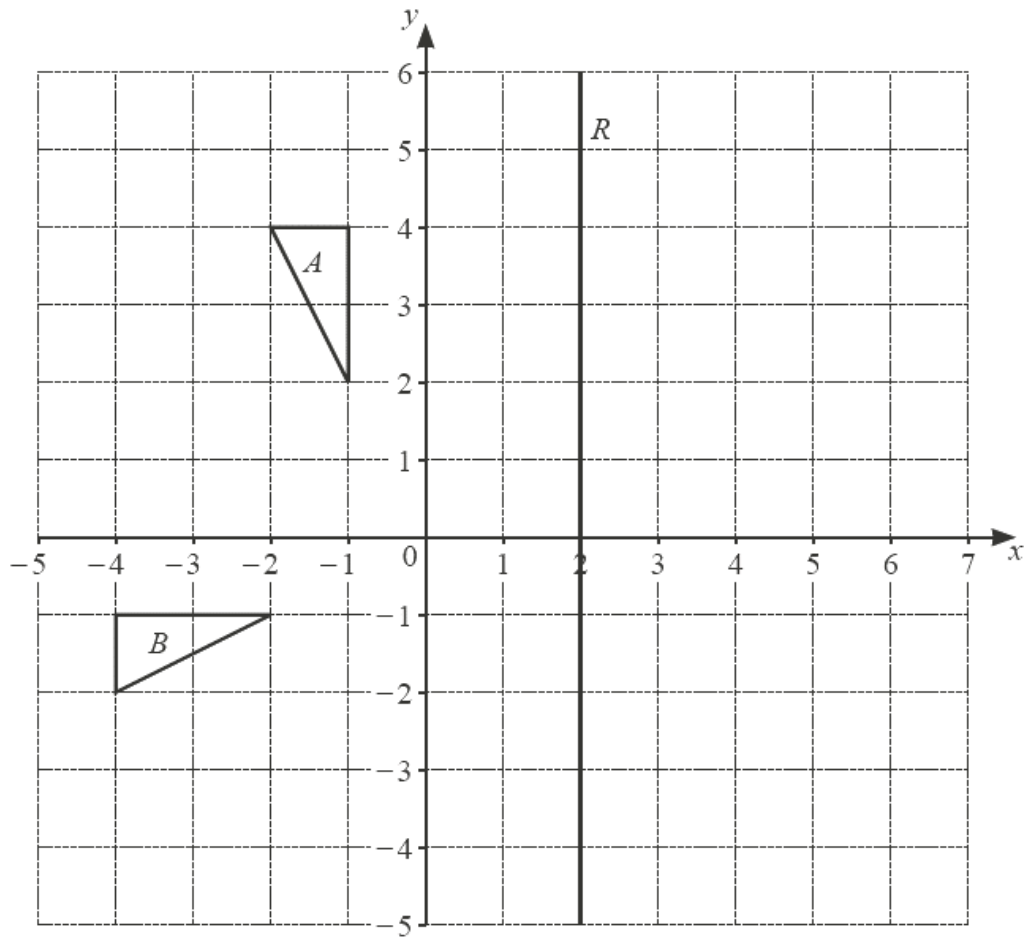
Triangle A, triangle B and line R are drawn on the grid.

(a) (i) Write down the equation of line R.

.... [1]

(ii) Draw the image of triangle A after a reflection in line R. [1]

(b) Describe fully the **single** transformation that maps triangle A onto triangle B.

....

.... [3]

7. Nov/2023/Paper_ 4024/22/No.7

(a)
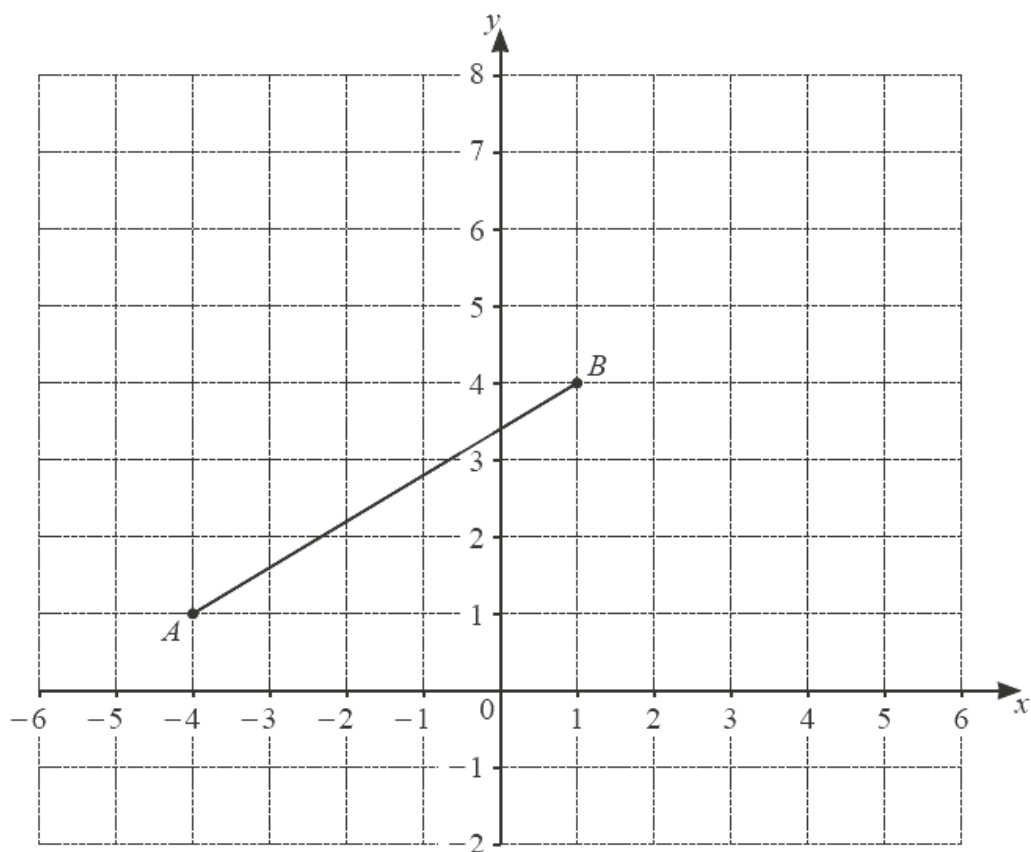
Point A and point B are shown on a centimetre square grid.

(i) ABC is a triangle.

Here are five possible coordinates for point C.

$(-2, 4)$ $(-2, -1)$ $(-1, -2)$ $(6, 1)$ $(-4, 6)$

Tick (✓) the **two** coordinates from the list that make ABC an isosceles triangle.   [2]

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

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

(iii) *A* is the midpoint of the line *DB*.

Find $\left|\overrightarrow{DB}\right|$.

$\left|\overrightarrow{DB}\right|$ = ... [3]

(b) The equation of line *P* is $y = 4x - 3$.
Line *L* is perpendicular to line *P*.
Line *L* passes through the point (6, 4).

Find the coordinates of the point where line *L* crosses the *x*-axis.

(........................ , ...) [4]

8. June/2023/Paper_ 4024/11/No.9

The diagram shows triangles A and B.
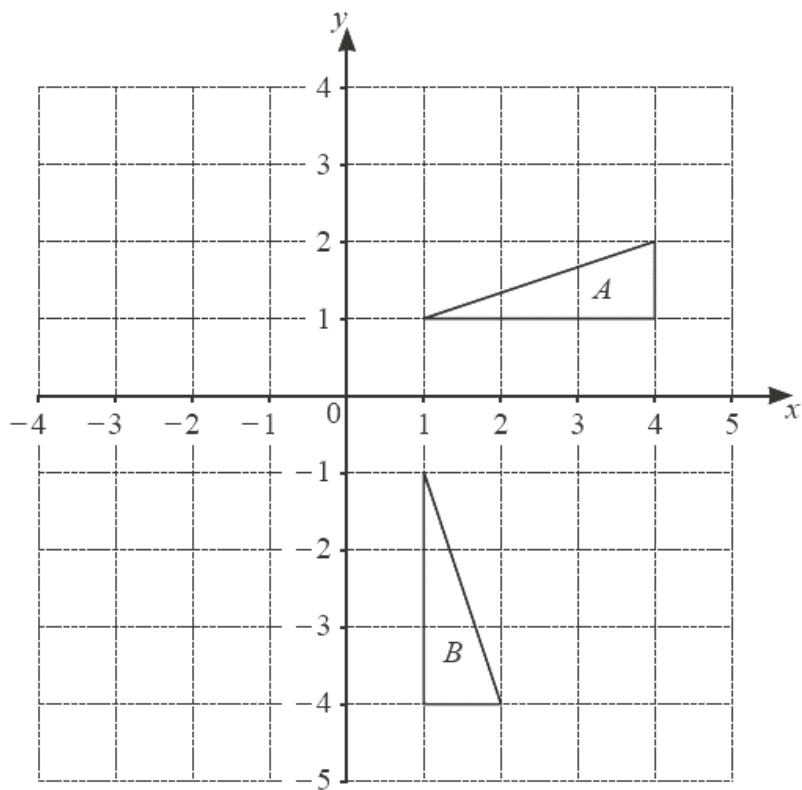
Describe fully the **single** transformation that maps triangle A onto triangle B.

....

.... [3]

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9. June/2023/Paper_ 4024/11/No.27
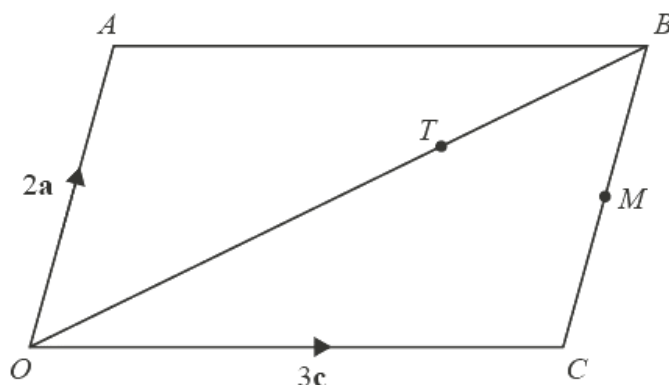
$OABC$ is a parallelogram.
$\overrightarrow{OA} = 2\mathbf{a}$ and $\overrightarrow{OC} = 3\mathbf{c}$.
M is the midpoint of BC.
T is the point on OB such that $OT : TB = 2 : 1$.

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

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

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

(i) $\overrightarrow{AM}$

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

(ii) $\overrightarrow{AT}$.

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

(c) Show that *ATM* is a straight line.

....

....

....

....

.... [2]
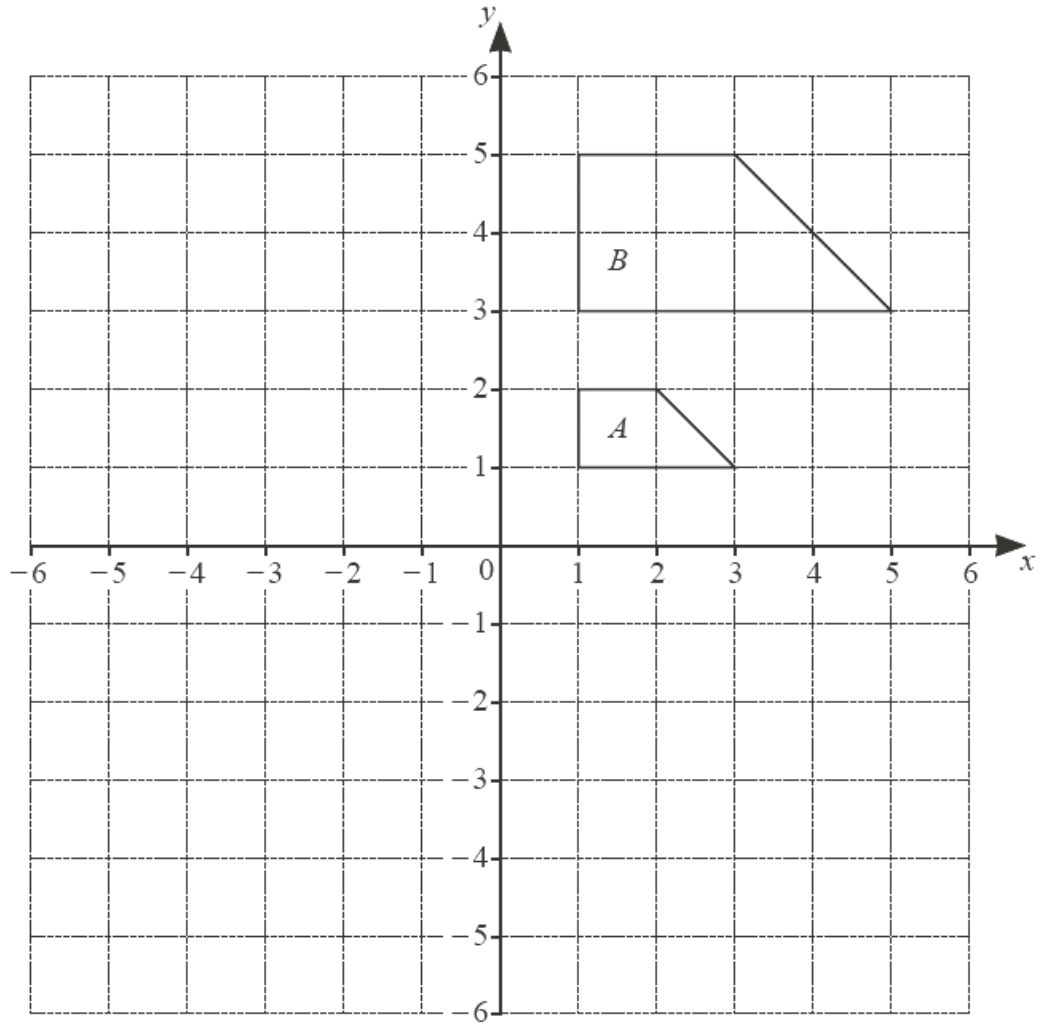
10. June/2023/Paper_ 4024/12/No.12

Shape A and shape B are drawn on the grid.

(a) Describe fully the **single** transformation that maps shape A onto shape B.

....

.... [3]

(b) Draw the image of shape A after a rotation of 180° about $(0, 0)$. [2]

11. June/2023/Paper_ 4024/12/No.18

   (a) These are the first four terms of a sequence.

$$1 \qquad 3 \qquad 9 \qquad 27$$

      Find the next term of the sequence.

      .... [1]

   (b) These are the first five terms of a different sequence.

$$35 \qquad 31 \qquad 27 \qquad 23 \qquad 19$$

      Find an expression, in terms of n, for the nth term of this sequence.

      .... [2]

12. June/2023/Paper_ 4024/21/No.9

   The Bukhari family and the Garcia family are going on holiday.

   In the Bukhari family there are 2 adults and 3 children.
   In the Garcia family there are 4 adults and 1 child.

   (a) Complete matrix **M** to represent this information.

$$\mathbf{M} = \begin{pmatrix} & \\ & \end{pmatrix} \begin{matrix} \text{Adults} & \text{Children} \\ \text{Bukhari} \\ \text{Garcia} \end{matrix}$$

      [1]

(b) The cost of a flight for each adult is x and the cost of a flight for each child is y.

The matrix $\mathbf{N} = \begin{pmatrix} x \\ y \end{pmatrix}$ shows this information.

The matrix $\mathbf{P} = \mathbf{MN} = \begin{pmatrix} 525 \\ 575 \end{pmatrix}$.

   (i) Using an algebraic method, find the value of x and the value of y.
   Show your working.

$x = $ ....

$y = $ .... [5]

   (ii) Explain what each element in $\mathbf{P}$ represents.

....

.... [1]
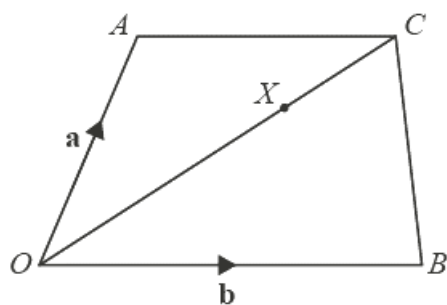
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13. June/2023/Paper_ 4024/22/No.10

(a) F is the point $(6, 1)$, G is the point $(-2, 4)$ and $\overrightarrow{GH} = \begin{pmatrix} -1 \\ -8 \end{pmatrix}$.

Calculate $\left|\overrightarrow{FH}\right|$.

$\left|\overrightarrow{FH}\right| =$ .... [3]

(b)

NOT TO
SCALE

$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{AC} = k\mathbf{b}$.
X is the point on OC such that $OX = mOC$.

(i) Write $\overrightarrow{OX}$ in terms of m, k, $\mathbf{a}$ and $\mathbf{b}$.

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

(ii) $\overrightarrow{BX} = \dfrac{3}{5}\mathbf{a} - \dfrac{1}{2}\mathbf{b}$

Find the value of k.

$k = $ .... [3]

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