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0580

IGCSE Maths

Contents

Vectors and Transformations

Revision

SP-20	M-20	S-20	W-19	W-20

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Vectors

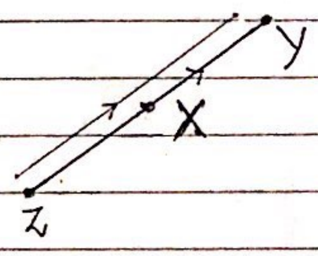
1 Point A has coordinates (6,4) and point B has cordinate (2,7)
Write $\overrightarrow{AB}$ as a column vector. [M-20/22/Q3] ---[1]

Solution: $\overrightarrow{AB} = \begin{pmatrix} 2-6 \\ 7-4 \end{pmatrix} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$ ✓

$\because A(x_1, y_1), B(x_2, y_2)$
$\overrightarrow{AB} = \begin{pmatrix} x_2 - x_1 \\ y_2 - y_1 \end{pmatrix}$

2. $\overrightarrow{XY} = 3a + 2b$ and $\overrightarrow{ZY} = 6a + 4b$
Write down two statements about the relationship between the points X, Y and Z. [M-20/22/Q21] ---[2]

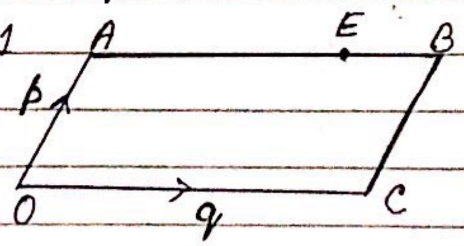
Solution: $\overrightarrow{ZY} = 6a + 4b$
$= 2(3a + 2b)$
$= 2 \cdot \overrightarrow{XY}$



(i) X, Y and Z are collinear.
(ii) ZY is twice the magnitude of XY
or X is the mid point of ZY.

3.(a) (i) $m = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$, find $3m$ ---[1]
(ii) $\overrightarrow{VW} = \begin{pmatrix} 10 \\ -24 \end{pmatrix}$, find $|\overrightarrow{VW}|$ --[2]

(b) OABC is a parallelogram. $\overrightarrow{OA} = p$ and $\overrightarrow{OC} = q$ [S-20/21/Q17]
E is a point on AB, such that AE : EB = 3 : 1
Find $\overrightarrow{OE}$, in terms of p and q.

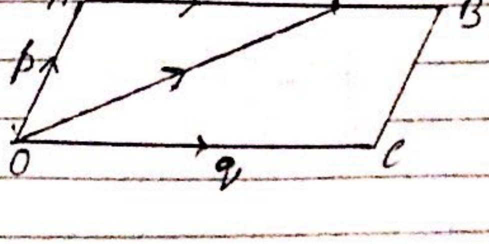


Solution: (a)(i) $m = \begin{pmatrix} 5 \\ 7 \end{pmatrix} \Rightarrow 3m = \begin{pmatrix} 5\times3 \\ 7\times3 \end{pmatrix} = \begin{pmatrix} 15 \\ 21 \end{pmatrix}$ ✓

(a)(ii) $\overrightarrow{VW} = \begin{pmatrix} 10 \\ -24 \end{pmatrix} \Rightarrow |\overrightarrow{VW}| = \sqrt{(10)^2 + (-24)^2} = \sqrt{676} = 26$ ✓

(b) $AE : EB = 3:1 \Rightarrow AE = \frac{3}{4} AB \Rightarrow \overrightarrow{AE} = \frac{3}{4}\overrightarrow{OC} = \frac{3}{4} q$ — (1) ($\because AB \parallel OC$)

In ΔOAE, $\overrightarrow{OE} = \overrightarrow{OA} + \overrightarrow{AE}$
$= p + \frac{3}{4} q$ ✓



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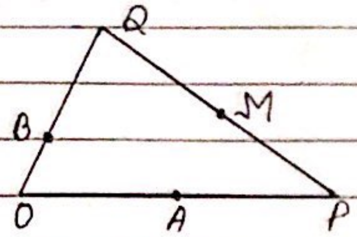
4. O is the origin, $\vec{OP} = 2\vec{OA}$, $\vec{OQ} = 3\vec{OB}$ and $\vec{PM} = \vec{MQ}$
$\vec{OP} = p$ and $\vec{OQ} = q$,
Find, in terms of p and q, in its simplest form.



(a) $\vec{BA}$ ...[2]

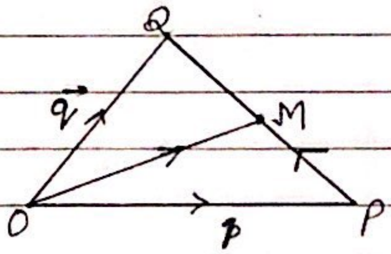
(b) the position vector of M [W-19/21/Q25] ...[2]

Solution: $3\cdot\vec{OB} = \vec{OQ} = q \Rightarrow \vec{OB} = \frac{1}{3}q$ —— ①

(a) and $2\cdot\vec{OA} = \vec{OP} = p \Rightarrow \vec{OA} = \frac{1}{2}p$ —— ②

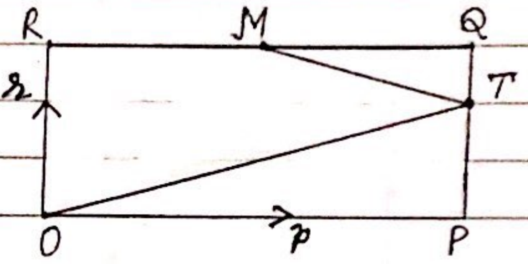
Now $\vec{BA} = \vec{OA} - \vec{OB}$
$= \frac{1}{2}p - \frac{1}{3}q$ ✓

(b) $\vec{OM} = \vec{OP} + \vec{PM}$ —— ③



Now $\vec{PM} = \frac{1}{2}\vec{PQ}$ (as $\vec{PM} = \vec{MQ}$)
$\vec{PM} = \frac{1}{2}(\vec{q} - p)$ ($\because \vec{PQ} = q - p$)
Put in ③
$\vec{OM} = p + \frac{1}{2}(q - p)$
$= p - \frac{1}{2}p + \frac{1}{2}q$
$= \frac{1}{2}p + \frac{1}{2}q$

5. OPQR is a rectangle and O is the origin.
M is the mid point of RQ and
$PT : TQ = 2:1$
$\vec{OP} = p$ and $\vec{OR} = r$



(a) Find in terms of p and/or r, in its simplest form.

(i) $\vec{MQ}$ --[1]

(ii) $\vec{MT}$ --[1]

(iii) $\vec{OT}$ --[1]

(b) RQ and OT are extended and meet at U.
Find the position vector of U in terms of p and r. ---[2]

(c) $\vec{MT} = \begin{pmatrix} 2k \\ -k \end{pmatrix}$ and $|\vec{MT}| = \sqrt{180}$
Find the positive value of k. $\boxed{SP\text{-}20/04/Q6}$ --[3]

Solution (a) (i) M is the mid point of RQ $\Rightarrow \vec{MQ} = \frac{1}{2}\vec{RQ} = \frac{1}{2}\vec{OP} = \frac{1}{2}p$ ✓

(ii) $\vec{MT} = \vec{MQ} + \vec{QT} = \vec{MQ} + \frac{1}{3}\vec{QP}$
$= \frac{1}{2}p - \frac{1}{3}r$ ✓

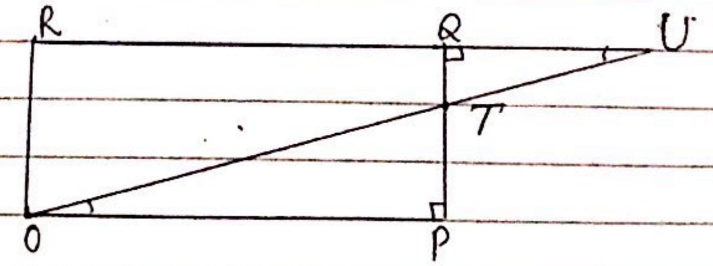
($PT : TQ = 2:1$
$\Rightarrow \vec{QT} = \frac{1}{3}\vec{QP} = \frac{1}{3}(-\vec{PQ})$
$= -\frac{1}{3}\vec{OR} = -\frac{1}{3}r$)

(iii) $\vec{OT} = \vec{OP} + \vec{PT} = \vec{OP} + \frac{2}{3}\vec{PQ} = \vec{OP} + \frac{2}{3}\vec{OR}$
$= p + \frac{2}{3}r$ ✓ —— (1)

(b) $\Delta QUT \overset{\text{Similar}}{\sim} \Delta POT$

$\frac{TU}{OT} = \frac{QT}{PT} = \frac{1}{2}$

$TU = \frac{1}{2}OT$ —— (2)



Now Position vector of U is $\vec{OU} = \vec{OT} + \vec{TU}$
$= \vec{OT} + \frac{1}{2}\vec{OT}$ (from (2))
$= \frac{3}{2}\vec{OT}$
$= \frac{3}{2}(p + \frac{2}{3}r)$
$= \frac{3}{2}p + r$ ✓

(c) $\vec{MT} = \begin{pmatrix} 2k \\ -k \end{pmatrix}$

$\Rightarrow |\vec{MT}| = \sqrt{(2k)^2 + (-k^2)}$
$= \sqrt{4k^2 + k^2} = \sqrt{180}$ given
$= 5k^2 = 180$
$\Rightarrow k^2 = 36$
$k = \sqrt{36} = 6$ ✓ (Only +)

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6(a) $p = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$ $\quad q = \begin{pmatrix} -2 \\ 7 \end{pmatrix}$ [S-20/42/Q2(a),(b),(d)]

(i) find $2p+q$ ---[2]

(ii) find $|p|$ ---[2]

Solution: (i) $2p+q = 2\cdot\begin{pmatrix} 4 \\ 5 \end{pmatrix} + \begin{pmatrix} -2 \\ 7 \end{pmatrix}$

$= \begin{pmatrix} 8 \\ 10 \end{pmatrix} + \begin{pmatrix} -2 \\ 7 \end{pmatrix} = \begin{pmatrix} 8-2 \\ 10+7 \end{pmatrix} = \underline{\begin{pmatrix} 6 \\ 17 \end{pmatrix}}$ ✓

(ii) $|p| = \sqrt{4^2+5^2} = \sqrt{16+25}$

$= \sqrt{41} = \underline{6\cdot403}$ ✓

(b) A is the point $(4,1)$ and $\vec{AB} = \begin{pmatrix} -3 \\ 1 \end{pmatrix}$

Find the coordinates of B. ---[1]

Solution; Let the coordinates of B are (x,y), $A(4,1)$

$\Rightarrow \vec{AB} = \begin{pmatrix} x-4 \\ y-1 \end{pmatrix} = \begin{pmatrix} -3 \\ 1 \end{pmatrix}$ Given.

$\Rightarrow x-4 = -3 \Rightarrow x = 1$

$y-1 = 1 \Rightarrow y = 2$

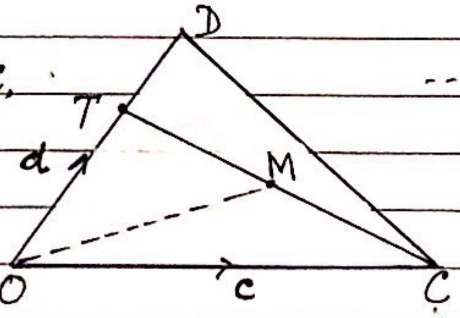
$\therefore \underline{B(1,2)}$ ✓

(c) In the diagram, O is the origin,

$OT = 2TD$ and M is the mid point of TC, ---[3]

$\vec{OC} = \mathbf{c}$ and $\vec{OD} = \mathbf{d}$

Find the position vector of M. Give your answer in terms of $\mathbf{c}$ and $\mathbf{d}$.



Solution: Join OM, Position vector of $M = \vec{OM}$

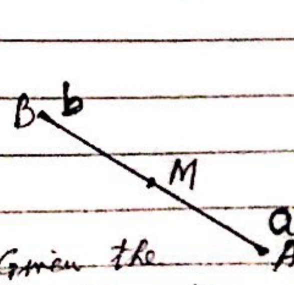
$OT = 2TD \Rightarrow OT = \frac{2}{3}OD \Rightarrow \vec{OT} = \frac{2}{3}\vec{OD} = \frac{2}{3}\vec{d}$ ——(1)

and position vector of $C = \vec{OC} = \vec{c}$ ——(2)

$\therefore$ Position vector of the mid point of TC

$\vec{OM} = \dfrac{\left(\vec{c} + \frac{2}{3}d\right)}{2} = \frac{1}{2}\left(c + \frac{2}{3}d\right)$

$= \frac{1}{2}\mathbf{c} + \frac{1}{3}\mathbf{d}$



Given the position vectors of A and B are $\mathbf{a}$ & $\mathbf{b}$

P.V. of $M\left(\dfrac{a+b}{2}\right)$

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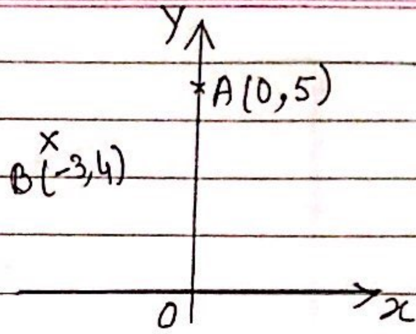
7.(a) (i) Write $\vec{OA}$ as a column vector. ---[1]

(ii) Write $\vec{AB}$ as a column vector. ---[1]

(iii) A and B lie on a circle, centre O. Calculate the length of arc AB. ---[6]



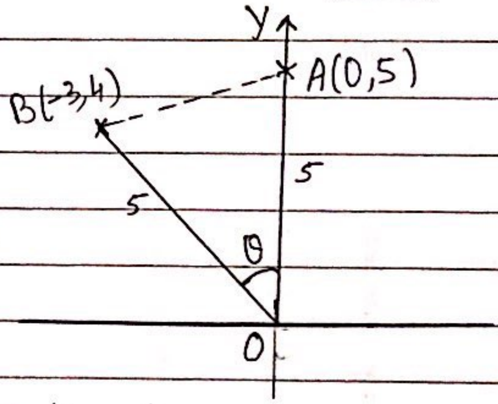
Solution (i) $\vec{OA} = \begin{pmatrix} 0 \\ 5 \end{pmatrix}$ $[A(0,5)]$

(ii) $\vec{OB} = \begin{pmatrix} -3 \\ 4 \end{pmatrix} \Rightarrow \vec{AB} = \vec{OB} - \vec{OA}$

$= \begin{pmatrix} -3 \\ 4 \end{pmatrix} - \begin{pmatrix} 0 \\ 5 \end{pmatrix} = \begin{pmatrix} -3-0 \\ 4-5 \end{pmatrix} = \begin{pmatrix} -3 \\ -1 \end{pmatrix}$ ✓

(iii) $OA = 5$

$OB = \sqrt{(-3)^2 + 4^2} = \sqrt{9+16} = 5$



$AB = |\vec{AB}| = \sqrt{(-3)^2 + (-1)^2} = \sqrt{10}$

Using cosine rule; Let $\angle AOB = \theta$

$= \dfrac{OA^2 + OB^2 - AB^2}{2 \times OA \times OB}$

$= \dfrac{5^2 + 5^2 - (\sqrt{10})^2}{2 \times 5 \times 5} = \dfrac{25+25-10}{50} = \dfrac{4}{5}$

$\therefore$ angle $AOB = \theta = \cos^{-1}\left(\frac{4}{5}\right) = 36.87°$ ✓

Circle with Centre at O, Passes through AB,

$OA = OB =$ radius $r = 5$ ✓

$\therefore$ length of arc $\widehat{AB} = \dfrac{\theta}{360} \times 2\pi r$

$= \dfrac{36.87}{360} \times 2\pi \times 5$

$= 3.217$ units ✓

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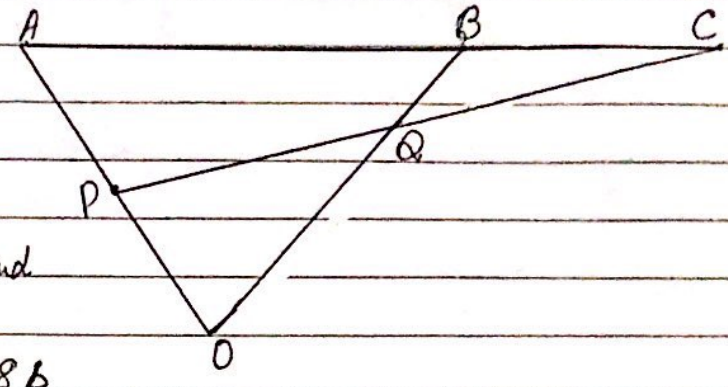
8. OAB is a triangle and ABC and PQC are straight lines.
P is the mid point of OA,
Q is the mid point of PC and
$OQ : QB = 3 : 1$.
$\vec{OA} = 4a$ and $\vec{OB} = 8b$.



(a) Find in terms of **a** and/or **b**. [W-19/43/Q11]

(i) $\vec{AB}$ ---[1]

(ii) $\vec{OQ}$ ---[1]

(iii) $\vec{PQ}$ ---[1]

(b) By using vectors, find the ratio AB : BC. --[3]

Solution (a)(i) $\vec{OA} = 4a$ and $\vec{OB} = 8b \Rightarrow \vec{AB} = \vec{OB} - \vec{OA}$
$= \underline{8b - 4a}$ ✓

(ii) $OQ : QB = 3:1 \Rightarrow \vec{OQ} = \frac{3}{4}\vec{OB} = \frac{3}{4} \times 8b = \underline{6b}$ ✓ —— ①

(iii) $\vec{OP} = \frac{1}{2}\vec{OA}$ (Since P is the mid point of OA)
$= \frac{1}{2} \times 4a = 2a$ —— ②

$\therefore \vec{PQ} = \vec{OQ} - \vec{OP} = \underline{6b - 2a}$ ✓ (from ① & ②)

(b) Q is the mid point of PC $\Rightarrow \vec{QC} = \vec{PQ} = 6b - 2a$
$\therefore \vec{QC} = 6b - 2a$ —— ③

In ΔQBC, $\vec{QB} + \vec{BC} = \vec{QC}$
$\therefore \vec{BC} = \vec{QC} - \vec{QB}$ $\left[\vec{QB} = \frac{1}{4}\vec{OB} = \frac{1}{4} \times 8b = 2b\right]$ ④
$= (6b - 2a) - 2b$
$= 4b - 2a$ —— ⑤

from Part (a)(i) $\vec{AB} = 8b - 4a$
$= 2(4b - 2a)$
$\vec{AB} = 2\vec{BC}$ (from ⑤)

$\therefore \frac{\vec{AB}}{\vec{BC}} = \frac{2}{1}$

or $AB : BC = 2 : 1$ ✓

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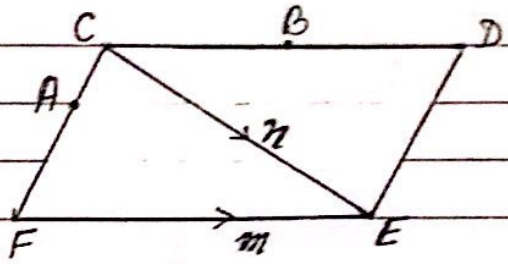
9. Ahmed finds the magnitude of the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.
From this list, put a ring around the correct calculation.
$\sqrt{2^2 + -3^2}$ $\quad 2^2 - 3^2$ $\quad \sqrt{2^2 - 3^2}$ $\quad 2^2 + (-3)^2$ $\quad \sqrt{2^2 + (-3)^2}$ --[1]

Answer: $\sqrt{2^2 + (-3)^2}$ ✓

[W-20|21|Q9(b)]

10 (a) The diagram shows a parallelogram CDEF. $\vec{FE} = m$ and $\vec{CE} = n$
B is the mid point of CD.
FA = 2AC.

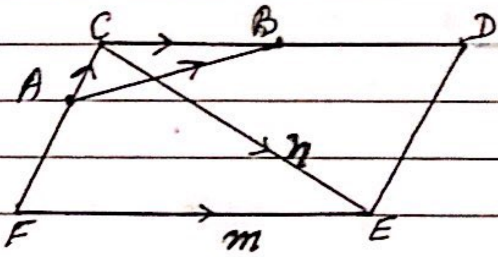


Find an expression, in terms of m and n, for $\vec{AB}$
Give your answer in its simplest form. ---[3]

(b) $\vec{GH} = \frac{5}{6}(2p + q)$ $\quad \vec{JK} = \frac{5}{18}(2p + q)$
Write down two facts about vectors $\vec{GH}$ and $\vec{JK}$ --[2]

[W-20|21|Q23]

Solution: (a)



$\vec{AB} = \vec{AC} + \vec{CB}$ — ①

$\vec{CD} = \vec{FE} = m$

$\therefore \vec{CB} = \frac{1}{2}\vec{CD} = \frac{1}{2}m$ — ②

$\vec{FC} + n = m$

$\Rightarrow \vec{FC} = m - n$ — ③

$\therefore \vec{AC} = \frac{1}{3}\vec{FC} = \frac{1}{3}(m-n)$ from ③ — ④

Now ② and ④ in ①

$\vec{AB} = \frac{1}{3}(m-n) + \frac{1}{2}m = \frac{1}{3}m + \frac{1}{2}m - \frac{1}{3}n = \frac{5}{6}m - \frac{1}{3}n$ ✓

(b) $\vec{GH} = \frac{5}{6}(2p+q) = 3 \times \frac{5}{18}(2p+q) = 3\vec{JK}$

(i) hence $\vec{GH}$ and $\vec{JK}$ are parallel

(ii) $\vec{GH}$ has a greater magnitude than $\vec{JK}$.

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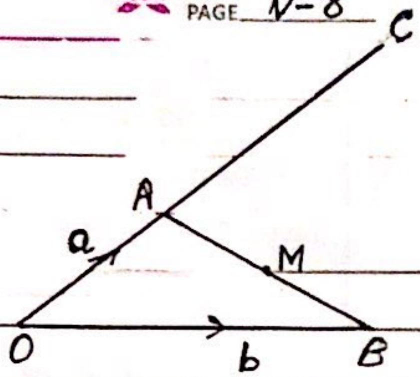
11. The diagram shows a triangle OAB and a straight line OAC. $OA : OC = 2 : 5$ and M is the mid point of AB.
$\overrightarrow{OA} = a$ and $\overrightarrow{OB} = b$
Find in terms of a and b, in its simplest form.



W-20/22/Q22

(a) $\overrightarrow{AB}$ ---- [1]
(b) $\overrightarrow{MC}$ ---- [3]

Solution (a) $\overrightarrow{OA} + \overrightarrow{AB} = \overrightarrow{OB} \Rightarrow a + \overrightarrow{AB} = b \Rightarrow \overrightarrow{AB} = \underline{b - a}$ ✓

(b) $\overrightarrow{AM} + \overrightarrow{MC} = \overrightarrow{AC} \Rightarrow \overrightarrow{MC} = \overrightarrow{AC} - \overrightarrow{AM}$ —— ①

$\overrightarrow{AM} = \frac{1}{2}\overrightarrow{AB} = \frac{1}{2}(b-a)$ —— ② (from Part (a))

$OA : AC = 2 : 3$ ($\because OA : OC = 2 : 5$)

$\Rightarrow \overrightarrow{AC} = \frac{3}{2}\overrightarrow{OA} = \frac{3}{2}a$ —— ③

from ② and ③ in ① $\Rightarrow$ $\overrightarrow{MC} = \frac{3}{2}a - \frac{1}{2}(b-a)$

$= \frac{3}{2}a + \frac{1}{2}a - \frac{1}{2}b$

$= \underline{2a - \frac{1}{2}b}$ ✓

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12 (a) $\overrightarrow{AB} = \begin{pmatrix} 6 \\ -1 \end{pmatrix}$ $\overrightarrow{BC} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ $\overrightarrow{DC} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

Find, (i) $\overrightarrow{AC}$ ---[2]

(ii) $\overrightarrow{BD}$ --[2]

(iii) $|\overrightarrow{BC}|$ --[2]

W-20/43/Q8

Solution (a)(i) $\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC} = \begin{pmatrix} 6 \\ -1 \end{pmatrix} + \begin{pmatrix} -2 \\ 5 \end{pmatrix} = \begin{pmatrix} 6-2 \\ -1+5 \end{pmatrix} = \underline{\begin{pmatrix} 4 \\ 4 \end{pmatrix}}$ ✓

(ii) $\overrightarrow{BD} = \overrightarrow{BC} + \overrightarrow{CD}$ [as $\overrightarrow{DC} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$, $\overrightarrow{CD} = -\begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$

$= \begin{pmatrix} -2 \\ 5 \end{pmatrix} + \begin{pmatrix} -2 \\ 3 \end{pmatrix}$

$= \underline{\begin{pmatrix} -4 \\ 8 \end{pmatrix}}$ ✓

(iii) $\overrightarrow{BC} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$

$\Rightarrow |\overrightarrow{BC}| = \sqrt{(-2)^2 + 5^2} = \sqrt{4+25} = \sqrt{29}$

$= \underline{5.39}$ ✓ (or 5.385)

(Continued →)

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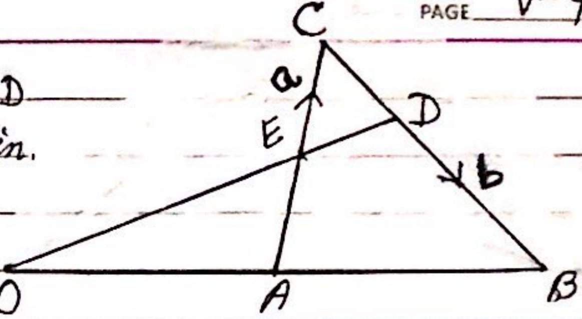


12(b) In the diagram, OAB and OED are straight lines. O is the origin. A is the mid point of OB and E is the mid point of AC.
$\vec{AC} = a$ and $\vec{CB} = b$
Find, in terms of a and b, in its simplest form.
(i) $\vec{AB}$ --[1]
(ii) $\vec{OE}$ --[2]
(iii) the position vector of D. --[3]

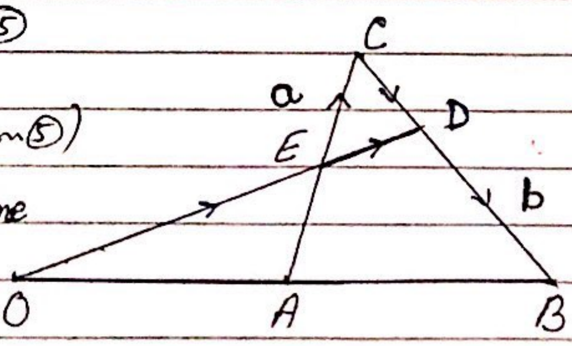
W-20/43/Q8

Solution (b) (i) $\vec{AB} = \vec{AC} + \vec{CB} = (a+b)$ ✓ —— ①

(ii) $\vec{OA} = \vec{AB} = a+b$ —② (from ①)
$\vec{AE} = \frac{1}{2}\vec{AC} = \frac{1}{2}a$ —— ③

$\vec{OE} = \vec{OA} + \vec{AE}$
$= (a+b) + \frac{1}{2}a = \frac{3}{2}a + b$ ✓ (from ② & ③) —④

(iii) Now let $\vec{CD} = t\,b$ —— ⑤
$\vec{ED} = \vec{EC} + \vec{CD}$
$= \frac{1}{2}a + tb$ —⑥ (from ⑤)



Now $\vec{OE}$ and $\vec{ED}$ lie in a line
$\Rightarrow \vec{ED} = \lambda . \vec{OE}$
$\Rightarrow \frac{1}{2}a + tb = \lambda(\frac{3}{2}a + b)$
Comparing the coefficients of a and b
$\Rightarrow \frac{1}{2} = \frac{3\lambda}{2} \Rightarrow \lambda = \frac{1}{3}$ ✓

and $t = \lambda \Rightarrow t = \frac{1}{3}$ ✓

$\therefore$ Position vector of D $= \vec{OD} = \vec{OE} + \vec{ED}$ from ④ & ⑥
$= (\frac{3}{2}a + b) + (\frac{1}{2}a + \frac{1}{3}b)$ $\because [t = \frac{1}{3}]$
$= 2a + \frac{4}{3}b$ ✓

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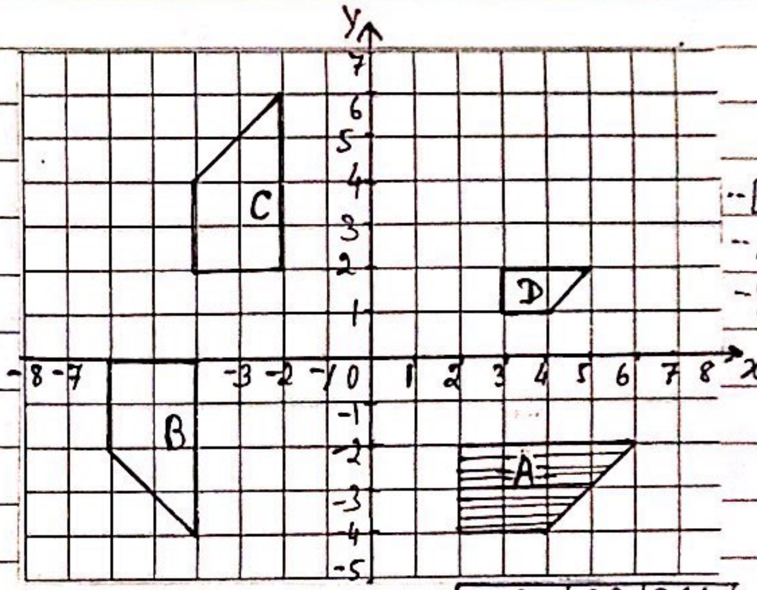
Transformations

1. Describe fully the single transformation that maps.

(a) Shape A onto shape B ...[3]

(b) Shape A onto shape C ...[2]

(c) Shape A onto shape D ...[3]



M-20/22/Q11

Solution:

(a) Rotation 90° clockwise, (0,2).

(b) Reflection. $y = x$

(c) Enlargement (sf) $\frac{1}{2}$, (4,6).

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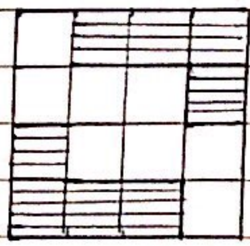
2. Write down the order of rotational symmetry of the diagram. S-20/22/Q1 ...[1]



Answer: Order of rotational symmetry = 2.

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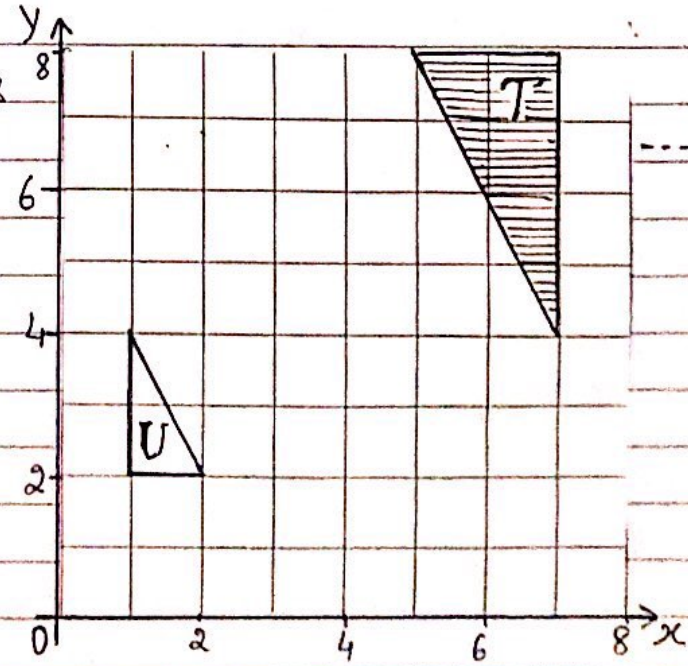
3. Describe fully the single transformation that maps triangle T onto triangle U. ...[3]



Answer: Enlargement
scale factor $-\frac{1}{2}$
Centre - (3,4)

S-20/22/Q18

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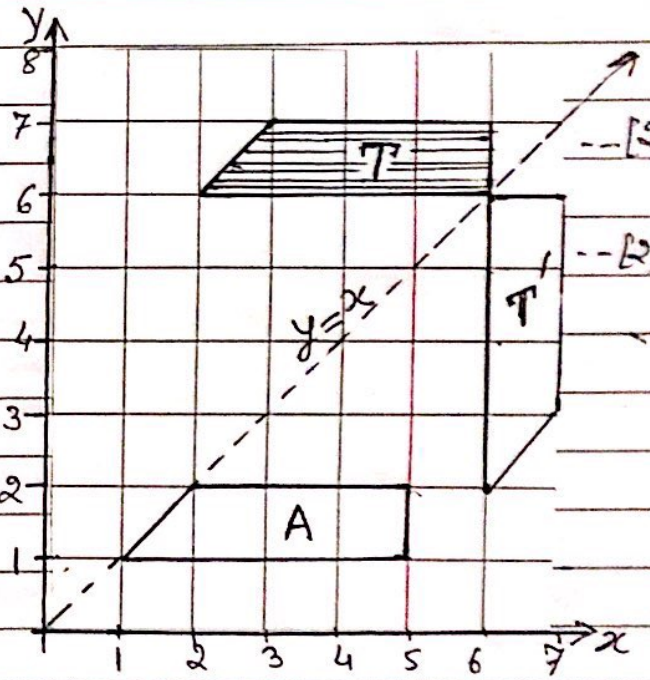
4. (a) Describe fully the single transformation that maps shape T onto shape A. --[2]

(b) on the grid reflect T in the line y=x --[2]

W-19/21/Q20



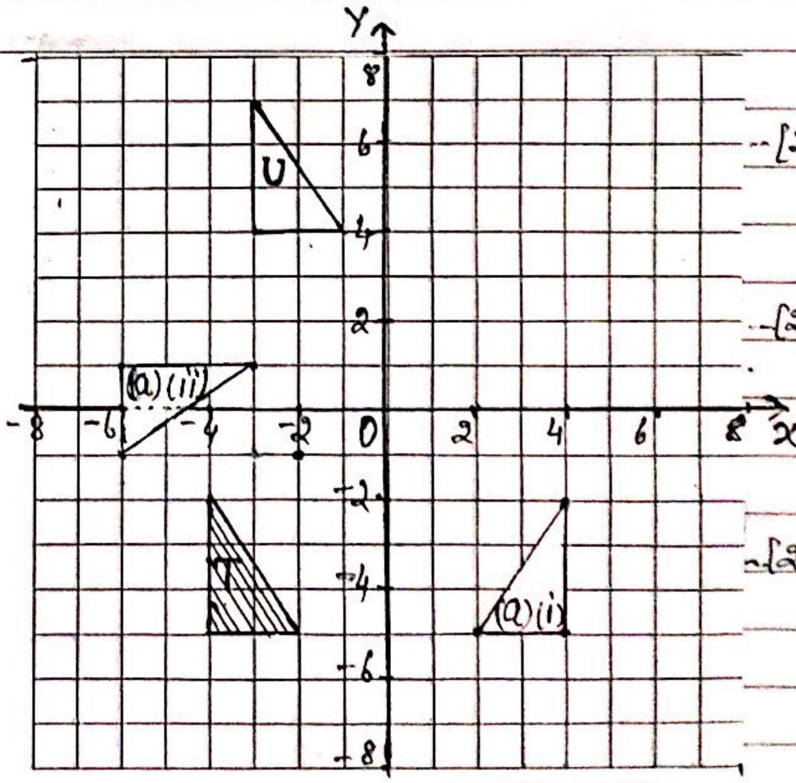
Solution (a) Translalation $\begin{pmatrix}-1\\-5\end{pmatrix}$

(b) Correct reflection at, T'
(6,2), (6,6), (7,6), (7,3)

5. (a)(i) Draw the reflection of triangle T in the line x=0 --[2]

(a)(ii) draw the rotation of Triangle T about (−2, −1) through 90°, clockwise. --[2]

(b) describe fully the single transformation that maps triangle T onto triangle U. --[2]



SP-20/04/04

Solution (i) Image at (2, −5), (4, −5), (4, −2)

(a)(ii) Image at (−3, 1), (−6, 1), (−6, −1)

(b) Translation $\begin{pmatrix}1\\9\end{pmatrix}$

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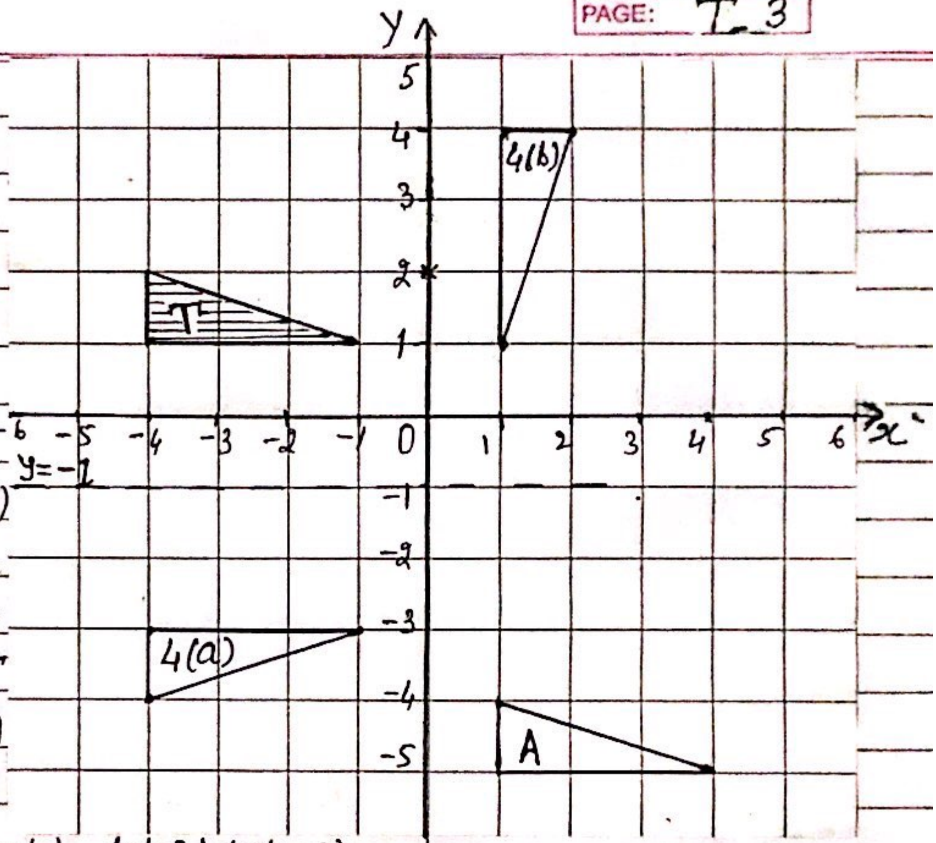
6 (a) Draw the image of triangle T after a reflection in the line $y=-1$ ---[2]

(b) Draw the image of Triangle T after a rotation through $90°$ clockwise about (0,2)

(c) Describe fully the single transformation that maps triangle T onto triangle A.--[2]



Solution (a) Triangle at (-4,-4), (-1,-3), (-4,-3)

(b) Triangle at (1,1), (1,4), (2,4)

(c) Translation $\begin{pmatrix} 5 \\ -6 \end{pmatrix}$

S-20/41/Q4

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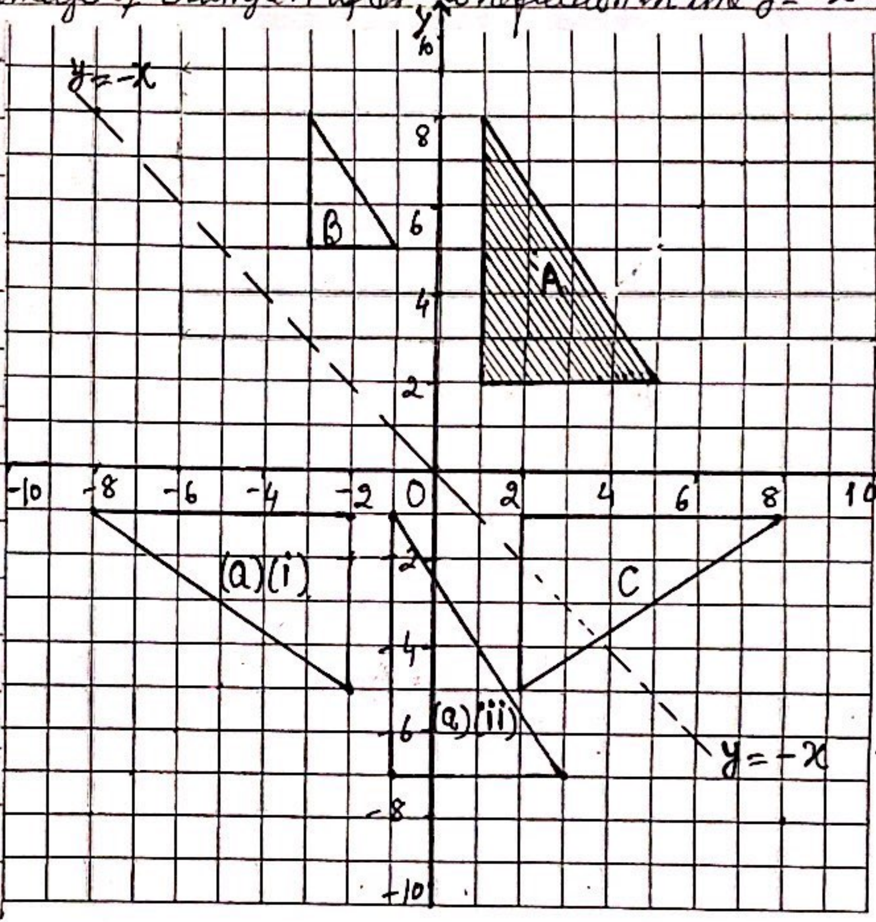
7 (a)(i) Draw the image of triangle A after a reflection in line $y = -x$ ---[2]

(ii) Draw the image of triangle A after a translation by the Vector $\begin{pmatrix} -2 \\ -9 \end{pmatrix}$ ---[2]

(b) describe fully the single transformation that maps:

(i) triangle A onto triangle B, ---[3]

(ii) triangle A onto triangle C. ---[3]



S-20/43/Q2

Solution:

(a)(i) triangle with vertices (-2, -1), (-8, -1), (-2, -5)

(ii) triangle with vertices: (-1, -1), (-1, -7), (3, -7).

b(i) Enlargement, centre (-7, 8), sf - $\frac{1}{2}$

(ii) Rotation, centre (0,0), 90° clockwise.

Scanned with CamScanner

8. A line joins A(1,3) to B(5,8)

(a) The line is transformed to line PQ.
Find the coordinates of P and the coordinates of Q after AB is transformed by:

(i) a translation by the vector $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ --- [2]

(ii) a rotation through 90° anticlockwise about the origin. --- [2]

(iii) a reflection in the line $x=2$

(b) Describe fully the single transformation that maps the line AB onto the line PQ where P is the point (−2, −6) and Q(−10, −16) --- [3]

W-19 | 42 | Q3(b)(c)

Solution (a) (i) (6, 1), (10, 6)

(ii) (−3, 1), (−8, 5)

(iii) (3, 3), (−1, 8)

(b) Enlargement, s.f. −2, Centre (0, 0)

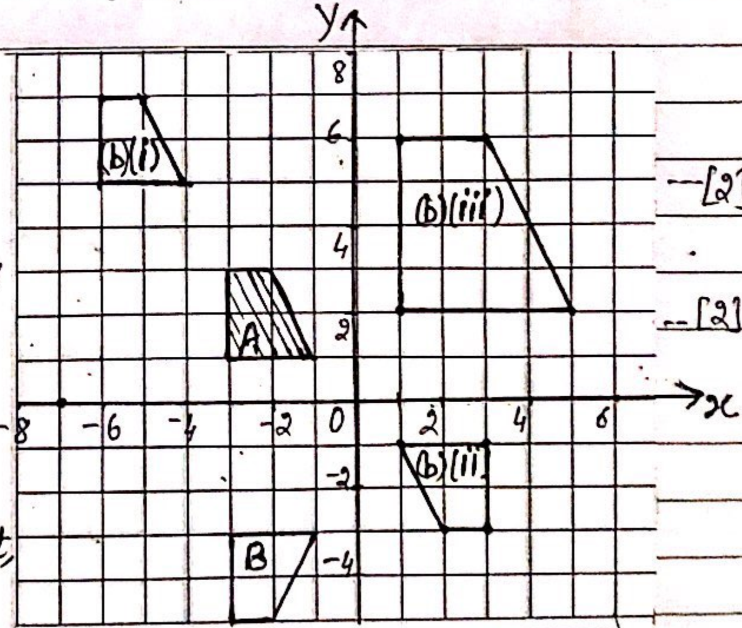
17(a) Describe fully the single transformation that maps shape A onto shape B. --- [2]

(b) On the grid, draw the image of:

(i) Shape A after translation by the vector $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$. --- [2]

(ii) Shape A after a rotation through 180° about (0,0)

(iii) Shape A after an enlargement, scale factor 2, Centre (−7, 0)



W−19 | 43 | Q7

Solution (a) Reflection on $y=-1$

(b)(i) Image at (−6, 5), (−6, 7), (−5, 7), (−4, 5)

(ii) Image at (1, −1), (3, −1), (3, −3), (2, −3)

(iii) Image at (1, 2), (1, 6), (3, 6), (5, 2)

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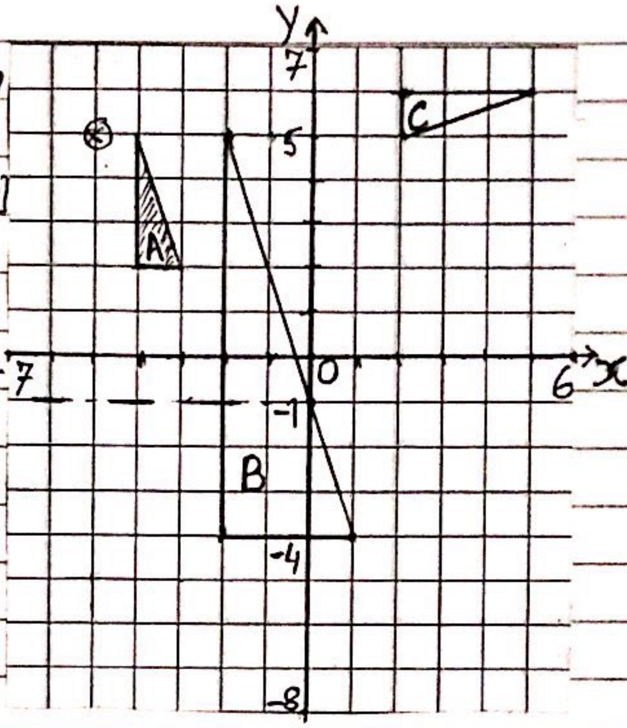
9. (a) Draw the image of shape A after a translation by vector $\begin{pmatrix}8\\-6\end{pmatrix}$ ...[2]
(b) Draw the image of shape A after a reflection in line $y=-1$, --[2]
(c) Describe fully the single transformation that maps shape A onto shape B. --[3]
(d) Describe fully the single transformation that maps shape A onto shape C. ---[3]



[W-20/41/Q1]

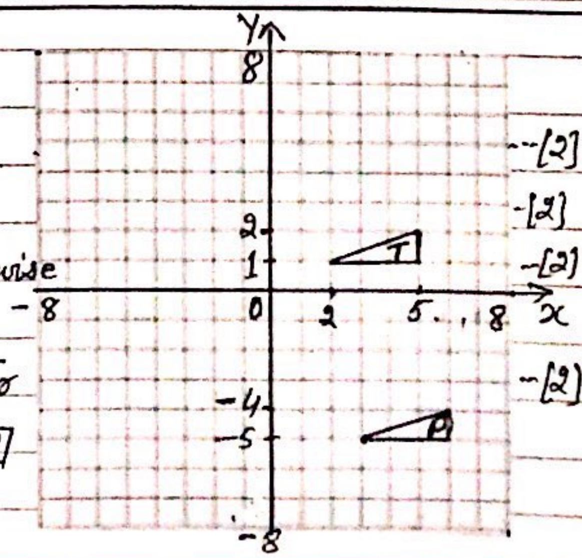
Solution (a) A $\begin{cases}(-4,5)\\(-4,2)\\(-3,2)\end{cases} + \begin{pmatrix}8\\-6\end{pmatrix} \rightarrow$ A' Image $\begin{cases}(4,-1)\\(4,-4)\\(5,-4)\end{cases}$

(b) A $\begin{cases}(-4,5)\\(-4,2)\\(-3,2)\end{cases}$ Reflection in line $y=-1 \longrightarrow$ Image A'' $\begin{cases}(-4,-7)\\(-4,-4)\\(-3,-4)\end{cases}$

(c) Enlargement 3, centre $(-5,5)$
(d) Rotation 90° clockwise, centre $(1,1)$

---

10. (a) Describe fully the single transformation that maps triangle T onto triangle P ---[2]
(b) (i) Reflect triangle T in the line $x=1$ -[2]
(ii) Rotate triangle T through 90° anticlockwise about $(6,0)$ -[2]
(iii) Enlarge triangle T by a scale factor of -2, centre $(1,0)$. -[2] [W-20/42/Q2]



Solution (a) Translation ('
(b) (i) Image at $(0,1)$, $(-3,1)$, $(-3,2)$
(ii) Image at $(5,-4)$, $(5,-1)$, $(4,-1)$
(iii) Image at $(-1,-2)$, $(-7,-2)$, $(-7,-4)$.

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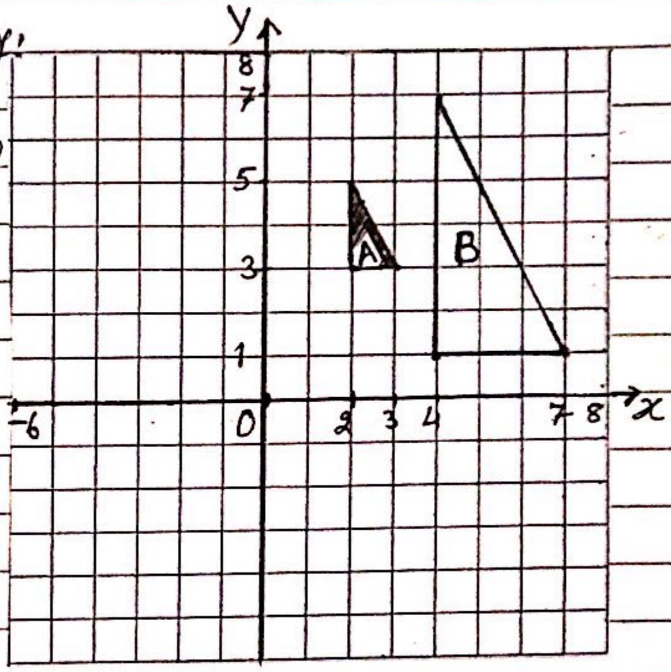
11. (a) On the grid, draw the image of:
(i) triangle A after a rotation of 90° anticlockwise about (0,0). --- [2]
(ii) triangle A after a translation by vector $\begin{pmatrix}3\\-5\end{pmatrix}$ --- [2]
(b) Describe fully the single transformation that maps triangle A onto triangle B. --- [3]



W-20 | 43 | Q2

Solution (a):
(i) Triangle at (-3, 2), (-3,3), (-5,2)
(ii) Triangle at (5,-2), (6,-2), (5,0)
(b) Enlargement [SF] 3, Centre (1,4)