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O LEVEL

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UNSOLVED EXAM PAPERS

MATHEMATICS

(Paper 1 - All Variants)

(Syllabus 4024)

period	2013 to 2022
contents	June & November, Paper 1 (P11 & P12) With Solutions
form	Topic By Topic
compiled for	O Levels

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Tel No : 042-35201010
Mobile No : 0300-8447654
E-Mail : info@redspot.com.pk
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TOPIC 11

Solutions of Equations

1. Solve the simultaneous equations.

$$3x + 5y = 2$$
$$2x - 3y = 14$$

Answer $x =$ ....

$y =$ .... [3]

[June/2012/P12/Q25(c)]

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2. $b = m(a - c)$

(a) Evaluate b when $m = 5$, $a = 8$ and $c = -3$.

Answer $b =$ .... [1]

(b) Rearrange the formula to make c the subject.

Answer $c =$ .... [2]

[June/2013/P11/Q10]

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3. (a) Solve $\frac{3x}{4} + \frac{2x-1}{2} = 3$.

Answer $x =$ .... [2]

(b) Write as a single fraction in its simplest form

$$\frac{5}{x+4} + \frac{2}{x-1}.$$

Answer .... [2]

[June/2013/P12/Q20]

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4. Solve the equation $\frac{3x+1}{2}-\frac{x}{3}=1$.

Answer x = ... [2]

[Nov/2013/P12/Q8]

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5. Solve the simultaneous equations.

$$4x-3y=14$$
$$2x+y=-3$$

Answer x = ...

y = ... [3]

[Nov/2013/P12/Q13]

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6. Make a the subject of the formula $y=\frac{a-4}{3-a}$.

Answer a = ... [3]

[June/2014/P11/Q9]

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7. (a) Given that $x^2-14x+40=(x-a)^2+b$, find the values of a and b.

Answer a = ...

b = ... [2]

(b) Solve the equation $3x^2+7x-6=0$ by factorisation.

Answer x = ... or .... [2]

[June/2014/P11/Q20]

8. In quadrilateral *ABCD*

angle $A = (2y + x)°$
angle $B = (3y + x)°$
angle $C = (2y + 10)°$
angle $D = (3x + 5)°$

(a) By finding the sum of the angles in the quadrilateral, show that $7y + 5x = 345$.

[1]

(b) Given that angle $A = 90°$ then $2y + x = 90$.

Solve the simultaneous equations to find x and y.

$$7y + 5x = 345$$
$$2y + x = 90$$

Answer $x =$ ....

$y =$ .... [3]

(c) Find the size of the smallest angle in the quadrilateral.

Answer .... [1]

[June/2014/P12/Q25]

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9. Solve the simultaneous equations.

$$2x - 3y = 11$$
$$5x - 4y = 24$$

Answer $x =$ ....

$y =$ .... [3]

[Nov/2014/P11/Q7]

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10. $s = \frac{n}{2}(a + b)$

(a) Evaluate s when $n = 200$, $a = 3.6$ and $b = 5.7$.

Answer $s =$ .... [1]

ANSWERS

Topic 11 - Solutions of Equations

1. $3x+5y=2 \quad \Rightarrow \quad x=\dfrac{2-5y}{3}$ ....(1)

$2x-3y=14$ ....(2)

substitute (1) into (2) to get, $y=-2$

substitute $y=-2$ into (1) to get, $x=4$

2. (a) $b=5(8+3)=55$

(b) $b=m(a-c)$

$\Rightarrow \quad a-c=\dfrac{b}{m} \quad \Rightarrow \quad c=a-\dfrac{b}{m}$

3. (a) $\dfrac{3x}{4}+\dfrac{2x-1}{2}=3$

$\Rightarrow \quad \dfrac{3x+2(2x-1)}{4}=3$

$\Rightarrow \quad 7x-2=12 \quad \Rightarrow \quad x=2$

(b) $\dfrac{5}{x+4}+\dfrac{2}{x-1}$

$=\dfrac{5(x-1)+2(x+4)}{(x+4)(x-1)}=\dfrac{7x+3}{(x+4)(x-1)}$

4. $\dfrac{3x+1}{2}-\dfrac{x}{3}=1$

$\Rightarrow \quad \dfrac{3(3x+1)-2x}{6}=1 \quad \Rightarrow \quad x=\dfrac{3}{7}$

5. $4x-3y=14$ ....(1)

$2x+y=-3 \quad \Rightarrow \quad y=-2x-3$ ....(2)

Subst. (2) into (1) and obtain, $x=\dfrac{1}{2}$

Subst. $x=\dfrac{1}{2}$ into (2), and obtain, $y=-4$

6. $y=\dfrac{a-4}{3-a}$

$\Rightarrow \quad 3y-ay=a-4$

$\Rightarrow \quad a(1+y)=3y+4 \quad \Rightarrow \quad a=\dfrac{3y+4}{1+y}$

7. (a) $x^2-14x+40=(x-7)^2-9$

$\therefore \quad a=7, \quad b=-9$

(b) $3x^2+7x-6=0 \quad \Rightarrow \quad (x+3)(3x-2)=0$

$\therefore \quad x=-3$ or $x=\dfrac{2}{3}$

8. (a) $(2y+x)+(3y+x)+(2y+10)+(3x+5)$
$=360$

$\Rightarrow \quad 7y+5x+15=360 \quad \Rightarrow \quad 7y+5x=345$

(b) $7y+5x=345$ ....(1)

$2y+x=90 \quad \Rightarrow \quad x=90-2y$ ....(2)

Subst. (2) into (1), simplify to get, $y=35$

Subst. $y=35$ into (2), to obtain, $x=20$,

(c) Smallest angle = angle D

$=3(20)+5=65°$

9. $2x-3y=11$ ......(1), $\quad 5x-4y=24$ ....(2)

$(1)\times 4: \quad 8x-12y=44$ ....(3)

$(2)\times 3: \quad 15x-12y=72$ ....(4)

$(3)-(4)$, gives, $x=4$

Subst. $x=4$ into (1), gives, $y=-1$

10. (a) $s=\dfrac{200}{2}(3.6+5.7)=930$

(b) $s=\dfrac{n}{2}(a+b)$

$\Rightarrow \quad a+b=\dfrac{2s}{n} \quad \Rightarrow \quad b=\dfrac{2s}{n}-a$

11. (a) $c=\sqrt{8(3)-3(-4)}=\sqrt{36}=6$

(b) $c=\sqrt{8a-3b}$

$\Rightarrow \quad c^2=8a-3b \quad \Rightarrow \quad b=\dfrac{8a-c^2}{3}$

12. $3x+4y=3$ .... (1)

$2x-y=13 \quad \Rightarrow \quad y=2x-13$ .... (2)

Subst. (2) into (1),

$3x+4(2x-13)=3 \quad \Rightarrow \quad x=5$

Subst. $x=5$ into (2), $\quad y=2(5)-13=-3$

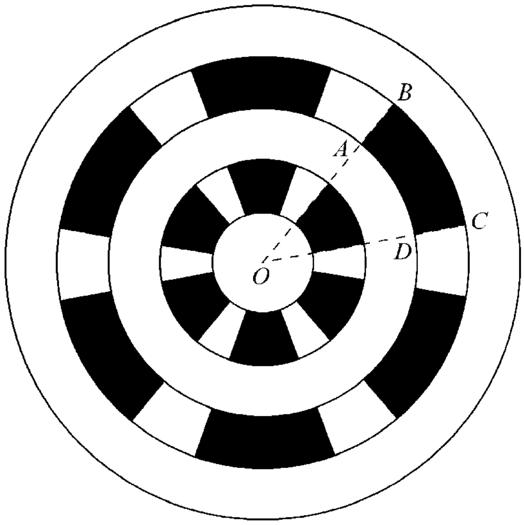
13. $\dfrac{5a-2}{3}=11 \quad \Rightarrow \quad 5a-2=33 \quad \Rightarrow a=\dfrac{35}{5}=7$

TOPIC 27

Mensuration

1. The diagram shows the metal cover for a circular drain.
Water drains out through the shaded sections.

O is the centre of circles with radii 1 cm, 2 cm, 3 cm, 4 cm and 5 cm.
The cover has rotational symmetry of order 6 and $B\hat{O}C = 40°$.



(a) Calculate the area of the shaded section $ABCD$, giving your answer in terms of π.

Answer .... cm^2 [2]

(b) The total area of the metal (unshaded) sections of the cover is $\frac{55}{3}\pi$ cm^2.

(i) Calculate the total area of the shaded sections, giving your answer in terms of π.

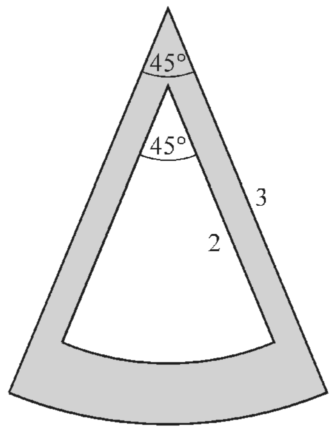
Answer .... cm^2 [1]

(ii) Calculate the fraction of the total area of the cover that is metal (unshaded).
Give your answer in its simplest form.

Answer .... [1]

[June/2013/P11/Q19]

2. The diagram shows part of an earring.
It is in the shape of a sector of a circle of radius 3 cm and angle 45°, from which a sector of radius 2 cm and angle 45° has been removed.



(a) Calculate the shaded area.

Give your answer in the form $\frac{a\pi}{b}$, where a and b are integers and as small as possible.

Answer .... cm^2 [2]

(b) The earring is cut from a sheet of silver.
The mass of 1 cm^2 of the silver sheet is 1.6 g.
By taking the value of π to be 3, estimate the mass of the earring.

Answer .... g [1]

[June/2013/P12/Q17]

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3. **[Volume of a cone** $= \frac{1}{3}\pi r^2 h$**]**

Cone 1 has radius $2x$ cm and height $7x$ cm.

Cone 2 has radius x cm and height $4x$ cm.

Find an expression, in terms of π and x, for the **difference** in the volume of the two cones.
Give your answer in its simplest form.

Answer ....cm^3 [3]

[Nov/2013/P11/Q19]

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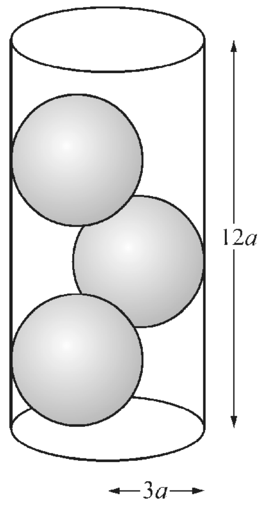
4. $\left[\textbf{Volume of a sphere} = \frac{4}{3}\pi r^3\right]$

Three spheres, each of radius $2a$ cm are placed inside a cylinder of radius $3a$ cm and height $12a$ cm.

Water is poured into the cylinder to fill it completely.

The volume of water is $k\pi a^3$ cm^3.

Find the value of k.



Answer k = ... [3]

[Nov/2013/P12/Q16]

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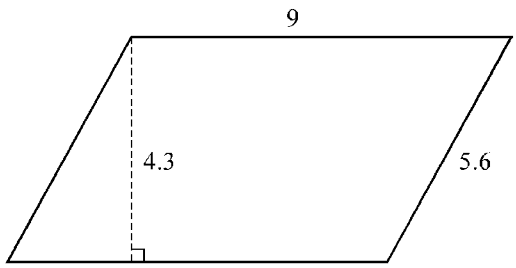
5. The diagram shows a parallelogram with lengths as marked.
All the lengths are in centimetres.

(a) Calculate the perimeter of the parallelogram.



Answer .... cm [1]

(b) Calculate the area of the parallelogram.

Answer .... cm^2 [1]

[June/2014/P11/Q3]

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6. In the triangle PQR, $PQ = 5$ cm, $QR = 7$ cm and $PR = 9$ cm.
Decide whether the triangle is acute angled or obtuse angled.
Show calculations to support your decision.

Answer Triangle PQR is .... [2]

[June/2014/P11/Q4]

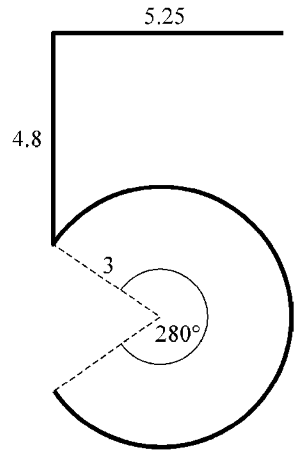
7. A thin piece of wire is shaped into a figure five as shown.

The shape has two straight sections of length 5.25 cm and 4.8 cm.

The curved part is the arc of the major sector of a circle, radius 3 cm.
The angle of the major sector is 280°.

The total length of wire needed to make the figure is $(a + b\pi)$ cm.

Find the values of a and b.



Answer a = ...

b = ... [2]

[June/2014/P11/Q7]

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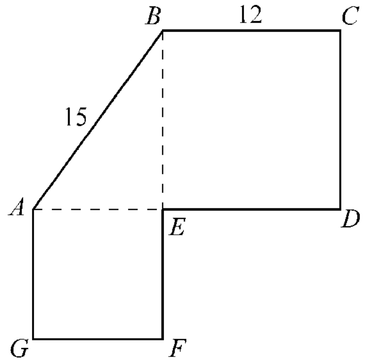
8. Shape $ABCDEFG$ is made from two squares and a right-angled triangle.
AB = 15 cm and BC = 12 cm.



(a) Find the length AG.

Answer .... cm [2]

(b) Find the total area of the shape.

Answer .... cm^2 [2]

[June/2014/P12/Q22]

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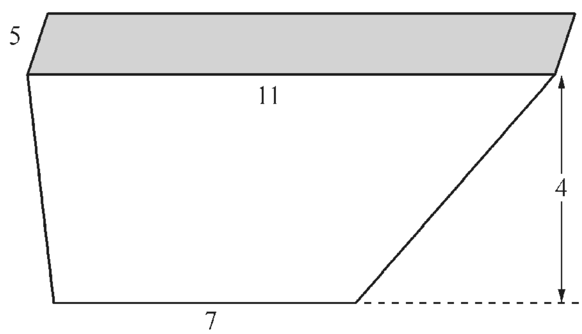
9. The diagram shows a scoop used for measuring washing powder.
The scoop is a prism. Its cross-section is a trapezium.
The trapezium has height 4 cm and parallel sides of length 7 cm and 11 cm.
The width of the scoop is 5 cm.



(a) Show that the volume of the scoop is 180 cm^3. [1]

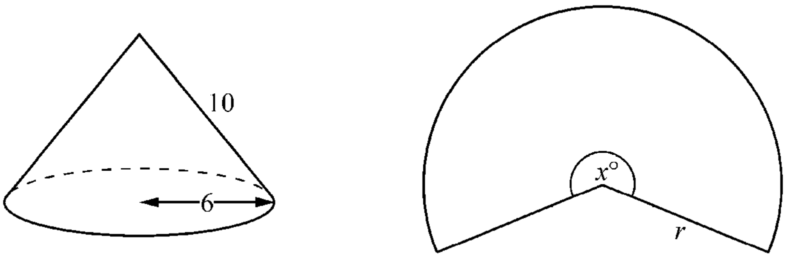
(b) A scoop used in industry is geometrically similar to the scoop above.
It has a volume of 22.5 litres.

Calculate the height of the industrial scoop.

Answer ....cm [3]

[Nov/2014/P11/Q17]

10.



A hollow cone has a base radius 6 cm and slant height 10 cm.
The curved surface of the cone is cut, and opened out into the shape of a sector of a circle, with angle $x°$ and radius r cm.

(a) Write down the value of r.

Answer r = ... [1]

(b) Calculate x.

Answer x = ... [2]

[Nov/2014/P12/Q14]

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11. [The volume of a sphere is $\frac{4}{3}\pi r^3$]

20 spheres, each of radius 3 cm, have a total volume of $k\pi$ cm^3.

(a) Find the value of k.

Answer k = ... [1]

ANSWERS

Topic 27 - Mensuration

1. (a) Area $ABCD = \frac{40}{360}(\pi 4^2 - \pi 3^2) = \frac{7}{9}\pi$ cm^2

(b) (i) Shaded sections area $= \pi(5)^2 - \frac{55}{3}\pi$

$= \frac{20}{3}\pi$ cm^2

(ii) Required fraction $= \frac{\frac{55}{3}\pi}{\pi(5)^2} = \frac{11}{15}$

2. (a) Shaded area = area of bigger sector − area of smaller sector

$= \frac{45}{360}(\pi)(3)^2 - \frac{45}{360}(\pi)(2)^2 = \frac{5\pi}{8}$ cm^2.

(b) Area of earring $= \frac{5(3)}{8} = \frac{15}{8}$ cm^2

$\therefore$ Mass of the earringr $= 1.6 \times \frac{15}{8} = 3$g

3. Difference in volume

$= \frac{1}{3}\pi(2x)^2(7x) - \frac{1}{3}\pi(x)^2(4x) = 8\pi x^3$

4. Vol. of 3 spheres $= 3\left(\frac{4}{3}\pi(2a)^3\right) = 32\pi a^3$

Vol. of cylinder $= \pi(3a)^2(12a) = 108\pi a^3$

volume of water = vol. of cylinder − vol. of 3 spheres

$\Rightarrow\ k\pi a^3 = 108\pi a^3 - 32\pi a^3 \ \Rightarrow\ k = 76$

5. (a) Perimeter $= 2(9) + 2(5.6) = 29.2$ cm

(b) Area $= 9(4.3) = 38.7$ cm^2

6. By Pythagoras, $5^2 + 7^2 = 74\ (< 9^2)$

$\therefore$ it is obtuse angled triangle.

7. Total length $= \frac{280°}{360°}(2)(\pi)(3) + 4.8 + 5.25$

$= \frac{14}{3}\pi + 10.05, \quad \therefore\ a = 10.05, \quad b = \frac{14}{3}$

8. (a) Using pythagoras theorem on ΔAEB,

$AE = \sqrt{15^2 - 12^2} = \sqrt{81} = 9$ cm

$\therefore\ AG = AE = 9$ cm

(b) Total area $= 9^2 + \frac{1}{2}(9)(12) + 12^2 = 279$ cm^2

9. (a) Volume $= \left(\frac{1}{2}(4)(7+11)\right) \times 5 = 180$ cm^3

(b) Using similar figures,

$\frac{22.5 \times 1000}{180} = \left(\frac{h}{4}\right)^3$

$\Rightarrow\ \left(\frac{h}{4}\right)^3 = 125 \ \Rightarrow\ h = 20$ cm

10. (a) $r = 10$ cm

(b) Circumference of base of cone = arc length of sector

$\Rightarrow\ 2\pi(6) = \frac{x°}{360}(2)(\pi)(10) \ \Rightarrow\ x° = 216°$

11. (a) Volume of 20 spheres $= 20\left(\frac{4}{3}\pi(3)^3\right)$

$\Rightarrow\ k\pi = 20(36\pi) \ \Rightarrow\ k = 720$

(b) Let h be the change in depth in water level.

$\therefore\ 720\pi = \pi(6)^2 h \ \Rightarrow\ h = 20$ cm

12. Area of trapezium $= \frac{1}{2} \times 12(b + 4b)$

$\Rightarrow\ 120 = \frac{1}{2} \times 12(5b) \ \Rightarrow\ b = 4$

13. (a) Vol. of hemisphere

$= \frac{1}{3}(\text{vol}._{\text{cone}} + \text{vol}._{\text{hemisphere}})$

$\Rightarrow\ \frac{1}{2}(\frac{4}{3}\pi r^3) = \frac{1}{3}\left(\frac{1}{3}\pi r^2 h + \frac{1}{2}(\frac{4}{3}\pi r^3)\right)$

$\Rightarrow\ \frac{2}{3}r^3 = \frac{1}{9}r^2 h + \frac{2}{9}r^3 \ \Rightarrow\ h = 4r$

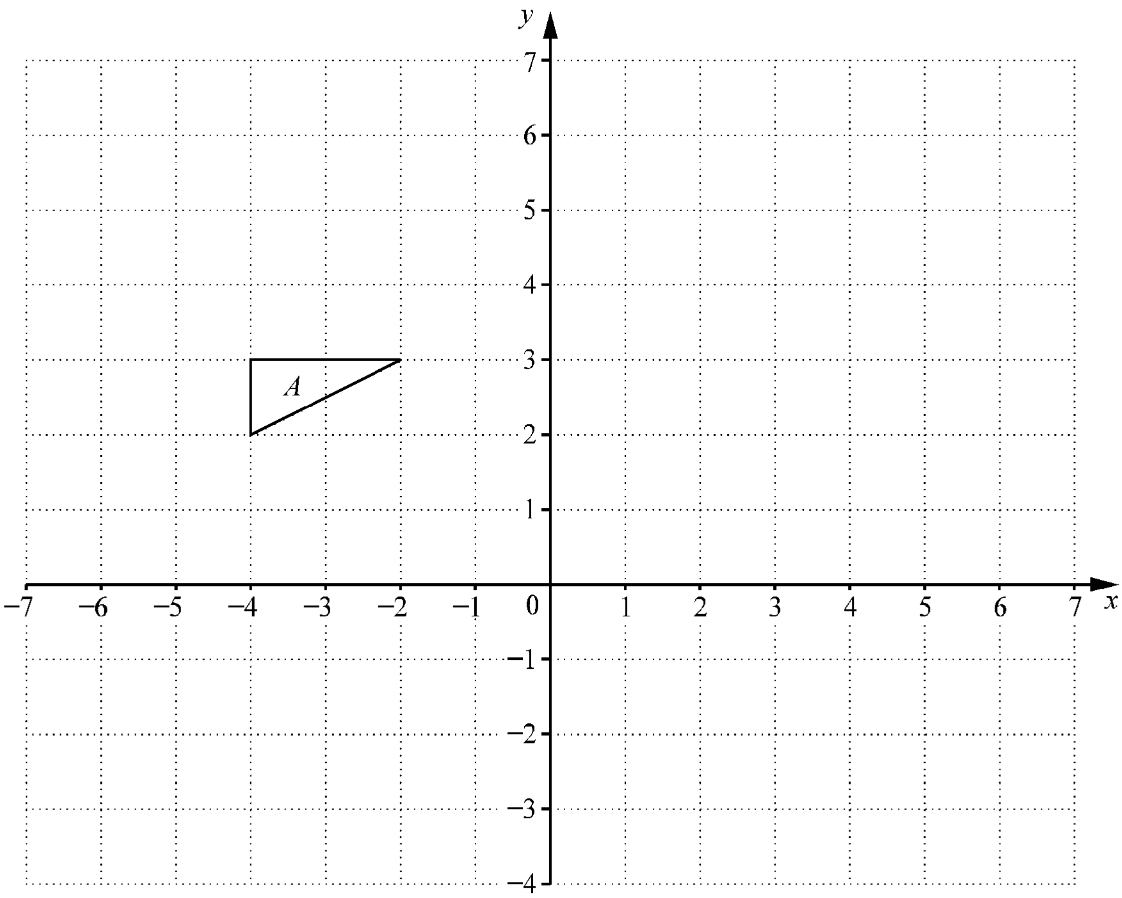
(b) $(r\sqrt{k})^2 = h^2 + r^2$

$\Rightarrow\ k = \frac{h^2 + r^2}{r^2} \ \Rightarrow\ k = \frac{(4r)^2 + r^2}{r^2} = 17$

TOPIC 35

Transformations

1. The diagram shows triangle A.

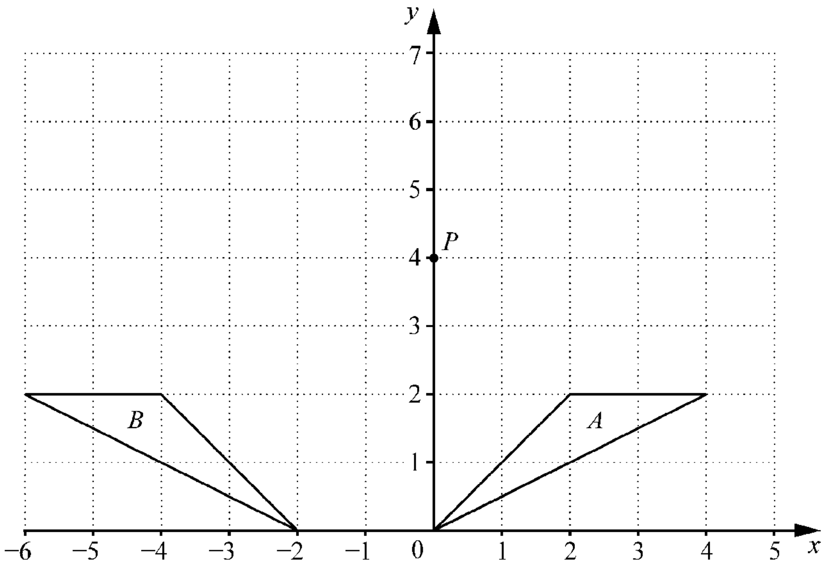


(a) Reflect triangle A in the line $x = 1$.
Label the image B. [1]

(b) Rotate triangle A through 90° clockwise about the point (–1, 3).
Label the image C. [1]

[June/2013/P12/Q6]

2. The diagram shows triangles A and B and the point P (0, 4).



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

Answer ....

.... [2]

(b) Triangle A is mapped onto triangle C by an enlargement, centre P, scale factor $-\frac{1}{2}$.

On the diagram, draw triangle C. [2]

(c) Find the value of $\frac{\text{area of triangle } A}{\text{area of triangle } C}$.

Answer .... [1]

[Nov/2013/P11/Q25]

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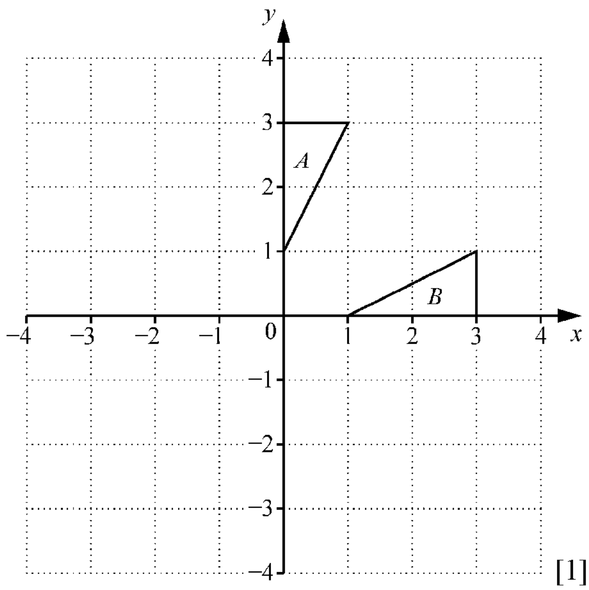
3. The diagram shows triangles A and B.



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

Answer ....

....

.... [2]

(b) Triangle A is mapped onto triangle C by the transformation **T**.

T is a rotation, centre the origin, through 270° clockwise.

(i) On the diagram, draw triangle C. [1]

(ii) Find the matrix that represents **T**.

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

[Nov/2013/P12/Q20]

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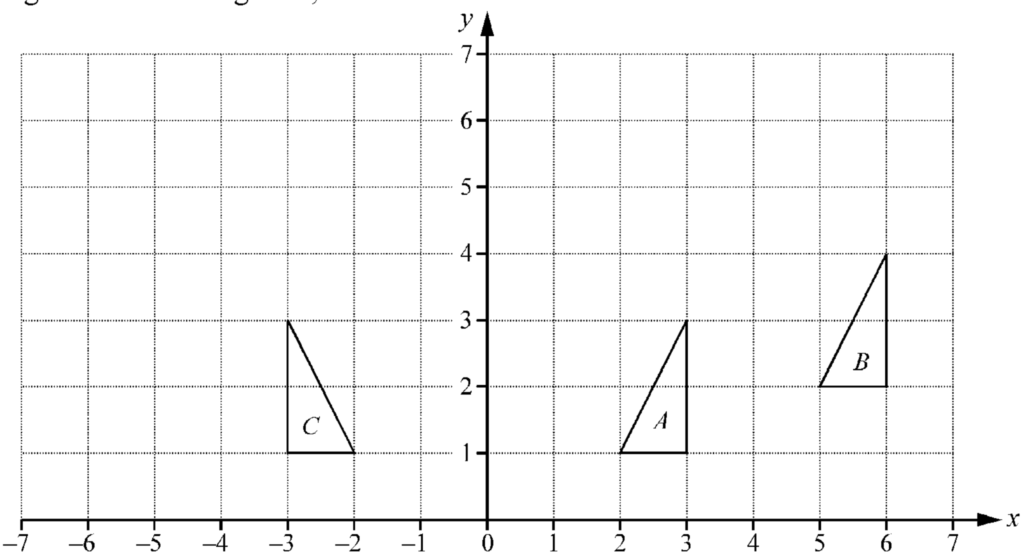
4. The diagram shows triangles *A*, *B* and *C*.



(a) Triangle *A* can be mapped onto triangle *B* by a translation.
Write down the column vector for the translation.

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

(b) Find the matrix representing the transformation that maps triangle *A* onto triangle *C*.

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

(c) Triangle *A* is mapped onto triangle *D* by an enlargement, scale factor 2, centre (5, 0).
Draw and label triangle *D*. [2]

[June/2014/P12/Q17]

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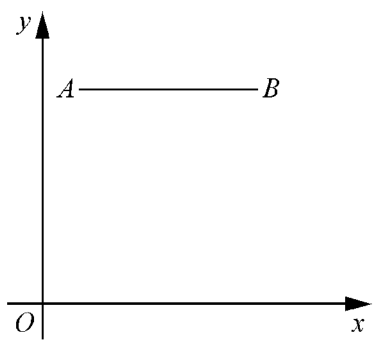
5. *A* is the point (1, 7). *B* is the point (6, 7)

The line *AB* is mapped onto the line *PQ* by the translation $\begin{pmatrix} 0 \\ -5 \end{pmatrix}$.



(a) Find the coordinates of *Q*.

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

(b) What special type of quadrilateral is *ABQP*?

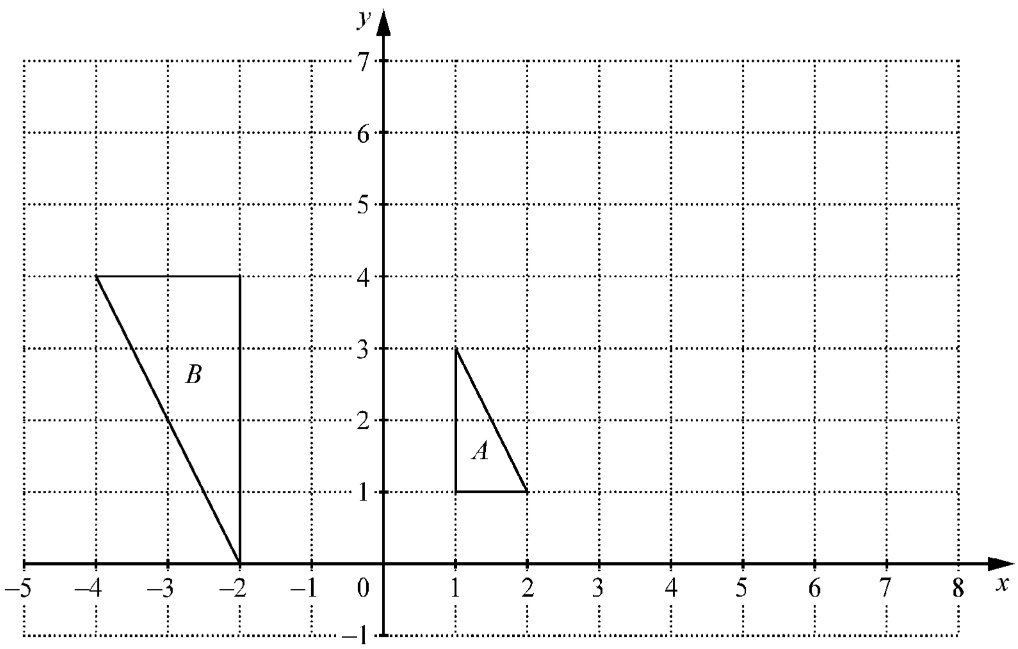
Answer .... [1]

(c) Find the area of the quadrilateral *ABQP*.

Answer .... units^2 [1]

[June/2015/P11/Q15]

6.



The diagram shows triangles *A* and *B*.

Triangle *A* is mapped onto triangle *B* by an enlargement.
Find the scale factor, and the centre, of this enlargement.

Answer scale factor = ... centre = ... [2]

[June/2015/P11/Q24]

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7. *A*, *B* and *C* are three triangles.

T_1, T_2 and T_3 are three transformations such that $T_1(A) = B$, $T_2(A) = C$ and $T_3(C) = B$.
The vertices of triangle *A* are (1, 0), (0, 1) and (1, 3).

The matrix that represents T_1 is $\begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}$.

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

Answer [2]

(b) The matrix that represents T_2 is $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$.

(i) Find the inverse of $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$.

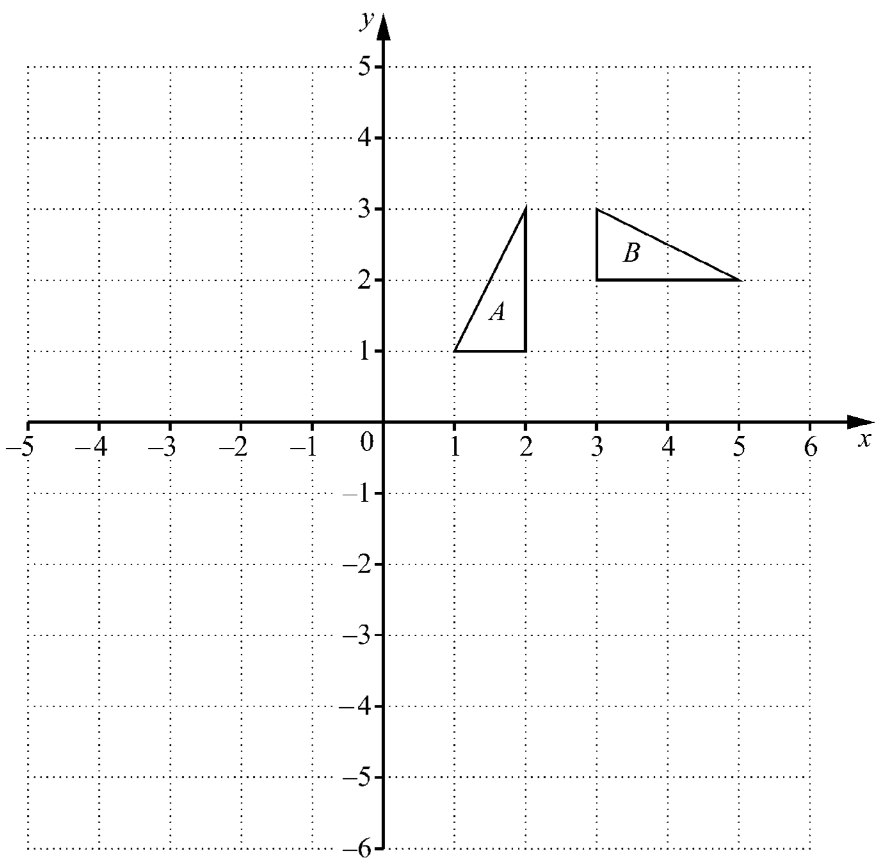
Answer [1]

(ii) The matrix that represents T_3 is **M**.
Find **M**.

Answer [2]

[Nov/2015/P12/Q26]

8.



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

Answer ....

.... [2]

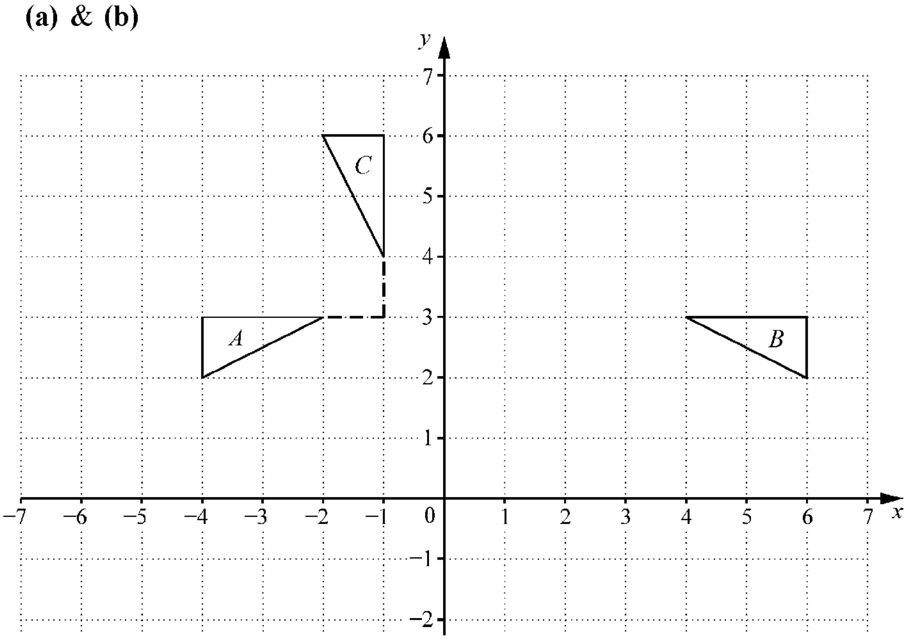
(b) Triangle A is mapped onto triangle C by an enlargement, centre (0, 2) and scale factor –2.
Draw, and label, triangle C on the diagram. [2]

[Nov/2016/P11/Q15]

ANSWERS

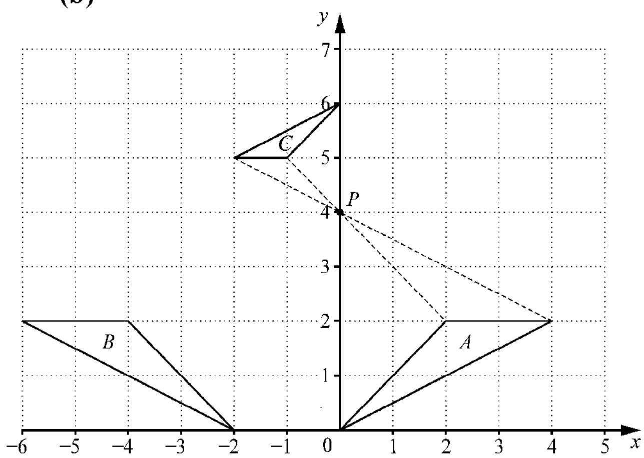
Topic 35 - Transformations

1. **(a) & (b)**



2. **(a)** ΔA is mapped onto ΔB by a reflection in the line $x = -1$.

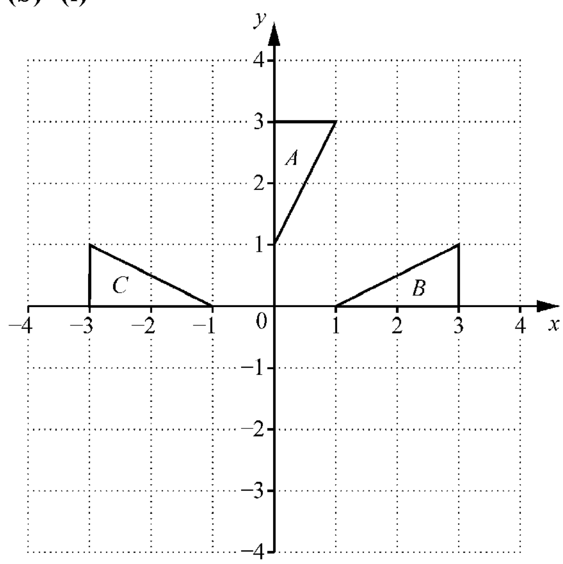
(b)



(c) $\dfrac{\text{area of triangle } A}{\text{area of triangle } C} = \left(\dfrac{1}{-\frac{1}{2}}\right)^2 = 4$

3. **(a)** ΔA is mapped onto ΔB by a reflection along the line $y = x$.

(b) **(i)**



(ii) 270° clockwise rotation about origin is same as 90° anticlockwise rotation.

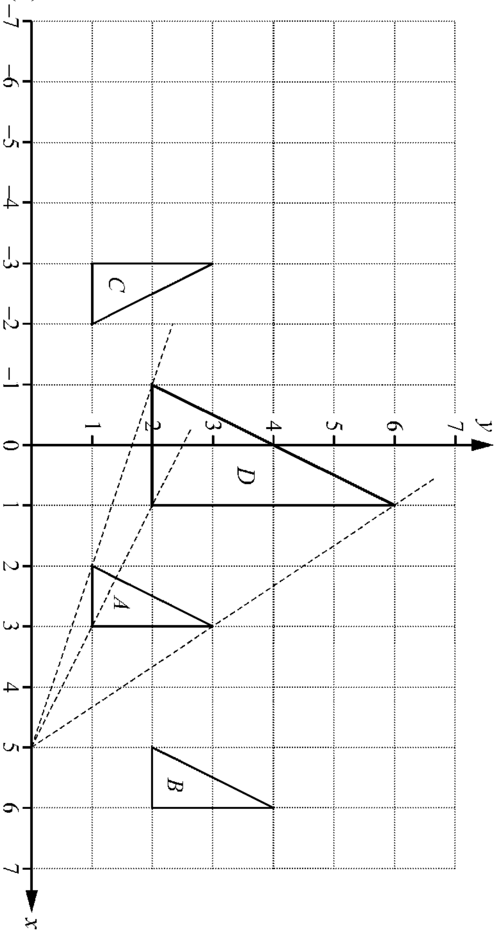
$\therefore$ the matrix is: $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.

4. **(a)** Using (2, 1) of ΔA and (5, 2) of ΔB.

Column vector $= \begin{pmatrix} 5 \\ 2 \end{pmatrix} - \begin{pmatrix} 2 \\ 1 \end{pmatrix} = \begin{pmatrix} 3 \\ 1 \end{pmatrix}$.

(b) ΔA is mapped onto ΔC by a reflection in y-axis. So, the matrix is $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$

(c)



5. **(a)** $\begin{pmatrix} 6 \\ 7 \end{pmatrix} + \begin{pmatrix} 0 \\ -5 \end{pmatrix} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$. $\therefore$ $Q(6, 2)$

(b) $ABQP$ is a square.

(c) Area $= 5^2 = 25$ unit^2.

6. Scale factor $= -2$. Centre (0, 2).

7. **(a)** $\begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 3 \end{pmatrix} = \begin{pmatrix} 2 & 2 & 8 \\ 0 & 1 & 3 \end{pmatrix}$

(b) **(i)** Determinant $= 2$. $\therefore$ Inverse $= \dfrac{1}{2}\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$

(ii) $T_1(A) = B$, so from (a), $B = \begin{pmatrix} 2 & 2 & 8 \\ 0 & 1 & 3 \end{pmatrix}$

$T_2(A) = C$

$\Rightarrow C = \begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 3 \end{pmatrix} = \begin{pmatrix} 2 & 0 & 2 \\ 0 & 1 & 3 \end{pmatrix}$

Now, $T_3(C) = B \;\Rightarrow\; \mathbf{M}(C) = B$

Using two points from ΔB and ΔC,

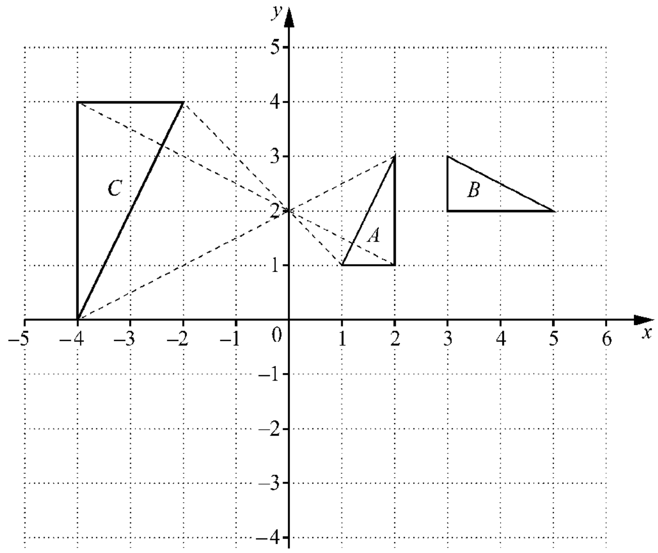
$\mathbf{M}\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}$

$\Rightarrow \mathbf{M} = \begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}^{-1}$

$\Rightarrow \mathbf{M} = \dfrac{1}{2}\begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix} = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$.

8. **(a)** It is a 90° clockwise rotation about (3, 1).

(b)



9.