Unit 9 · Transformation

WORKSHEET

Full marks 32

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 32

1 Key words [3]

Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

combined	**enlargement**	**F**	**G**	**isometric**	**rotation**	**translation**	**translation vector**

A transformation whose image is congruent to its object is called _____. A translation is fully described by its _____, which is the image minus the object. Two transformations done one after the other make a _____ transformation, and in $G \circ F$ the transformation done first is _____. Two reflections in parallel lines make a _____, and two reflections in lines that cross make a _____.

2 Match the columns [3]

Each image of $P(x, y)$ on the left is made by one transformation on the right. Match them. One transformation on the right is not needed. Each pair carries 0.5 mark.

Column A		Column B
1. $P'(y, x)$	☐	**a.** reflection in the line $y = -x$
2. $P'(-y, -x)$	☐	**b.** reflection in the line $x = 2$
3. $P'(-y, x)$	☐	**c.** rotation of $-90°$ about O
4. $P'(y, -x)$	☐	**d.** enlargement $E[(0, 0), -2]$
5. $P'(4 - x, y)$	☐	**e.** reflection in the X-axis
6. $P'(-2x, -2y)$	☐	**f.** rotation of $+90°$ about O
		g. reflection in the line $y = x$

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. Under which transformation does every point of a figure move the same distance in the same direction? [1]

a. a reflection **b.** a rotation
c. a translation **d.** an enlargement

ii. A figure is reflected in the line $x = 1$ and then in the line $x = 4$. Which single transformation does both? [1]

a. a translation 3 units to the right **b.** a translation 6 units to the right
c. a translation 6 units to the left **d.** a reflection in the line $x = 5$

iii. A point is rotated $+90^\circ$ about O and then 180° about O. Which single transformation does both? [1]

a. a rotation of -90° about O
b. a rotation of $+90^\circ$ about O
c. a rotation of 180° about O
d. the reflection in the line $y = x$

iv. Which point is never moved by any 2×2 transformation matrix? [1]

a. $(1, 0)$
b. $(0, 0)$
c. $(1, 1)$
d. it depends on the matrix

v. $E_1 = E[(0, 0), 3]$ is followed by $E_2 = E\left[(0, 0), -\frac{1}{3}\right]$. What is $E_2 \circ E_1$? [1]

a. no change at all
b. a rotation of 180° about O
c. the enlargement $E\left[(0, 0), \frac{8}{3}\right]$
d. the reflection in the X-axis

4 Very short answers [3]

Write very short answers to the following questions.

a. A translation takes $A(2, -3)$ to $A'(-1, 4)$. Write its translation vector. [1]

b. Name the single transformation made by a reflection in the X-axis followed by a reflection in the Y-axis. [1]

c. Find the image of the point $(3, -5)$ under the matrix $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$. [1]

5 Short answers [8]

Write short answers to the following questions.

a. Find the mistake. T is the translation by $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$ and R the reflection in the Y-axis. Bimala finds the image of $P(2, 1)$ under $R \circ T$ like this: [2]
R: $P(2, 1) \to (-2, 1)$; then T: $(-2, 1) \to (1, 1)$. So $P''(1, 1)$.
What has she done wrong? Find the correct image.

Science Playground, Katunje, Bhaktapur
https://science-playground.com/learn/grade-10-optional-math/transformation

b. Under the enlargement $E[(1, 2), 3]$, the image of a point P is $P'(7, -4)$. Find P. **[2]**

c. One mirror shows writing reversed. A periscope has two mirrors set parallel to each other, yet the writing you see through it reads the right way. Explain why, using combined transformations. **[2]**

d. The matrix $A = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$ is followed by the matrix $B = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$. Find the single matrix that does both, and say what it does to a figure. **[2]**

6 Long answers **[8]**

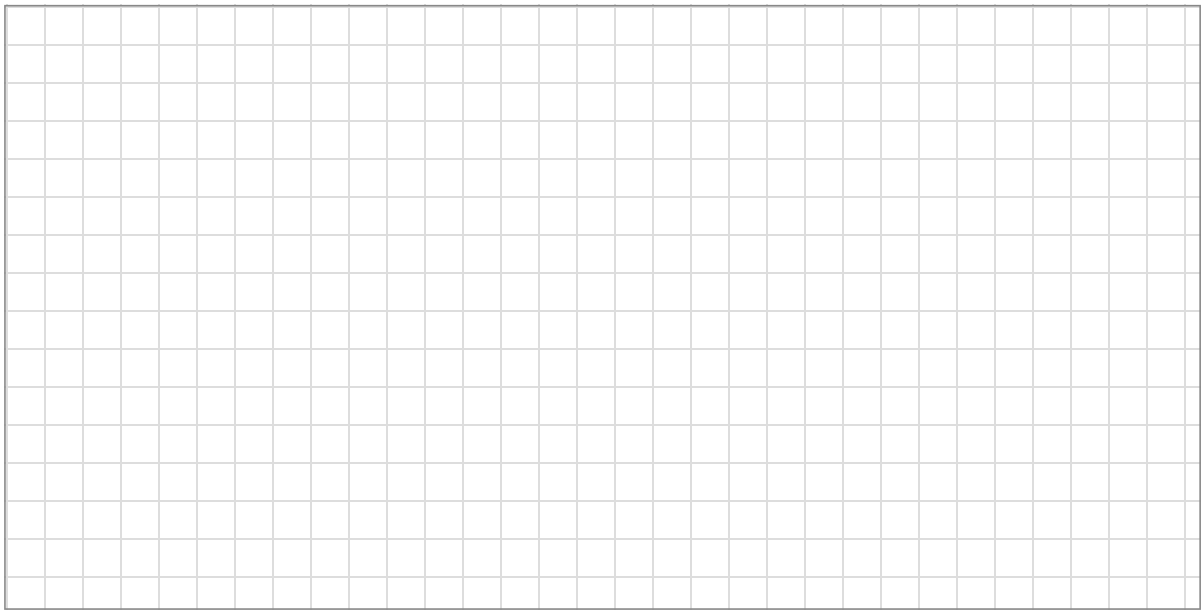
Solve the following problems. Show your working.

a. $\triangle ABC$ has vertices $A(1, 1)$, $B(4, 1)$ and $C(1, 3)$. It is reflected in the line $x = -1$ to $\triangle A'B'C'$, and $\triangle A'B'C'$ is then reflected in the line $x = 3$ to $\triangle A''B''C''$. **[4]**

i. Find the vertices of $\triangle A'B'C'$ and of $\triangle A''B''C''$.

ii. Name the single transformation that takes $\triangle ABC$ to $\triangle A''B''C''$.

iii. Draw the three triangles and both mirror lines on one graph.



Answer:

b. The unit square $OABC$, with $O(0, 0)$, $A(1, 0)$, $B(1, 1)$ and $C(0, 1)$, is mapped by a 2×2 matrix M to $OA'B'C'$, with $A'(2, 1)$, $B'(3, 4)$ and $C'(1, 3)$. **[4]**

i. Write the matrix M.

ii. Find the area of $OA'B'C'$.

iii. Use M to find the image of the point $(-1, 2)$.

iv. Is M a reflection, a rotation or an enlargement? Give a reason.

Answer: _____

7 Think [2]

Think, then answer.

A phone saves a photo with the instruction "turn it 90° clockwise", and an app then flips the photo top to bottom. Gita says the two together are just a turn of 90° anticlockwise. Is she right? Use matrices, with the photo's center at O, x to the right and y up.

8 Activity: Two mirrors make a turn (not marked)

Tape two small mirrors together along one edge, like a book. Stand them on a sheet of paper and put a coin halfway between them. Set the mirrors at each angle below (draw the angles on the paper with a protractor first), count the coins you see in the mirrors, and fill in the table.

Angle between the mirrors	Turn made by two reflections	Images of the coin you count	Coins in the whole circle (the real one too)
120°			
90°			
60°			
45°			