



Grade 6 Math Circles

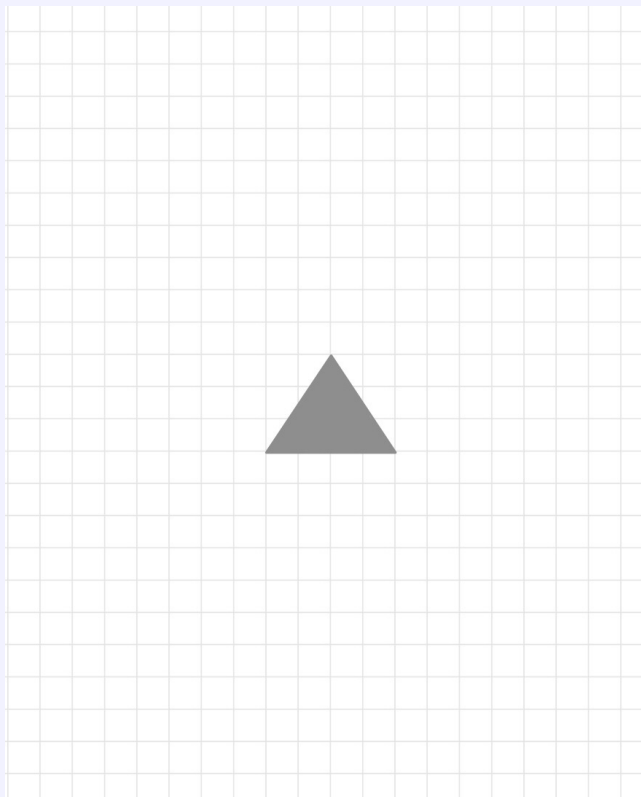
March 7/8/9, 2023

Transformations - Solutions

Exercise Solutions

Exercise 1

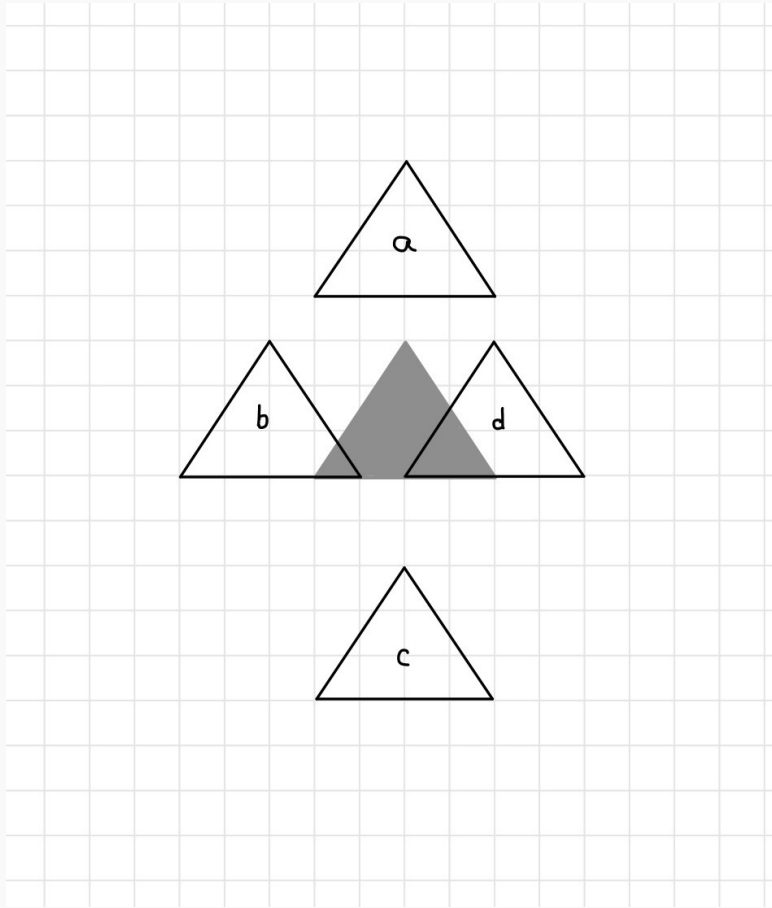
Perform the following individual transformations on the triangle below. Each transformation should be applied to the original triangle, not an image from the previous part.



- a) Translate 4 units up
- b) Translate 3 units left
- c) Translate 5 units down
- d) Translate 2 units right



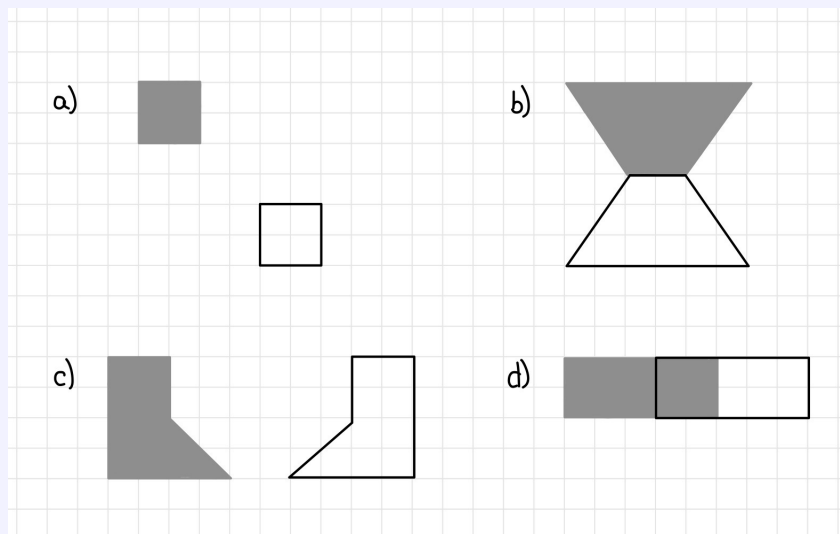
Exercise 1 Solution



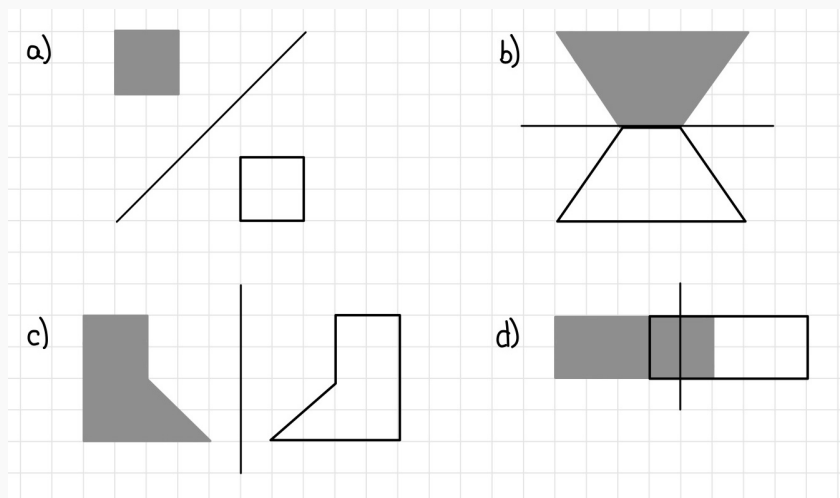


Exercise 2

For each of the following reflections, draw where the mirror line should go.



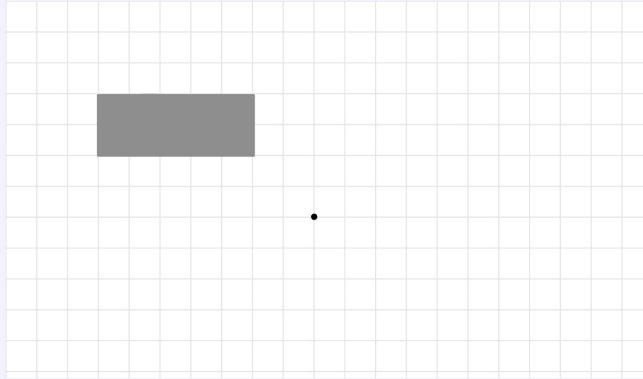
Exercise 2 Solution



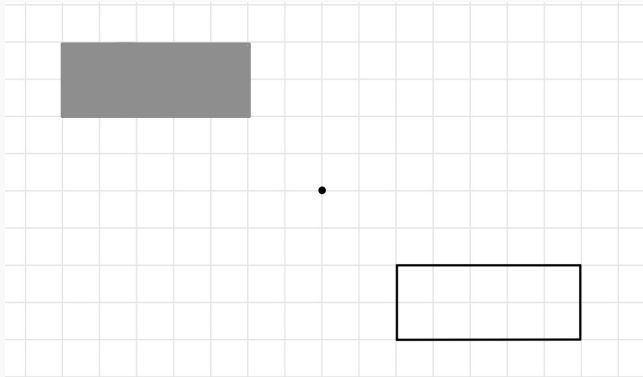


Exercise 3

Rotate the following rectangle 180° CW around the given centre of rotation.



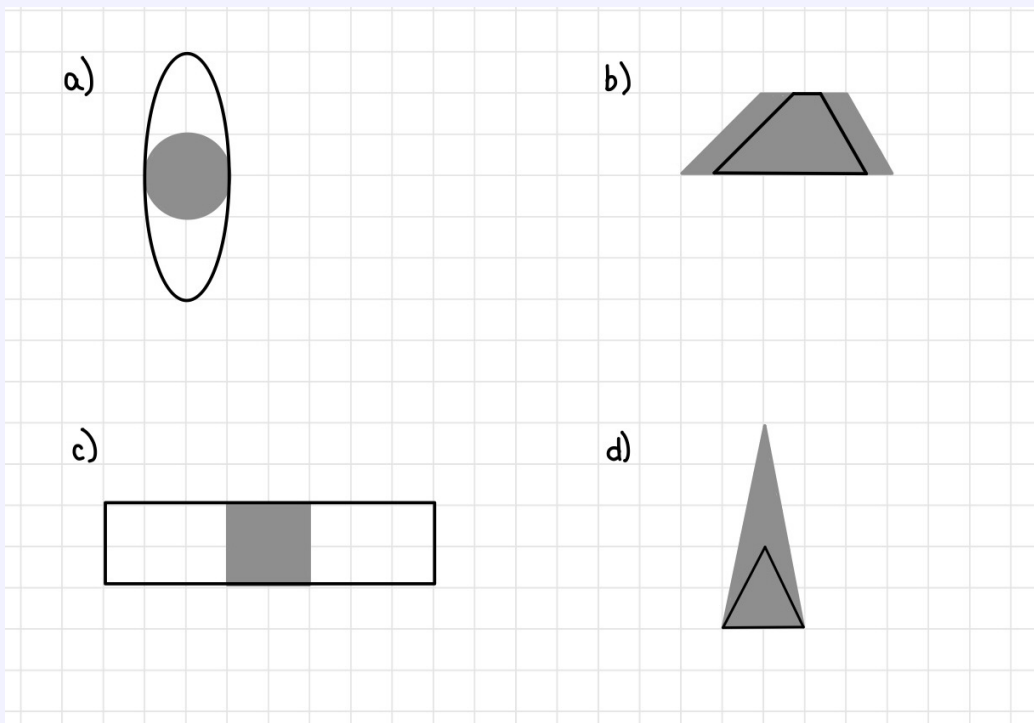
Exercise 3 Solution





Exercise 4

Determine whether each object has been stretched or compressed. In addition, state whether it was a vertical or horizontal stretch/compression.



Exercise 4 Solution

- a) Vertical stretch
- b) Horizontal compression
- c) Horizontal stretch
- d) Vertical compression

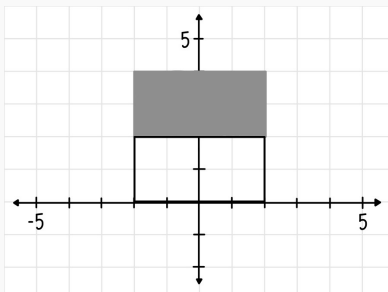
Exercise 5

Draw any shape you would like on the Cartesian plane. Draw an image of that shape with the translation of 2 units down. Write down a few coordinates of the object and the image.



Exercise 5 Solution

Sample solution:



Object coordinates

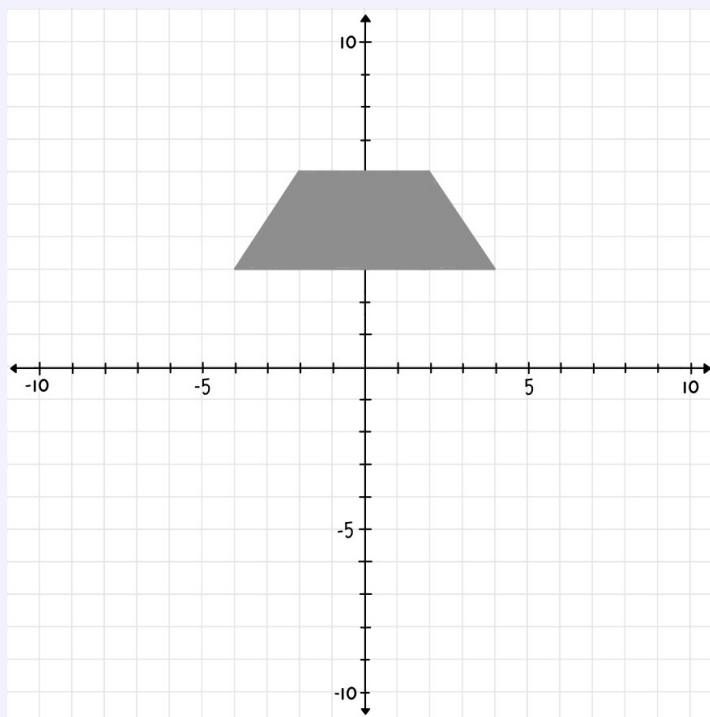
x	-2	-2	2	2
y	2	4	2	4

Image coordinates

x	-2	-2	2	2
y	0	2	0	2

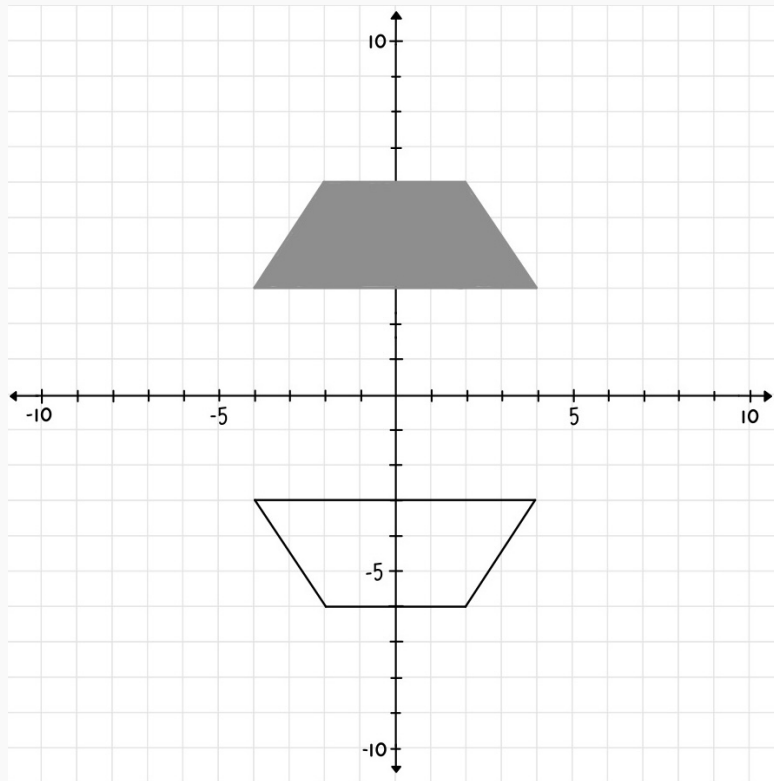
Exercise 6

Reflect the following object over the x -axis and write some coordinates for the object and the image.





Exercise 6 Solution



Object coordinates

x	4	-4	2	-2
y	3	3	6	6

Image coordinates

x	4	-4	2	-2
y	-3	-3	-6	-6



Exercise 7

Rotate the following objects. Start by writing the coordinates of the object and using the table above to find the coordinates of the image. Then, sketch the image.

a) 90° CW around the origin

x	y

x	y

b) 90° CCW around the origin

x	y

x	y

Exercise 7 Solution

a) 90° CW around the origin

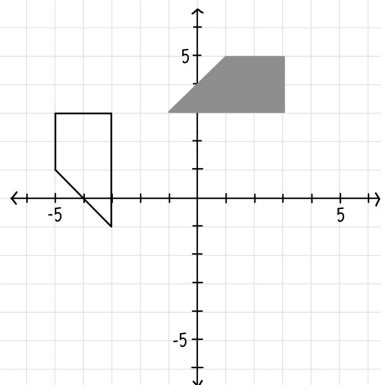
x	y
1	-1
4	-1
4	-2
3	-2
3	-3
2	-3
1	-2

x	y
-1	-1
-1	-4
-2	-4
-2	-3
-3	-3
-3	-2
-2	-1



b) 90° CCW around the origin

x	y	x	y
-1	3	-3	-1
3	3	-3	3
3	5	-5	3
1	5	-5	1



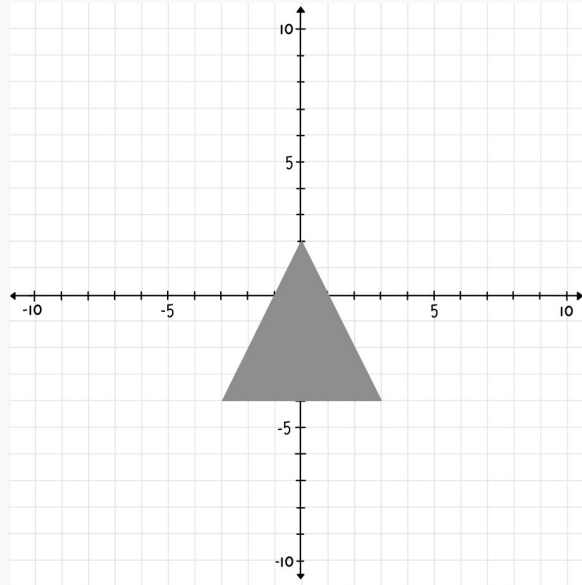
Exercise 8

On the Cartesian plane, draw a shape of your choosing. Write out the coordinates and divide each y -coordinate by 2. Sketch the resulting image and observe what happened to the original object.



Exercise 8 Solution

Sample solution:

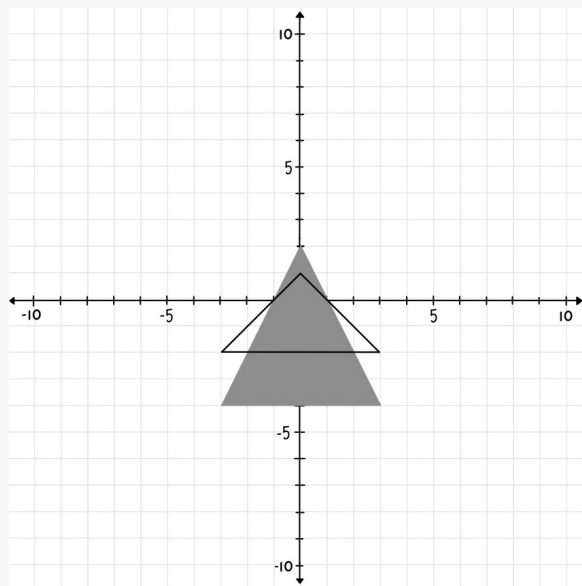


Object coordinates

x	-3	3	0
y	-4	-4	2

Image coordinates

x	-3	3	0
y	-2	-2	1

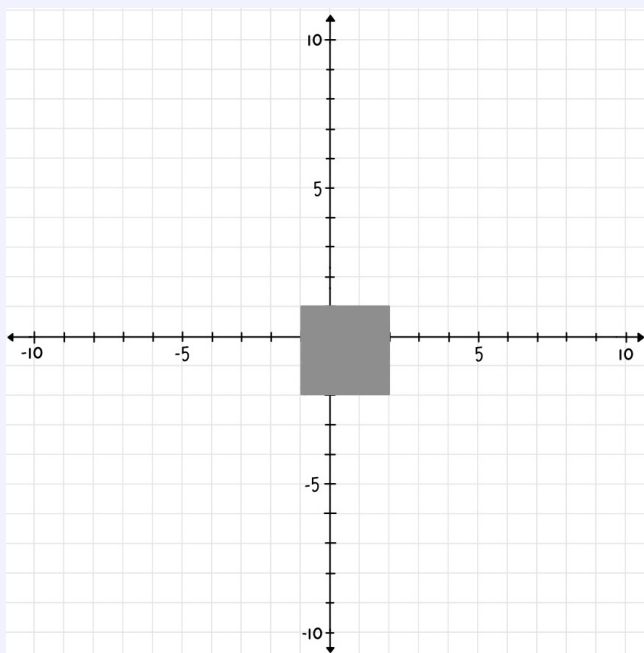




Exercise 9

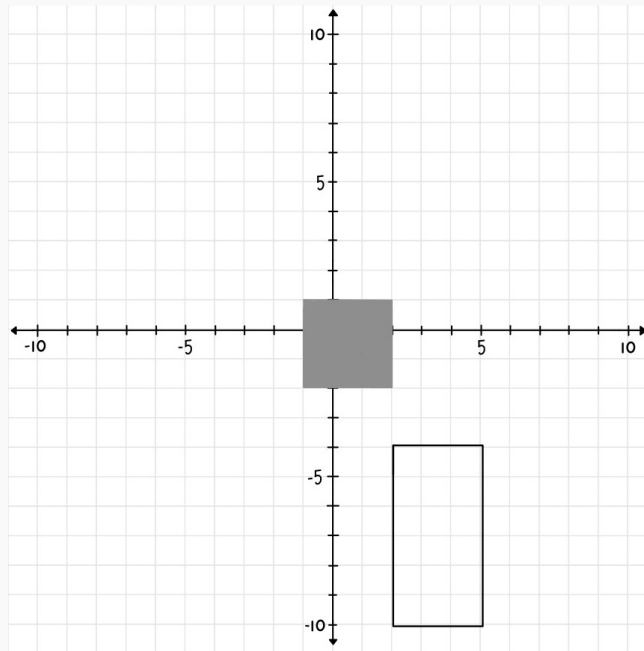
Perform the following transformations in order on the shape below.

1. Reflection over y -axis
2. Shift 3 units up
3. Shift 4 units right
4. Rotation 90° CW about the origin
5. Vertical stretch by a factor of 2





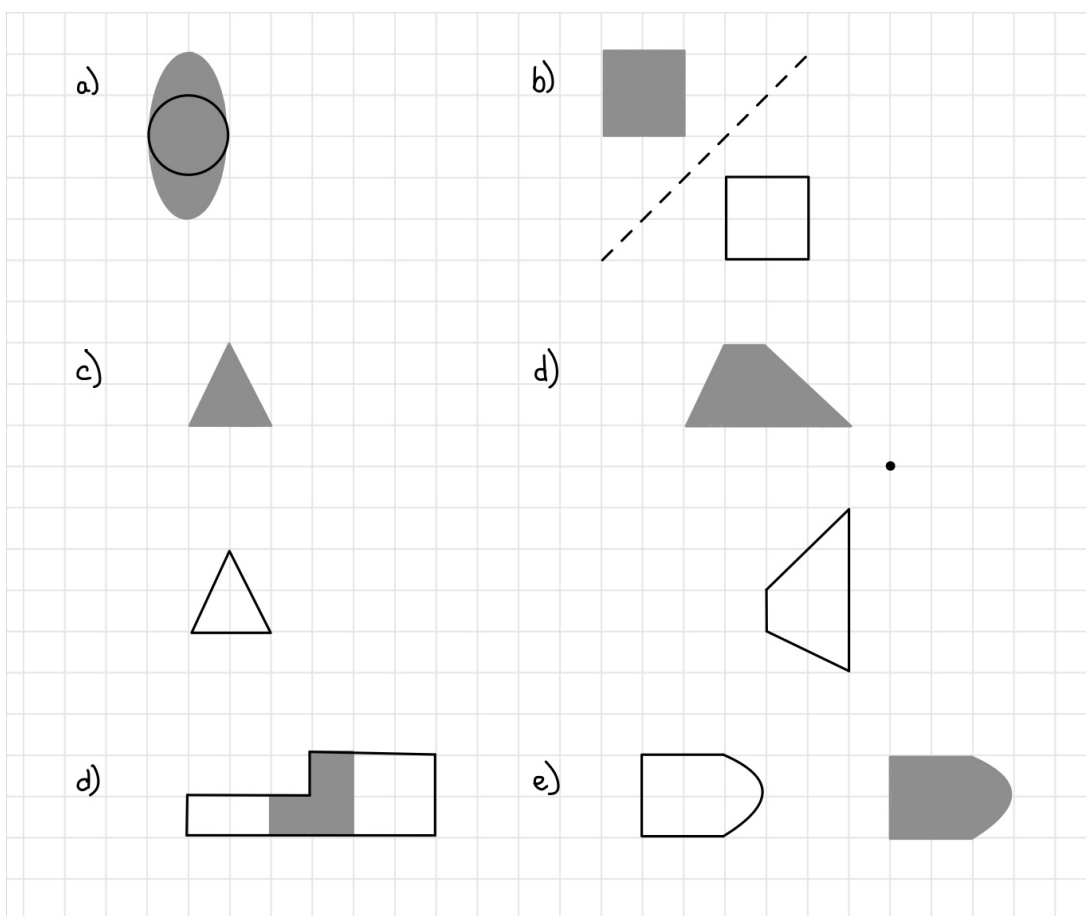
Exercise 9 Solution





Problem Set Solutions

1. Determine which transformation was performed on each object and image below. Be specific (ex. instead of saying translation, say translation 3 units up).



Solution:

- a) Vertical stretch
- b) Reflection over the given mirror line
- c) Translation 5 units down
- d) Rotation 90° CCW about the given point of rotation
- e) Horizontal stretch
- f) Translation 6 units left

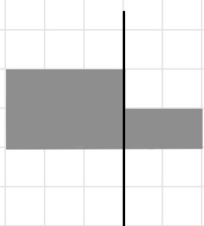


2. Perform the given transformations for each of the objects below.

a) Rotation 180° about the given point



b) Reflection over the given mirror line



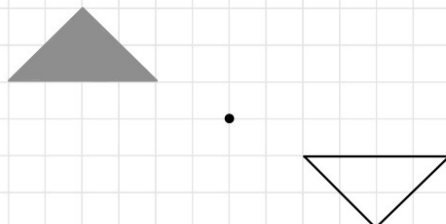
c) Translation 3 units down and 6 units right



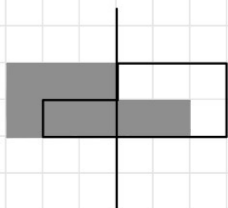


Solution:

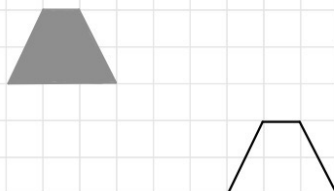
a) Rotation 180° about the given point



b) Reflection over the given mirror line



c) Translation 3 units down and 6 units right

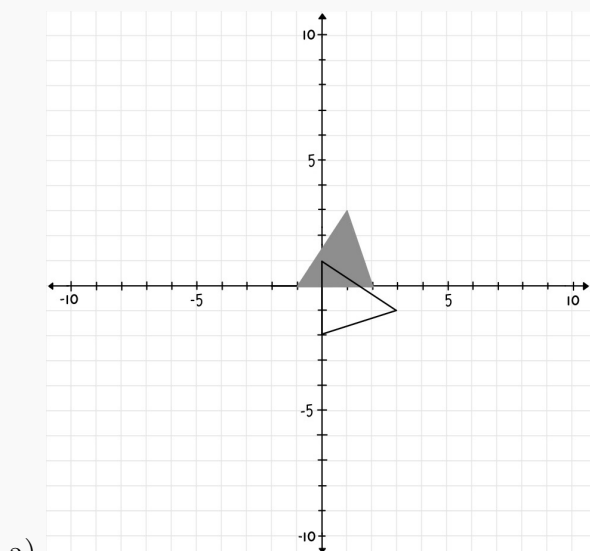




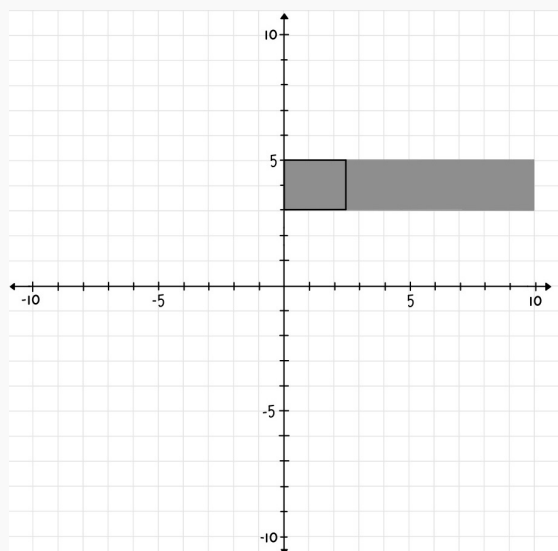
3. Given the coordinates of the shapes' vertices, sketch the object, perform the transformation on the object, and sketch the image.

- a) $(-1, 0), (2, 0), (1, 3)$. 270° rotation CCW about the origin.
- b) $(0, 3), (0, 5), (10, 3), (10, 5)$. Horizontal compression by a factor of 4.
- c) $(-1, -1), (-2, -3), (4, -1), (3, -3)$. Reflection over the y -axis.
- d) $(4, 2), (4, -1), (-2, 2), (-2, -1)$. Vertical stretch by a factor of 2.

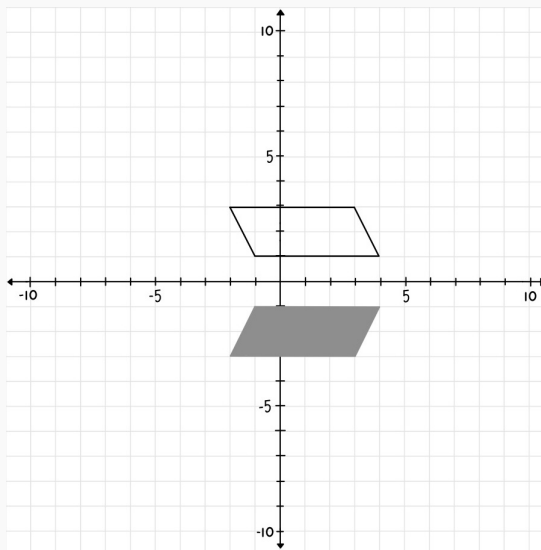
Solution:



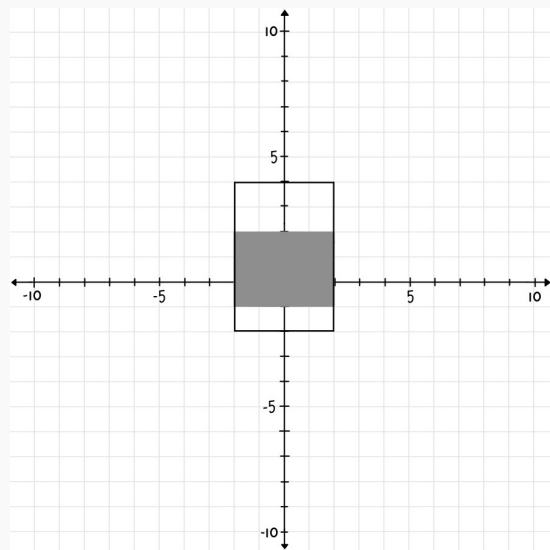
a)



b)



c)

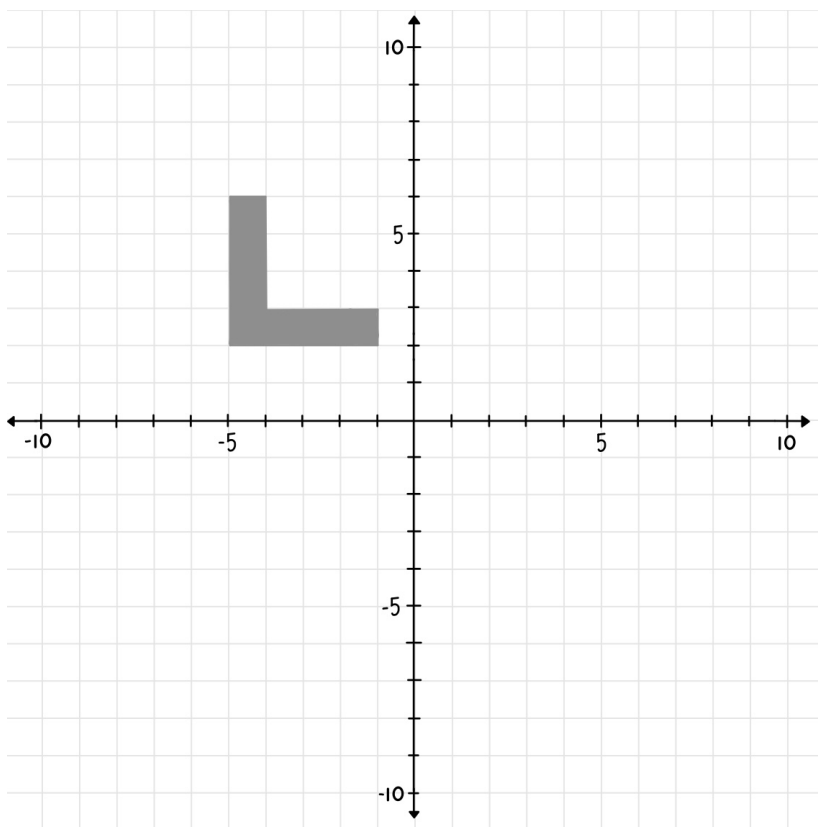


d)



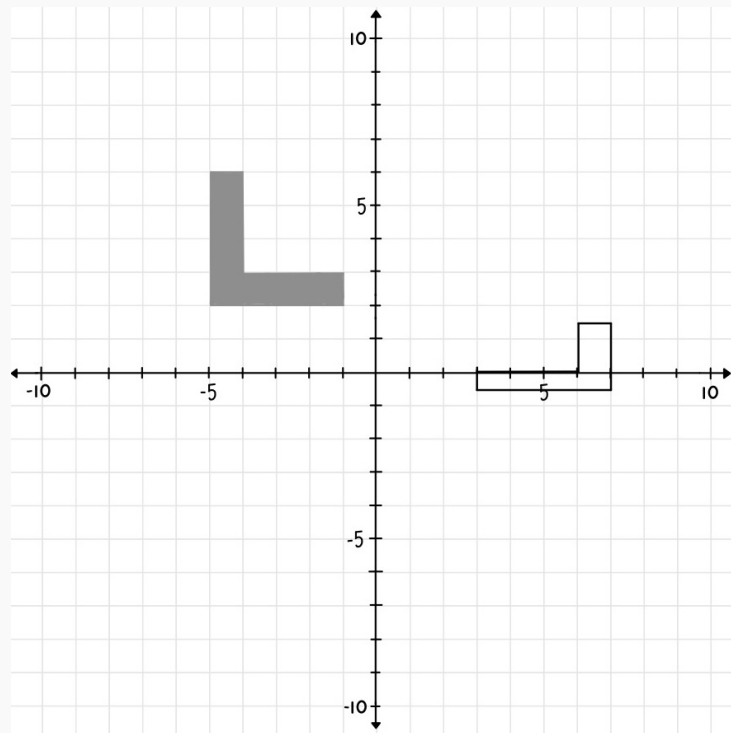
4. Perform all of the following transformations on the given shape in order.

- (a) Translation 3 units down
- (b) 180° rotation about the origin
- (c) Translation 2 units right
- (d) Reflection over x -axis
- (e) Vertical compression by a factor of 2





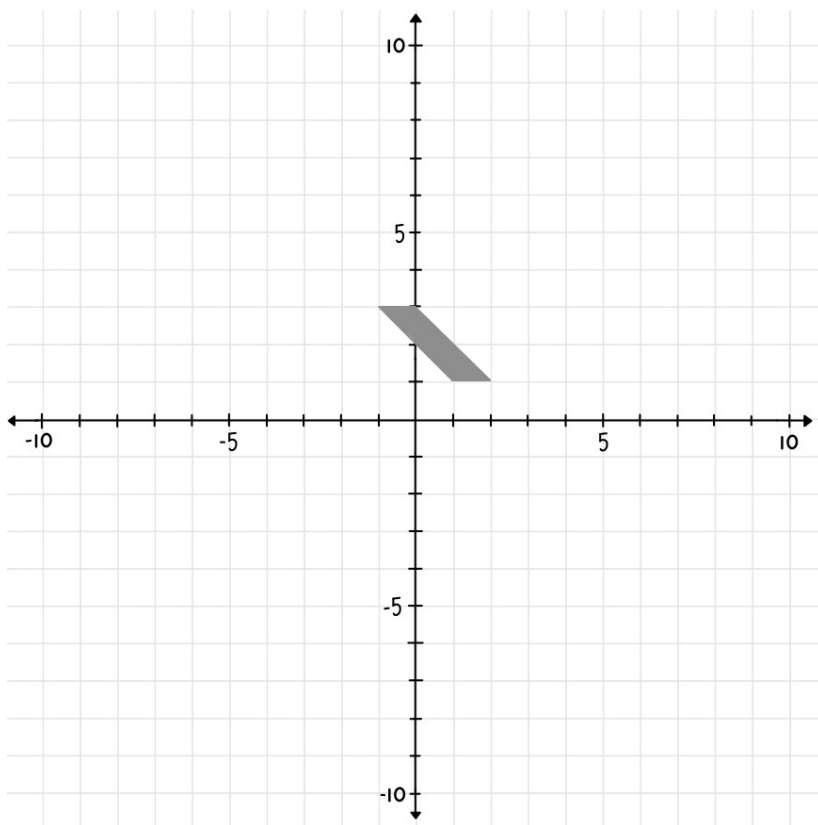
Solution:





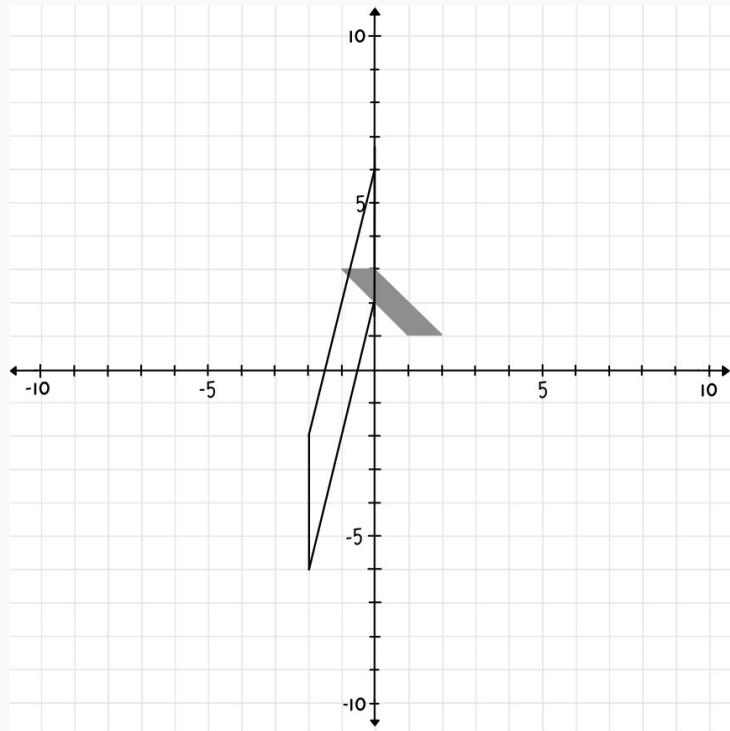
5. Perform all of the following transformations on the given shape in order.

- (a) Horizontal stretch by a factor of 4
- (b) 270° rotation CCW about the origin
- (c) Reflection over the y -axis
- (d) Translation 3 units left
- (e) Translation 2 units up



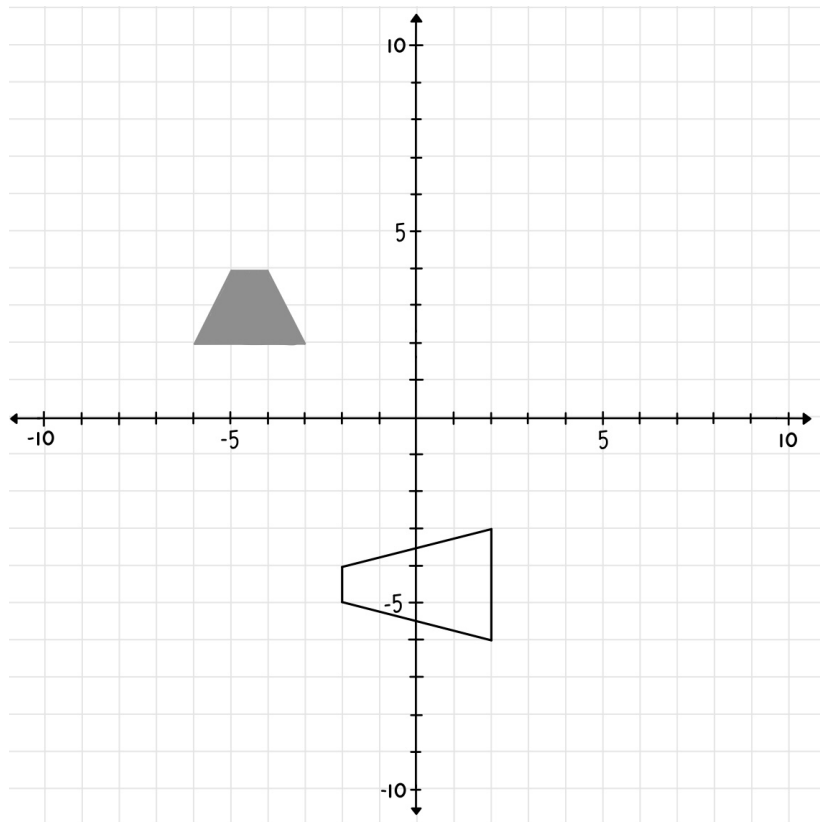


Solution:





6. **Challenge:** Determine which transformations were applied to the object to get the given image.



Solution:

- 1) Rotation 90° CCW
- 2) Horizontal stretch by a factor of 2
- 3) Shift 6 units to the right

Note that there is possibly more than one correct solution