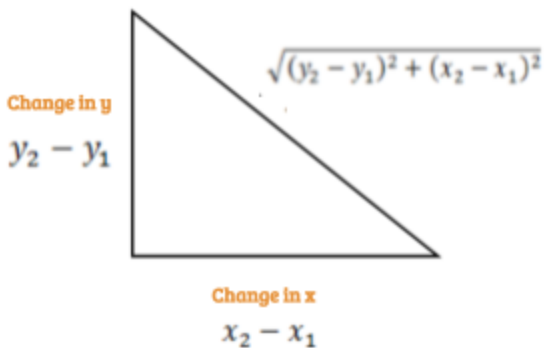# The SAT Initiative

G3 Topic Breakdown
SOL - Geometry

Topic: *Using formulas for finding distance, midpoint and slope*

Distance Formula

$$\sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$$

Change in y
$$y_2 - y_1$$

Change in x
$$x_2 - x_1$$

Example

Points (3,2) and (7,8)

$$\sqrt{(8-2)^2 + (7-3)^2}$$

$$= \sqrt{(6)^2 + (4)^2} = \sqrt{36 + 16} = \sqrt{52} = 2\sqrt{13}$$

Midpoint Formula

$$\left(\frac{(x_1 + x_2)}{2}, \frac{(y_1 + y_2)}{2} \right)$$

Example

Points (3,2) and (7,8)

$$\left(\frac{3+7}{2}, \frac{2+8}{2} \right)$$

$$\left(\frac{10}{2}, \frac{10}{2} \right) \rightarrow (5,5)$$

Slope Formula
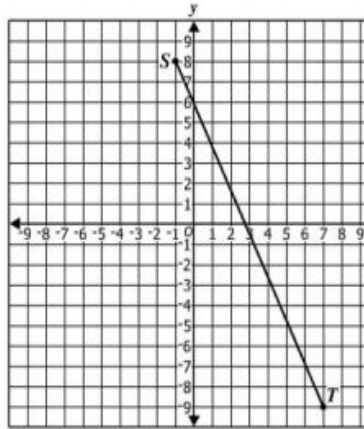
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Example

Points (3,2) and (7,8)

$$\frac{8-2}{7-3} = \frac{6}{4} = 1.5$$

SOL Practice Problem

Question 1:

Given: $S(-1, 8)$ and $T(7, -9)$

Answer

$$\sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$$

Two points (-1,8) (7, -9)

$$\sqrt{(-9 - 8)^2 + (7 - (-1))^2}$$

$$\sqrt{(-17)^2 + (8)^2}$$

$$\sqrt{289 + 64} = \sqrt{353}$$

What is the length of $\overline{ST}$?

○ A $\sqrt{23}$

○ B 5

○ C $5\sqrt{13}$

○ D $\sqrt{353}$

Question 2:

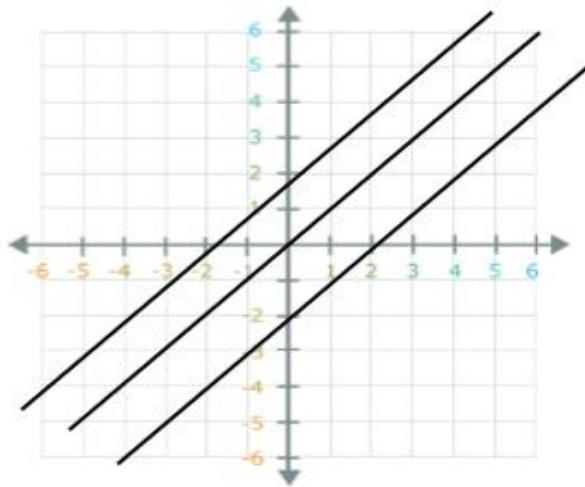Given: $P(5, 7)$ and $T(-3, 3)$

What is the slope of $\overrightarrow{PT}$?

○ A -2

○ B $\frac{-1}{2}$

○ C $\frac{1}{2}$

○ D 2

Answer

$$Slope = \frac{Rise}{Run} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 3}{5 - (-3)} = \frac{4}{8} = \frac{1}{2}$$

Applying slope to determine parallel or perpendicular.

❖ Lines are **parallel** if they have the **same slope**.

Here, the lines have the **same slope** (m = 1), so they will not cross and are **parallel**.

❖ Lines are **perpendicular** if their slopes are the **opposite inverse** of each other.
Opposite Inverse: Flipping the value of the slope and giving it the opposite sign (positive to negative, or negative to positive).

Ex. The opposite inverse of 2 is -½.
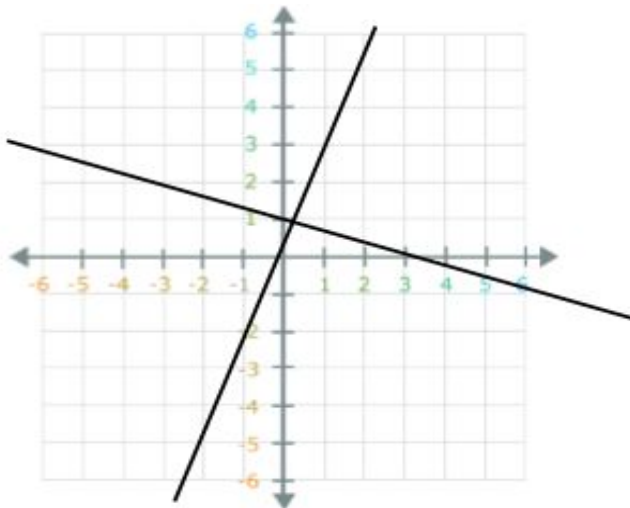
The lines are **perpendicular** because the slope of one line is 3 and the other is -⅓, meaning that they are **opposite inverse** of each other.
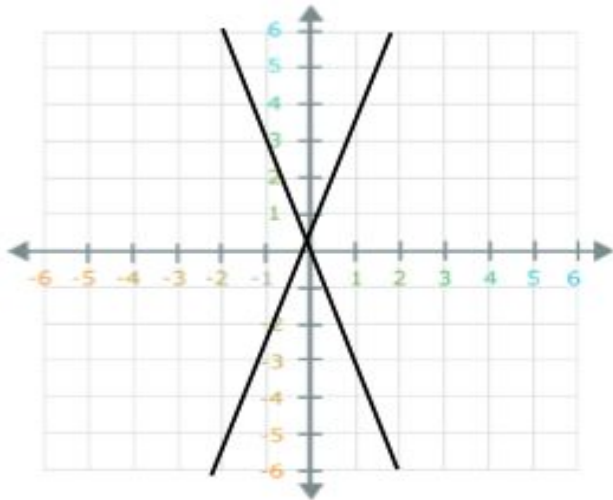
These lines are **not perpendicular** because the slopes are **not opposite inverses** of each other. Their slopes are 3 and -3.
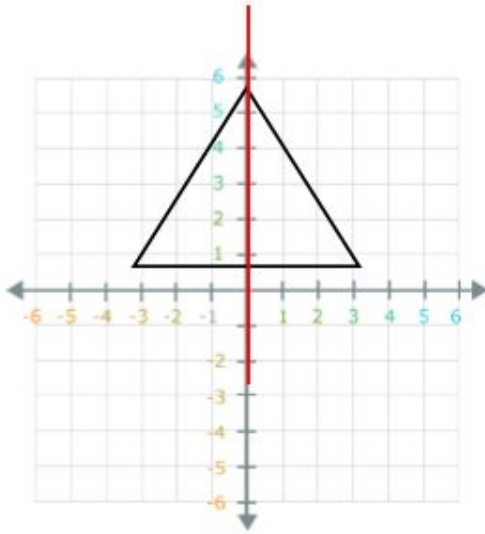
Symmetry:

Symmetry is when one shape becomes exactly like another if you flip, slide or turn it.

Line Symmetry

Line Symmetry, also called **Reflection symmetry**, is when one half of the shape is the reflection of the other half. Like in this picture, the line down the center is the **line of symmetry,** dividing the shape into two similar parts. The Line of Symmetry can be in any direction (not just vertical or horizontal).
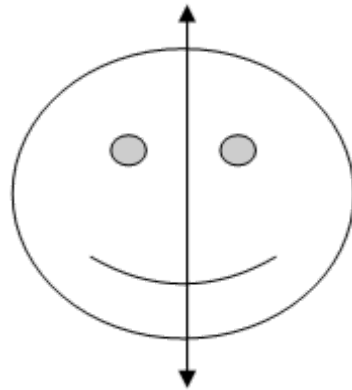
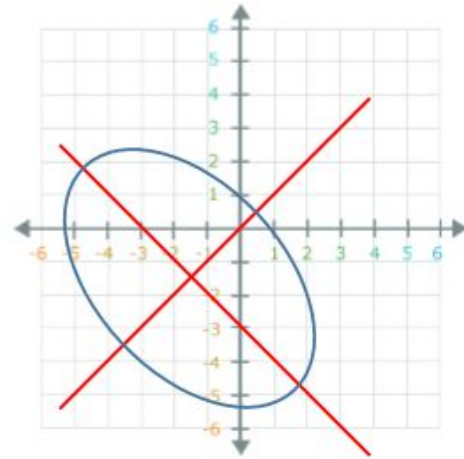The figure on the left is symmetrical because it has a line of symmetry at x=0: both sides of the shape are the same.

Figure B is symmetrical on two lines, y=x and y=-x-3.

Point Symmetry

Point Symmetry is when there exists a **central point** that can split the shape into two similar parts. Every part on each has a matching part on the other that is:
- the **same distance** from the central point,
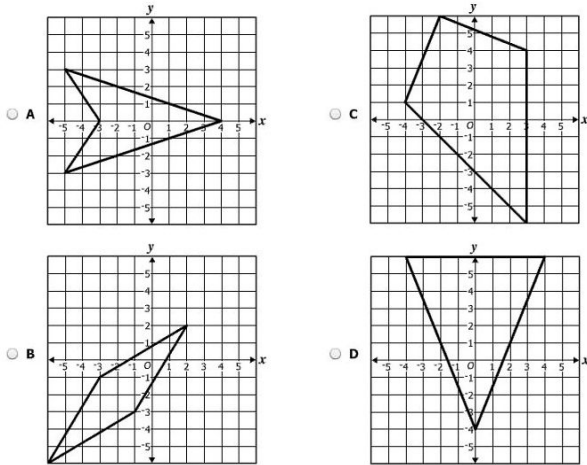- but facing **different direction**.

In this graph, the point of symmetry is the origin, dividing the graph into 2 similar parts.
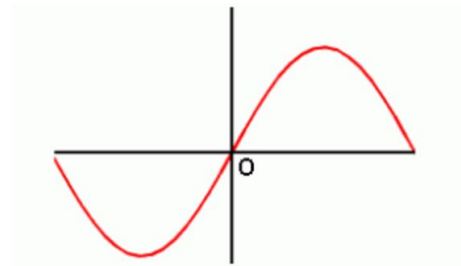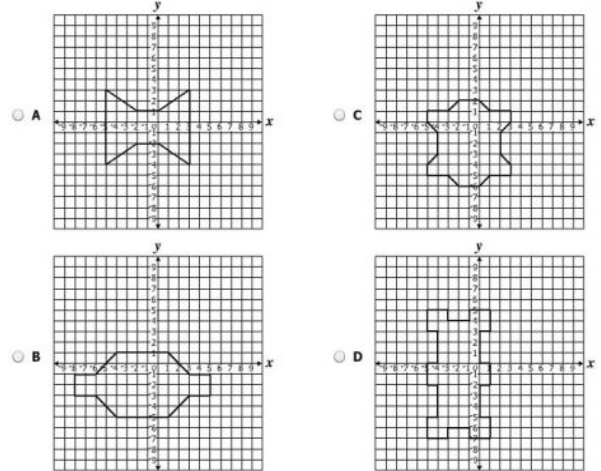
SOL Practice Problems

Question 1:

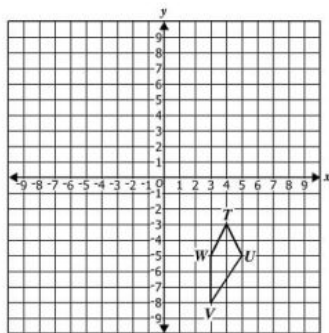**Which figure appears to have exactly two lines of symmetry?**

A

C

B

D

Question 2:

For which polygon are both $x = -1$ and $y = -2$ lines of symmetry?
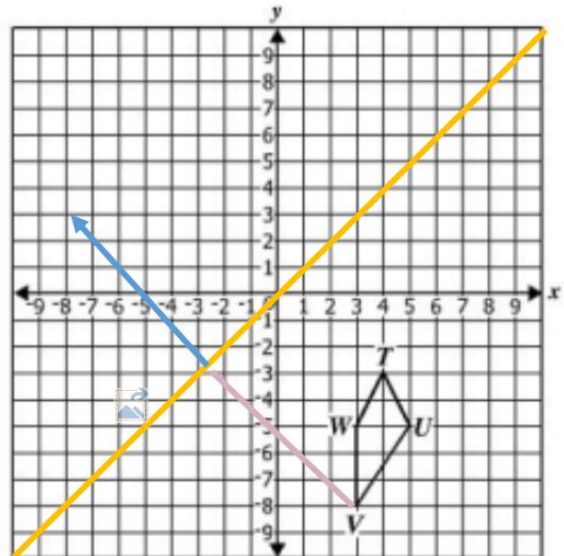
A

C

B

D

Question 3:

Quadrilateral $TUVW$ is shown.

If $TUVW$ is reflected across the line $y = x$, what are the coordinates of V'?

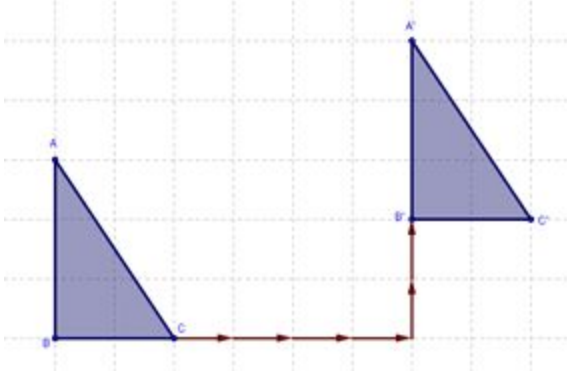A (8, −3)

B (3, 8)

C (−3, −8)

D (−8, 3)

Answer: A

Translation, Reflection, Rotation and Dilation
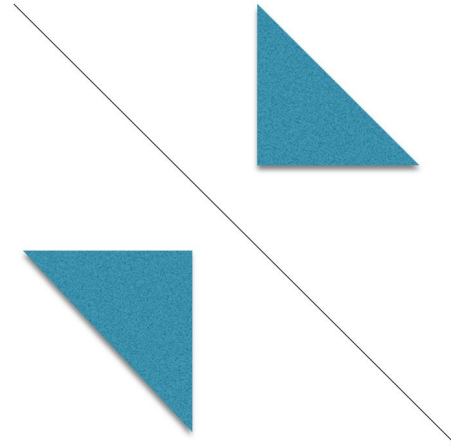
Translation

Moving every point in a shape with:
- the **same distance**

- in the **same direction.**

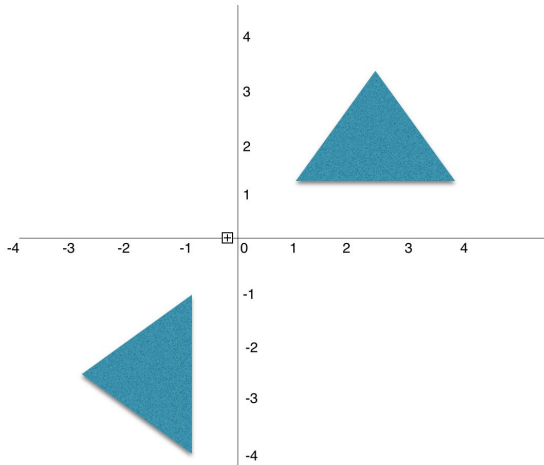Ex: Translating the shape 4 units right and 2 units up. $(x,y) \rightarrow (x+4, y+2)$

Reflection

The mirror image of a shape across an axis or a central point. The original shape of the object is **pre-image,** and the **image** is the result of the transformation.
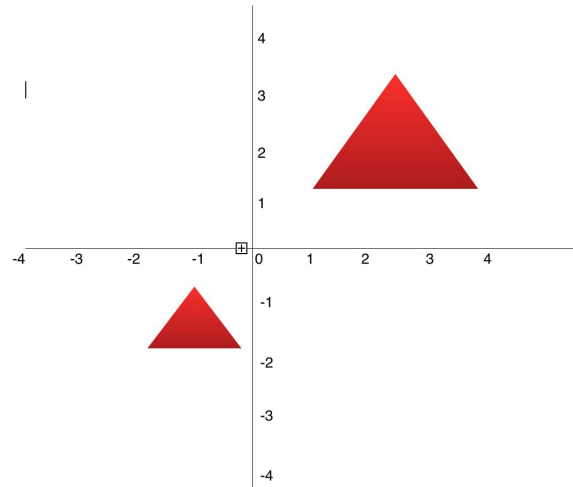
Rotation

A shape is turning around a fixed point. The **distance** from the center to any point of the shape stays the same.
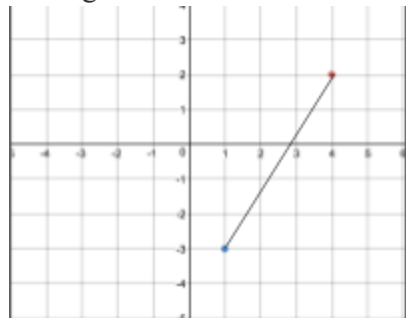
Dilation

Resize the shape.

Additional Practice Problems
G.3 Review

Question 1:
A segment is reflected in the y-axis. What is the length of the image of this segment?

A) $\sqrt{34}$ C) $\sqrt{26}$
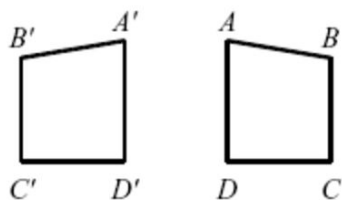
B) 6   D) $\sqrt{40}$

Question 2:
Find the midpoint of this segment.

A) (4,6)   C) (6,5)

B) (5,6)   D) (3,8)

Question 3:
Hexagon ABCDEF is inscribed in a circle. Which point shows the location of point B after a 150 degrees clockwise rotation around the center O:

A) A   C) C
B) B   D) D

Question 4:
Under the translation $(x, y) \rightarrow (x - 5, y + 2)$, the point (7, 3) becomes:

A) (2, 5)
B) (1, 4)
C) (12, 1)
D) (2, 1)

Question 5:
If this segment is rotated 180 degrees, then the segment is symmetric about:

A) The x-axis   C) The origin (0,0)

B) The y-axis   D) The point (-3, 1)

Question 6:
Which of the following transformations creates a figure that is similar (but not congruent) to the original figure?
I. translation
II. rotation
III. dilation
A) Only (I)
B) Only (II)
C) Only (III)
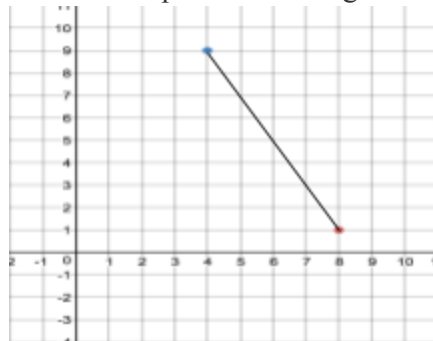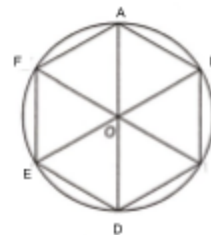D) (I) and (III)
E) All of them

Question 7:
Given the pre-image ABCD and its image A'B'C'D', what transformation is taking place?

A) Dilation   C) Translation
B) Reflection   D) Rotation

Question 8:
Point M '(9,-3) is the image of point M(1,6) under translation T. What is the image of (2,1) under the same translation?

A) (10, -8)
B) (5, 4)
C) (-6, 10)
D) (10, 8)

Question 9:
If the endpoint of a segment is (8, -10) and the midpoint is (3, -2), what are the coordinates of the other end of the segment?
A) (-3, 9)
B) (5, -8)
C) (4, 8)
D) (-2, 6)

Answer Key: Practice Problems
G.2 Geometry

1.	A
2.	C
3.	A
4.	A
5.	C
6.	C
7.	B
8.	A
9.	D