

Name: Kelly

Date: \_\_\_\_\_

UNIT 2

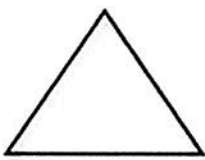

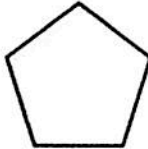
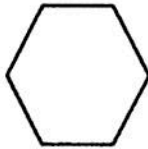
LESSON 8

AIM: WHAT IS REFLECTIONAL, ROTATIONAL AND POINT SYMMETRY?

Do Now: Take an educated guess on how many degrees each figure must be rotated to map onto itself. Follow along with the geometers sketch pad to see what the answers should be!

\*A regular polygon means that all sides and angles are equal\*

1. EDUCATED GUESS: How many degrees do you think it will take before an equilateral triangle maps onto itself? \_\_\_\_\_ 3 sides  
 ACTUAL ANSWER: 120°
2. EDUCATED GUESS: How many degrees do you think it will take before a square maps onto itself? \_\_\_\_\_ 4 sides  
 ACTUAL ANSWER: 90°
3. EDUCATED GUESS: How many degrees do you think it will take before a regular pentagon maps onto itself? \_\_\_\_\_ 5 sides  
 ACTUAL ANSWER: 72°
4. EDUCATED GUESS: How many degrees do you think it will take before a regular hexagon maps onto itself? \_\_\_\_\_ 6 sides  
 ACTUAL ANSWER: 60°

	Equilateral Triangle	Square	Regular Pentagon	Regular Hexagon
				
# of sides	3	4	5	6
Angles of Rotation	120, 240, 360	90, 180, 270, 360	72, 144, 216, 288, 360	60, 120, 180, 240, 300, 360



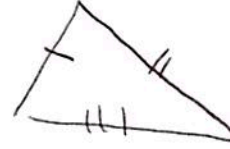
the MINIMUM  
 FORMULA TO FIND ANGLE OF ROTATION FOR REGULAR POLYGONS

$$\frac{360}{n}$$

n = # of sides

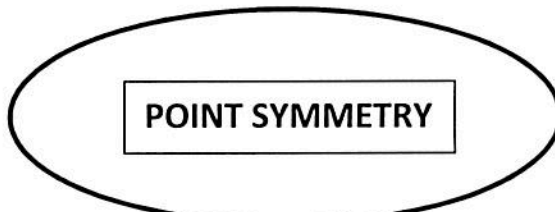
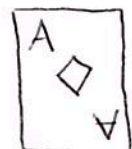



↳ only in regular polygons!

→ Angles of rotation = # of sides

<b>DEFINITION</b> A figure has rotational symmetry if it can be rotated by an $\angle$ BETWEEN $0^\circ$ and $360^\circ$ so that the image maps onto the pre-image <i>about its center</i>	
<b>EXAMPLE</b>  equilateral $\Delta$	<b>NON-EXAMPLE</b>  scalene $\Delta$ A figure that only maps onto itself after $360^\circ$ rotation

**DISCOVERY ACTIVITY:**  
 →  $120^\circ$  rotational

1. Watch the video and see if you can identify what determines if something has point symmetry!
2. Each group has several cards from a deck, sort these by what you believe has point symmetry and what does not have point symmetry.

<b>DEFINITION</b> A figure that is rotated $180^\circ$ and looks exactly the same as the pre-image <i>about its center</i>	
<b>EXAMPLE</b>  	<b>NON-EXAMPLE</b>  

**GROUP ACTIVITY!**

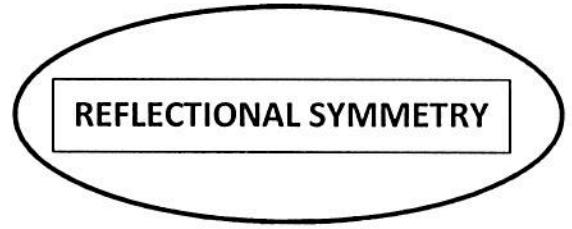
Here are the letters of the alphabet. Classify them into the given categories.

**A B C D E F G H I J K L M N O P Q R S T U V W X Y Z**

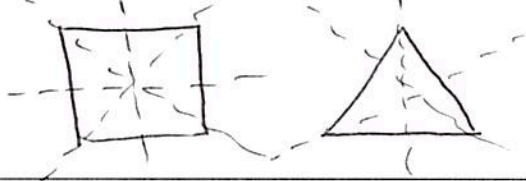
<b>One Line of Symmetry</b> A B C D E K M T U V H I O W X Y	<b>Two Lines of Symmetry</b> H I O X	<b>Rotational Symmetry</b> H I N O S X Z
<b>Point Symmetry</b> H I N O S X Z	<b>No Symmetry</b> F G L P Q R	

**DEFINITION**

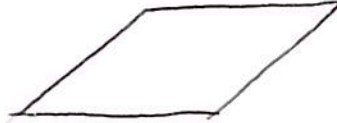
A figure which has one or more lines of symmetry which divide the figure into mirror images



**EXAMPLE**

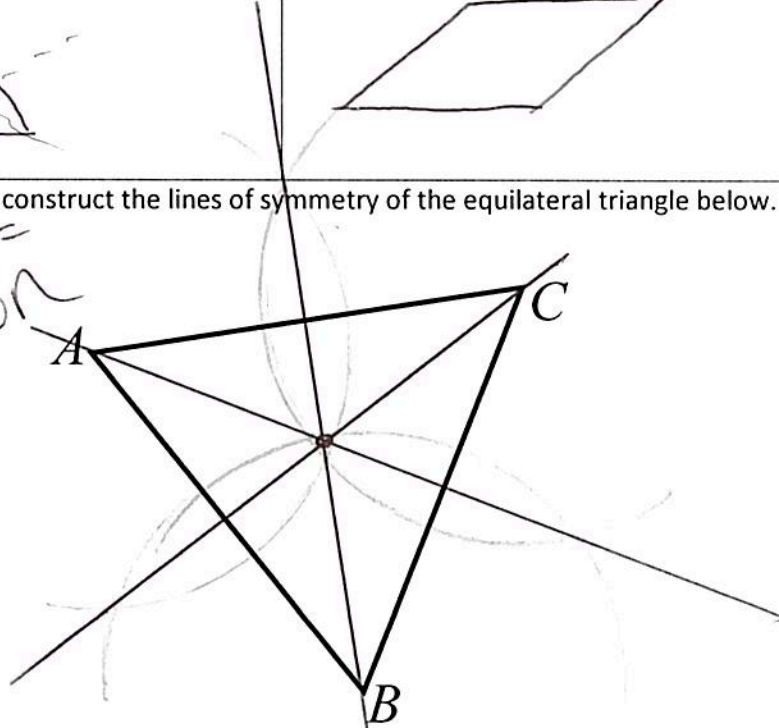


**NON-EXAMPLE**



Using a compass and a straightedge, construct the lines of symmetry of the equilateral triangle below.

Line of symmetry =  
Line of reflection  
↳ ⊥ bisector!



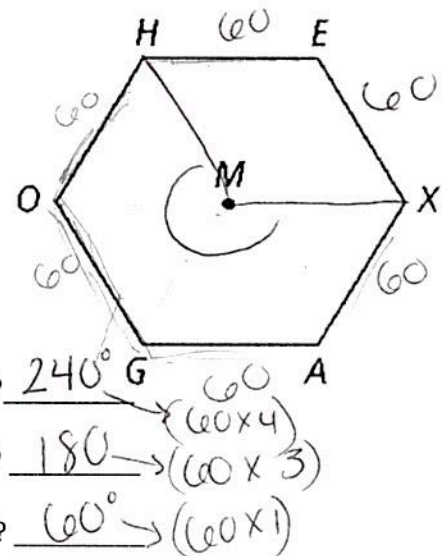
**CONCLUSION:** # of sides = # of lines of symmetry in regular polygons

where the lines meet = center of rotation

**EXAMPLE PROBLEMS:**

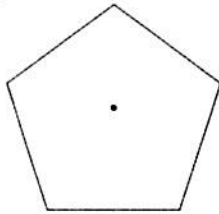
1. Point M is the center of rotation of the given regular hexagon to the right.

- a) How many sides does a hexagon have? 6
- b) What is the total # of lines of symmetry? 6
- c) What is the total # of rotational symmetry? 6      $\frac{360}{6} = 60^\circ$
- d) What is the minimum number of degrees of each turn? 60
- e) What is the angle measurement of the counterclockwise rotation that maps H to X? 240°
- f) What is the angle measurement of the counterclockwise rotation that maps E to G? 180°
- g) What is the angle measurement of the counterclockwise rotation that maps O to G? 60°





2. A regular pentagon is shown in the diagram below.

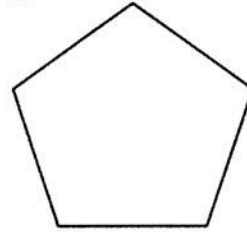


If the pentagon is rotated clockwise around its center, the minimum number of degrees it must be rotated to carry the pentagon onto itself is

- 1)  $54^\circ$
- 2)  $72^\circ$
- 3)  $108^\circ$
- 4)  $360^\circ$

$$\frac{360}{5} = 72$$

3. The regular polygon below is rotated about its center.



Which angle of rotation will carry the figure onto itself?

- 1)  $60^\circ$
- 2)  $108^\circ$
- 3)  $216^\circ$
- 4)  $540^\circ$

72, 144, 216, 288, 360

4. Which regular polygon has a minimum rotation of  $45^\circ$  to carry the polygon onto itself?

- 1) octagon  $\frac{360}{8} = 45$
- 2) decagon  $\frac{360}{10} = 36$
- 3) hexagon  $\frac{360}{6} = 60$
- 4) pentagon  $\frac{360}{5} = 72$

5. Which rotation about its center will carry a regular decagon onto itself?

- 1)  $54^\circ$
- 2)  $162^\circ$
- 3)  $198^\circ$
- 4)  $252^\circ$

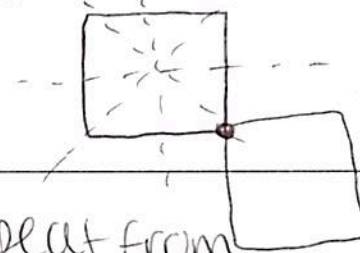
36, 72, 108, 144, 180  
216, 252, 288, 324, 360

6. A regular decagon is rotated  $n$  degrees about its center, carrying the decagon onto itself. The value of  $n$  could be

- 1)  $10^\circ$
- 2)  $150^\circ$
- 3)  $225^\circ$
- 4)  $252^\circ$

7. Which transformation would not carry a square onto itself?

- 1) a reflection over one of its diagonals ✓
- 2) a  $90^\circ$  rotation clockwise about its center ✓
- 3) a  $180^\circ$  rotation about one of its vertices
- 4) a reflection over the perpendicular bisector of one side ✓



→ \* repeat from previous lesson

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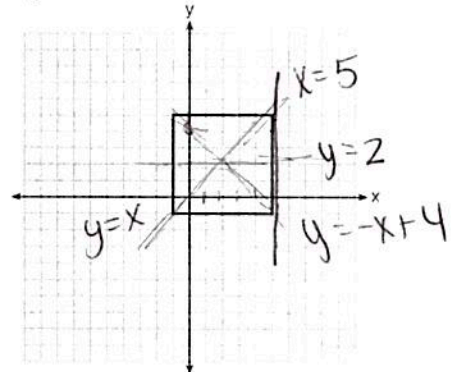
UNIT 2

LESSON 8 HOMEWORK

1. Which figure always has exactly four lines of reflection that map the figure onto itself?

- ① square
- 2) rectangle
- 3) regular octagon
- 4) equilateral triangle

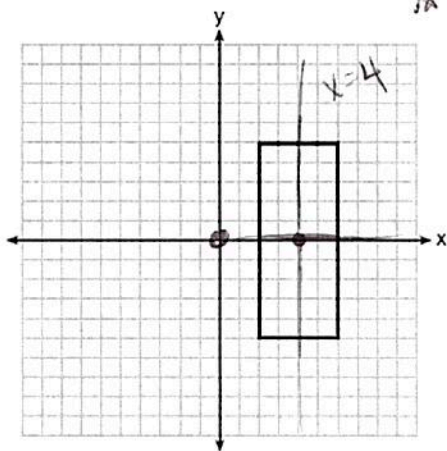
2. In the diagram below, a square is graphed in the coordinate plane.



A reflection over which line does *not* carry the square onto itself?

- ①  $x = 5$
- 2)  $y = 2$  ✓
- 3)  $y = x$  ✓
- 4)  $x + y = 4$   
 $-x \quad -x$   $y = -x + 4$

3. As shown in the graph below, the quadrilateral is a rectangle.



*\*reflect from previous lesson*

Which transformation would *not* map the rectangle onto itself?

- 1) a reflection over the x-axis ✓
- 2) a reflection over the line  $x = 4$  ✓
- ③ a rotation of  $180^\circ$  about the origin  $x \rightarrow$  not the center of rectangle ✓
- 4) a rotation of  $180^\circ$  about the point  $(4, 0)$  ✓

4. A regular hexagon is rotated in a counterclockwise direction about its center. Determine and state the minimum number of degrees in the rotation such that the hexagon will coincide with itself.

$$\frac{360}{6} = \boxed{60^\circ}$$



5. Which of the following capital letters has at least one line of reflection symmetry?

[A] F

[B] R

[C] O

[D] L

6. In the regular nonagon shown below, is a rotated  $n$  degrees about its center  $T$  carrying the nonagon onto itself.

a. How many sides does a nonagon have? 9

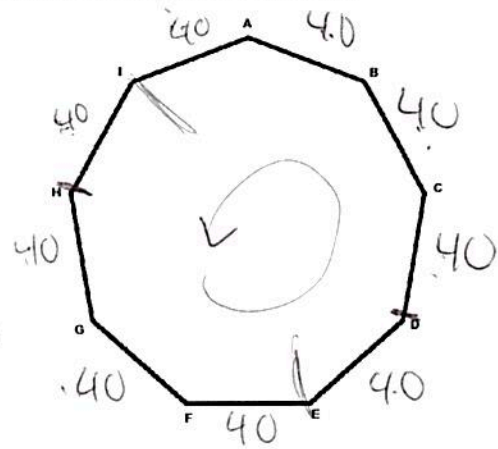
b. What is the total # of lines of symmetry? 9

c. What is the total # of rotational symmetry? 9

d. What is the minimum number of degrees of each turn?  $\frac{360}{9} = 40^\circ$

e. Identify each of the values that  $n$  could be.

40, 80, 120, 160, 200, 240, 280, 320, 360



f. What is the angle measurement of the counterclockwise rotation that maps A to D?  $6 \times 40 = 240^\circ$

g. What is the angle measurement of the counterclockwise rotation that maps D to H?  $5 \times 40 = 200^\circ$

h. What is the angle measurement of the counterclockwise rotation that maps I to E?  $4 \times 40 = 160^\circ$

7. What kind of symmetry does the figure on the right have?

- (1) Reflection symmetry
- (2) Rotation symmetry  $180^\circ$
- (3) Both reflection and rotation symmetry
- (4) No symmetry

