G.CO.A.3: Mapping a Polygon onto Itself

1. 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) $360^\circ$

2. 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) $540^\circ$

3. A regular hexagon is rotated about its center.
   Which degree measure will carry the regular hexagon onto itself?
   1) $45^\circ$
   2) $90^\circ$
   3) $120^\circ$
   4) $135^\circ$

4. Which rotation about its center will carry a regular decagon onto itself?
   1) $54^\circ$
   2) $162^\circ$
   3) $198^\circ$
   4) $252^\circ$

5. 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) $252^\circ$

6. Which regular polygon has a minimum rotation of $45^\circ$ to carry the polygon onto itself?
   1) octagon
   2) decagon
   3) hexagon
   4) pentagon

7. 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

8. 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
9 A rhombus is graphed on the set of axes below.

Which transformation would carry the rhombus onto itself?
1) 180° rotation counterclockwise about the origin
2) reflection over the line \( y = \frac{1}{2}x + 1 \)
3) reflection over the line \( y = 0 \)
4) reflection over the line \( x = 0 \)

10 The figure below shows a rhombus with noncongruent diagonals.

Which transformation would not carry this rhombus onto itself?
1) a reflection over the shorter diagonal
2) a reflection over the longer diagonal
3) a clockwise rotation of 90° about the intersection of the diagonals
4) a counterclockwise rotation of 180° about the intersection of the diagonals

11 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) \( x + y = 4 \)

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

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° about the origin
4) a rotation of 180° about the point (4,0)
13 In the diagram below, rectangle $ABCD$ has vertices whose coordinates are $A(7,1), B(9,3), C(3,9),$ and $D(1,7)$.

Which transformation will not carry the rectangle onto itself?
1) a reflection over the line $y = x$
2) a reflection over the line $y = -x + 10$
3) a rotation of $180^\circ$ about the point $(6,6)$
4) a rotation of $180^\circ$ about the point $(5,5)$

14 Which transformation carries the parallelogram below onto itself?

1) a reflection over $y = x$
2) a reflection over $y = -x$
3) a rotation of $90^\circ$ counterclockwise about the origin
4) a rotation of $180^\circ$ counterclockwise about the origin

15 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.
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Answer Section

1  ANS: 2
Segments drawn from the center of the regular pentagon bisect each angle of the pentagon, and create five
isosceles triangles as shown in the diagram below. Since each exterior angle equals the angles formed by the
segments drawn from the center of the regular pentagon, the minimum degrees necessary to carry a regular
polygon onto itself are equal to the measure of an exterior angle of the regular polygon.

\[
\frac{360}{5} = 72. 
\]

REF: spr1402geo

2  ANS: 3
\[
\frac{360}{5} = 72^\circ \quad 216^\circ \text{ is a multiple of } 72^\circ
\]

REF: 061819geo

3  ANS: 3
\[
(6 - 2)180 = 720 \quad \frac{720}{6} = 120
\]

REF: 012011geo

4  ANS: 4
\[
\frac{360}{10} = 36^\circ \quad 252^\circ \text{ is a multiple of } 36^\circ
\]

REF: 011717geo

5  ANS: 4
\[
\frac{360}{10} = 36^\circ \quad 252^\circ \text{ is a multiple of } 36^\circ
\]

REF: 081722geo

6  ANS: 1
\[
\frac{360}{45} = 8
\]

REF: 061510geo

7  ANS: 1  REF: 061707geo
8  ANS: 3  REF: 011815geo
9  ANS: 4  REF: 081923geo
10 ANS: 3  REF: 011904geo
11 ANS: 1  REF: 081505geo
12 ANS: 3
The x-axis and line $x = 4$ are lines of symmetry and (4,0) is a point of symmetry.

REF: 081706geo

13 ANS: 3 REF: 081817geo

14 ANS: 4 REF: 061904geo

15 ANS:
\[
\frac{360}{6} = 60
\]

REF: 081627geo