A transformation of a geometric figure is a mapping that results in a change in the position, shape, or size of the figure.

In the game of dominoes, you often move the dominoes by sliding them, turning them or flipping them. Each of these moves is a type of transformation.

- **Translation**: slide
- **Rotation**: turn
- **Reflection**: flip

In the examples below, the preimage is green and the image is pink.
Transformations

Some transformations (like the dominoes) preserve distance and angle measures. These transformations are called **rigid motions**.

To preserve distance means that the distance between any two points of the image is the same as the distance between the corresponding points of the preimage.

To preserve angles means that the angles of the image have the same measures as the corresponding angles in the preimage.

Transformations

A transformation maps every point of a figure onto its image and may be described using arrow notation (→).

**Prime notation** (') is sometimes used to identify image points.

In the diagram below, A’ is the image of A.

Note: You list the corresponding points of the preimage and image in the same order, just as you would for corresponding points in congruent figures or similar figures.

Transformations

Which of these is a rigid motion?

- **Translation**- slide
- **Rotation**- turn
- **Reflection**- flip
- **Dilation**- size change

1. Does the transformation appear to be a rigid motion? Explain.
   - ❓ Yes, it preserves the distance between consecutive points.
   - ❓ No, it does not preserve the distance between consecutive points.

2. Does the transformation appear to be a rigid motion? Explain.
   - ❓ Yes, distances are preserved.
   - ❓ Yes, angle measures are preserved.
   - ❓ Both A and B.
   - ❓ No, distance are not preserved.

3. Which transformation is not a rigid motion?
   - ❓ Reflection
   - ❓ Translation
   - ❓ Rotation
   - ❓ Dilation
4 Which transformation is demonstrated?
- Reflection
- Translation
- Rotation
- Dilation

5 Which translation is demonstrated?
- Reflection
- Translation
- Rotation
- Dilation

6 Which transformation is demonstrated?
- Reflection
- Translation
- Rotation
- Dilation

Translations

A translation is a transformation that maps all points of a figure the same distance in the same direction.

A translation is a rigid motion with the following properties:

\[ \overline{AA'} = \overline{BB'} = \overline{CC'} \]
\[ \overline{AB} = \overline{A'B'}, \overline{BC} = \overline{B'C'}, \overline{AC} = \overline{A'C'} \]
\[ m\angle A = m\angle A', \ m\angle B = m\angle B', \ m\angle C = m\angle C' \]

Write the translation that maps \( \triangle ABC \) onto \( \triangle A'B'C' \) as \( T(\triangle ABC) = \triangle A'B'C' \)
Translations in the Coordinate Plane

Each \((x, y)\) pair in \(ABCD\) is mapped to \((x + 9, y - 4)\).

You can use the function notation \(T_{9,-4}(ABCD) = A'B'C'D'\) to describe the translation.

Finding the Image of a Translation

What are the vertices of \(T_{-2, 5}(\Delta DEF)\)?

Graph the image of \(\Delta DEF\).

Draw \(DD', EE'\) and \(FF'\).

What relationships exist among these three segments?

How do you know?

Writing a Translation Rule

Write a translation rule that maps \(PQRS\) onto \(P'Q'R'S'\).

In the diagram, \(\Delta A'B'C'\) is an image of \(\Delta ABC\). Which rule describes the translation?

- A \(T_{-2, 5}(\Delta ABC)\)
- B \(T_{-3, 5}(\Delta ABC)\)
- C \(T_{-3, 5}(\Delta ABC)\)
- D \(T_{-3, 5}(\Delta ABC)\)

If \(T_{-4, 6}(JKLM) = J'K'L'M'\), what translation maps \(J'K'L'M'\) onto \(JKLM\)?

- A \(T_{-4, 6}(J'K'L'M')\)
- B \(T_{-6, 4}(J'K'L'M')\)
- C \(T_{-6, 4}(J'K'L'M')\)
- D \(T_{-4, 6}(J'K'L'M')\)

\(\Delta RSV\) has coordinates \(R(2, 1), S(3, 2),\) and \(V(2, 6)\). A translation maps point \(R\) to \(R'\) at \((-4, 8)\). What are the coordinates of \(S'\) for this translation?

- (-6, 4)
- (-3, 2)
- (-3, 9)
- (-4, 13)
- E none of the above
Reflections

Reflections Activity Lab
(Click for link to lab)

Reflection

A reflection is a transformation of points over a line. This line is called the line of reflection. The result looks like the preimage was flipped over the line. The preimage and the image have opposite orientations.

If a point $B$ is on line $m$, then the image of $B$ is itself ($B = B'$).

If a point $C$ is not on line $m$, then $m$ is the perpendicular bisector of $CC'$.

The reflection across $m$ that maps $\triangle ABC \rightarrow \triangle A'B'C'$ can be written as $R_m(\triangle ABC) = \triangle A'B'C'$

Reflection

When reflecting a figure, reflect the vertices and then draw the sides.
Reflect $ABCD$ over line $r$. Label the vertices of the image.

Reflect $WXYZ$ over line $s$. Label the vertices of the image.

Hint: Turn page so line of symmetry is vertical

Reflection

Reflect $MNP$ over line $t$. Label the vertices of the image.

Where is the image of $N$? Why?

10 Which point represents the reflection of $X$?

- point A
- point B
- point C
- point D
- None of the above

Click here to see a video
11 Which point represents the reflection of X?

- point A
- point B
- point C
- point D
- none of the above

12 Which point represents the reflection of X?

- point A
- point B
- point C
- point D
- none of the above

13 Which point represents the reflection of D?

- point A
- point B
- point C
- point D
- none of these

14 Is a reflection a rigid motion?

- Yes
- No

Reflections in the Coordinate Plane

Since reflections are perpendicular to and equidistant from the line of reflection, we can find the exact image of a point or a figure in the coordinate plane.

Reflections in the Coordinate Plane

Reflect A, B, & C over the y-axis.

How do the coordinates of each point change when the point is reflected over the y-axis?

Notation

- \( R_{y-axis}(A) = A' \)
- \( R_{y-axis}(B) = B' \)
- \( R_{y-axis}(C) = C' \)
Reflections in the Coordinate Plane

Reflect figure JKLM over the x-axis.

Notation
\( R_{\text{x-axis}} (JKLM) = J'K'L'M' \)

How do the coordinates of each point change when the point is reflected over the x-axis?

Reflections in the Coordinate Plane

Reflect A, B, C & D over the line \( y = x \).

Notation
\[ R_{y=x} (A) = A' \]
\[ R_{y=x} (B) = B' \]
\[ R_{y=x} (C) = C' \]
\[ R_{y=x} (D) = D' \]

How do the coordinates of each point change when the point is reflected over the y-axis?

Reflections in the Coordinate Plane

Reflect \( \triangle ABC \) over \( x = 2 \).

Notation
\[ R_{x=2}(\triangle ABC) = \Delta A'B'C' \]

*Hint: draw line of reflection first

Reflections in the Coordinate Plane

Reflect quadrilateral MNPQ over \( y = -3 \)

Notation
\[ R_{y=-3}(MNPQ) = M'N'P'Q' \]

Find the Coordinates of Each Image

1. \( R_{\text{x-axis}}(A) \)
2. \( R_{\text{y-axis}}(B) \)
3. \( R_{x=1}(C) \)
4. \( R_{x=-1}(D) \)
5. \( R_{y=2}(E) \)
6. \( R_{x=2}(F) \)

15 The point (4,2) reflected over the x-axis has an image of ______.

\( \quad (4,2) \)
\( \quad (-4,2) \)
\( \quad (-4,-2) \)
\( \quad (4,-2) \)
16 The point \((4,2)\) reflected over the y-axis has an image of _____.
A \((4,2)\)  
B \((-4,-2)\)  
C \((-4,2)\)  
D \((4,-2)\)

17 B has coordinates \((-3,0)\). What would be the coordinates of B’ if B is reflected over the line \(x = 1\)?
A \((-3,0)\)  
B \((4,0)\)  
C \((-3,2)\)  
D \((5,0)\)

18 The point \((4,2)\) reflected over the line \(y=2\) has an image of _____.
A \((4,2)\)  
B \((4,1)\)  
C \((2,2)\)  
D \((4,-2)\)

**Line of Symmetry**
A line of symmetry is a line of reflection that divides a figure into 2 congruent halves. These 2 halves reflect onto each other.

Draw Lines of Symmetry Where Applicable

A  B  C  
D  E  F

Draw Lines of Symmetry Where Applicable

M  N  O  
P  Q  R
19. How many lines of symmetry does the following have?
   - one
   - two
   - three
   - none

20. How many lines of symmetry does the following have?
   - 10
   - 2
   - 100
   - infinitely many

21. How many lines of symmetry does the following have?
   - none
   - one
   - nine
   - infinitely many

22. How many lines of symmetry does the following have?
   - none
   - one
   - two
   - infinitely many

23. How many lines of symmetry does the following have?
   - none
   - one
   - two
   - infinitely many
24 How many lines of symmetry does the following have?

- none
- 5
- 7
- 9

Rotations

A rotation is a rigid motion that turns a figure about a point.

The amount of turn is in degrees.

The direction of turn is either clockwise or counterclockwise.

The arrow was rotated 120° counterclockwise about point P.

The heart was rotated 160° clockwise about H.

Rotations

A rotation of \( x \), about a point \( P \) is a transformation with the following properties:

- The image of \( P \) is itself (\( P = P' \))
- For any other point \( B \), \( PB = PB' \)
- The measure of \( \angle BPB' = x \)
- The preimage \( B \) and its image \( B' \) are equidistant from the center of rotation.

\[
\tau_{x', P}(\Delta ABC) = \Delta A'B'C' \quad \text{for a rotation clockwise } x \text{ about } P
\]

\[
\tau_{-x', P}(\Delta ABC) = \Delta A'B'C' \quad \text{for a rotation counterclockwise } x \text{ about } P
\]

Drawing Rotation Images

What is the image of \( r_{100^\circ, C}(\Delta LOB) \)?

Step 1
Draw \( CO \). Use a protractor to draw a 100° angle with side \( CO \) and vertex \( C \).

Step 2
Use a compass or a ruler to construct \( CO = CO' \).

Step 3
Locate \( L' \) and \( B' \) following steps 1 and 2.

Step 4
Draw \( \Delta L'O'B' \)

Click here to see video
Rotations in the Coordinate Plane

When a figure is rotated 90°, 180°, or 270° clockwise about the origin O in the coordinate plane, you can use the following rules:

\[ r_{90°} : (x, y) = (y, -x) \]
\[ r_{180°} : (x, y) = (-x, -y) \]
\[ r_{270°} : (x, y) = (-y, x) \]

Graphing Rotation Images

PQRS has vertices P(1, 1), Q(3, 3), R(4, 1) and S(3, 0).

a) What is the graph of \( r_{90°} \circ (PQRS) = P'Q'R'S' \)?

b) What is the graph of \( r_{90°} \circ (PQRS) = P''Q''R''S'' \)?
Graphing Rotation Images

PQRS has vertices P(1, 1), Q(3, 3), R(4, 1) and S(3, 0).
c) What is the graph of \( r_{270^\circ,0}(PQRS) = P'''Q'''R'''S'''? \)

Square ABCD has vertices A(3,3), B(-3,3), C(-3, -3), and D(3, -3). Which of the following images is A?
- A  \( r_{90^\circ,0}(C) \)
- B  \( r_{180^\circ,0}(D) \)
- C  \( r_{90^\circ,0}(B) \)
- D  \( r_{270^\circ,0}(C) \)

PQRS has vertices P(1,5), Q(3, -2), R(-3, -2), and S(-5, 1). What are the coordinates of Q' after \( r_{270^\circ,0}(Q) \)?
- (-2, -3)
- (2,3)
- (-3, 2)
- (-3, -2)

MATH is a regular quadrilateral with center R. Name the image of M for a 180° rotation counterclockwise about R.
- M
- A
- T
- H

MATH is a regular quadrilateral with center R. Name the image of H for a 270° rotation clockwise about R.
- A \( \overline{HM} \)
- B \( \overline{MA} \)
- C \( \overline{AT} \)
- D \( \overline{TH} \)

Identifying a Rotation Image

A regular polygon has a center that is equidistant from its vertices. Segments that connect the center to the vertices divide the polygon into congruent triangles. You can use this fact to find rotation images of regular polygons.

PENTA is a regular pentagon with center O.
- a) Name the image of E for a 72° rotation counterclockwise about O.
- b) Name the image of P for a 216° rotation clockwise about O.
- c) Name the image of \( \overline{AP} \) for a 144° rotation counterclockwise about O.
29 HEXAGO is a regular hexagon with center M. Name the image of G for a $300^\circ$ rotation counterclockwise about M.

- A
- X
- E
- H
- O

30 HEXAGO is a regular hexagon with center M. Name the image of OH for a $240^\circ$ rotation clockwise about M.

- HE
- AG
- EX
- AX
- OG

Rotational Symmetry
A figure has rotational symmetry if there is at least one rotation less than or equal to $180^\circ$ about a point so that the preimage is the image.

For example, a 3-bladed fan has a rotational symmetry at $120^\circ$.

A circle has infinite rotational symmetry.

Do the following have rotational symmetry? If yes, what is the degree of rotation?

- a.
- b.
- c.

Rotational Symmetry

In general, what is the rule that can be used to find the degree of rotation for a regular polygon?

31 Does the following figure have rotational symmetry? If yes, what degree?

- yes, $90^\circ$
- yes, $120^\circ$
- yes, $180^\circ$
- no
32 Does the following figure have rotational symmetry? If yes, what degree?
- yes, 90°
- yes, 120°
- yes, 180°
- no

33 Does the following figure have rotational symmetry? If yes, what degree?
- yes, 90°
- yes, 120°
- yes, 180°
- no

34 Does the following figure have rotational symmetry? If yes, what degree?
- yes, 18°
- yes, 36°
- yes, 72°
- no

Composition of Transformations

Isometry
An isometry is transformation that preserves distance or length.

Translation
Rotation

Reflection
Glide Reflection

Isometry
The transformations below are isometries. The composition of two or more isometries is an isometry.
Glide Reflections

If two figures are congruent and have opposite orientations (but are not simply reflections of each other), then there is a translation and a reflection that will map one onto the other. A glide reflection is the composition of a glide (translation) and a reflection across a line parallel to the direction of translation.

Notation for a Composition

\[ R_y = -2 \circ T_{<1,0>} \quad (\Delta ABC) \]

Note: Transformations are performed right to left.

Glide Reflections

Graph the glide reflection image of \( \Delta ABC \).

1.) \( R_{x=-3} \circ T_{<1,0>} \quad (\Delta ABC) \)

Glide Reflections

Graph the glide reflection image of \( \Delta ABC \).

2.) \( R_{y=2} \circ T_{<0,-3>} \quad (\Delta ABC) \)

Glide Reflections

Graph the glide reflection image of \( \Delta ABC \).

3.) \( R_{y=1} \circ T_{<1,-1>} \quad (\Delta ABC) \)

Composition of Reflections

Translate \( \Delta XYZ \) by using a composition of reflections. Reflect over \( x = -3 \) then over \( x = 4 \). Label the first image \( \Delta X'Y'Z' \) and the second \( \Delta X''Y''Z'' \).

1.) What direction did \( \Delta XYZ \) slide? How is this related to the lines of reflection?

2.) How far did \( \Delta XYZ \) slide? How is this related to the lines of reflection?

35 FGHJ is translated using a composition of reflections. FGHJ is first reflected over line \( r \) then line \( s \). How far does FGHJ slide?

- 5"
- 10"
- 15"
- 20"
36. FGHJ is translated using a composition of reflections. FGHJ is first reflected over line \( r \) then line \( s \). Which arrow shows the direction of the slide?

- A
- B
- C
- D

37. FGHJ is translated using a composition of reflections. FGHJ is first reflected over line \( s \) then line \( r \). How far does FGHJ slide?

- 5"
- 10"
- 20"
- 30"

Rotations as Composition of Reflection

If ABCDE is reflected over \( r \) then \( s \):
What is the angle of rotation?
What is the direction of the rotation?

The amount of rotation is twice the acute, or right, angle formed by the lines of reflection. The direction of rotation is clockwise because rotating from \( m \) to \( n \) across the acute angle is clockwise. Had the triangle reflected over \( n \) then \( m \), the rotation would have been counterclockwise.
Rotations as Composition of Reflection

If ABCDE is reflected over s then r:
What is the angle of rotation?
What is the direction of the rotation?

38. If the image of ΔABC is the composite of reflections over e then f, what is the angle of rotation?

- 40°
- 80°
- 160°
- 280°

39. What is the direction of the rotation if the image of ΔABC is the composite of reflections first over e then f?

- Clockwise
- Counterclockwise

40. If the image of ΔABC is the composite of reflections over f then e, what is the angle of rotation?

- 90°
- 180°
- 270°
- 360°

41. What is the direction of rotation if the image of ΔABC is the composite of reflections first over f then e?

- Clockwise
- Counterclockwise

42. If the image of ΔABC is the composite of reflections over e then f, what is the angle of rotation?

- 40°
- 80°
- 140°
- 160°
43. What is the direction of the rotation if the image of \( \Delta ABC \) is the composite of reflections first over \( e \) then \( f \)?

- Clockwise
- Counterclockwise

**Congruence Transformations**

**Congruent Figures**

Two figures are congruent if and only if there is a sequence of one or more rigid motions that maps one figure onto another.

The composition \( R_m \circ T_{2,3} \) \( (# ABC) = (# DEF) \)

Since compositions of rigid motions preserve angle measures and distances the corresponding sides and angles have equal measures. Fill in the blanks below:

\[
\begin{align*}
\overline{AB} &= \_\_\_ \\
\overline{BC} &= \_\_\_ \\
\overline{AC} &= \_\_\_
\end{align*}
\]

\[
\begin{align*}
m\angle A &= m\angle \_\_\_ \\
m\angle B &= m\angle \_\_\_ \\
m\angle C &= m\angle \_\_\_
\end{align*}
\]

**Identifying Congruence Transformations**

Because compositions of rigid motions take figures to congruent figures, they are also called congruence transformations.

What is the congruence transformation that maps \( \triangle XYZ \) to \( \triangle ABC \)?

**Using Congruence Transformations**

Use congruence transformations to verify that \( \triangle ABC \neq \triangle DEF \).

1. 
2. 

To show that \( \triangle ABC \) is an equilateral triangle, what congruence transformation can you use that maps the triangle onto itself? Explain.
44 Which congruent transformation maps $\triangle ABC$ to $\triangle DEF$?

- A $T_{<5,5>}$
- B $r_{<180^\circ, D>}$
- C $R_{x-axis} \circ T_{<5,0>}$
- D $R_{y-axis} \circ r_{<90^\circ, O>}$

45 Which congruence transformation does not map $\triangle ABC$ to $\triangle DEF$?

- A $r_{(180^\circ, O)}$
- B $T_{<5,0>} \circ R_{y-axis}$
- C $R_{x-axis} \circ R_{y-axis}$
- D $R_{y-axis} \circ R_{y-axis}$

46 Which of the following best describe a congruence transformation that maps $\triangle ABC$ to $\triangle DEF$?

- a reflection only
- a translation only
- a translation followed by a reflection
- a translation followed by a rotation

47 Quadrilateral $ABCD$ is shown below. Which of the following transformations of $\triangle AEB$ could be used to show that $\triangle AEB$ is congruent to $\triangle DEC$?

- a reflection over $DB$
- a reflection over $AC$
- a reflection over line $m$
- a reflection over line $n$

Dilations

A dilation is a transformation whose pre image and image are similar. Thus, a dilation is a similarity transformation. It is not, in general, a rigid motion.

Every dilation has a center and a scale factor $n, n > 0$. The scale factor describes the size change from the original figure to the image.
A dilation with center $R$ and scale factor $n$, $n > 0$, is a transformation with the following properties:

- The image of $R$ is itself ($R' = R$)
- For any other point $B$, $B'$ is on $RB$
- $RB' = n \cdot RB$ or $n = \frac{RB'}{RB}$
- $\triangle ABC \sim \triangle A'B'C'$

A dilation is an enlargement if the scale factor is greater than 1. A dilation is a reduction if the scale factor is less than one, but greater than 0.

The symbol for scale factor is $n$.

A dilation is an enlargement if $n > 1$.

A dilation is a reduction if $0 < n < 1$.

What happens to a figure if $n = 1$?

The ratio of corresponding sides is $\frac{\text{image}}{\text{preimage}}$, which is the scale factor ($n$) of the dilation.

Corresponding angles are congruent.

The dashed line figure is a dilation image of the solid-line figure. $D$ is the center of dilation. Tell whether the dilation is an enlargement or a reduction. Then find the scale factor of the dilation.

Answer:

$\text{Answer}$

$\text{Answer}$

$\text{Answer}$

$\text{Answer}$
48 Is a dilation a rigid motion?
- Yes
- No

49 Is the dilation an enlargement or a reduction? What is the scale factor of the dilation?
- enlargement, $n = 3$
- enlargement, $n = 1/3$
- reduction, $n = 3$
- reduction, $n = 1/3$

50 Is the dilation an enlargement or reduction? What is the scale factor of the dilation?
- enlargement, $n = 3$
- enlargement, $n = 1/3$
- reduction, $n = 3$
- reduction, $n = 1/3$

51 Is the dilation an enlargement or reduction? What is the scale factor of the dilation?
- enlargement, $n = 2$
- enlargement, $n = 1/2$
- reduction, $n = 2$
- reduction, $n = 1/2$

52 Is the dilation an enlargement or reduction? What is the scale factor of the dilation?
- enlargement, $n = 2$
- enlargement, $n = 3$
- enlargement, $n = 6$
- not a dilation

53 The solid-line figure is a dilation of the dashed-line figure. The labeled point is the center of dilation. Find the scale factor of dilation.
- 2
- 3
- 1/2
- 1/3
A dilation maps triangle LMN to triangle L'M'N'. MN = 14 in. and M'N' = 9.8 in. If LN = 13 in., what is L'N'?

A 13 in.
B 14 in.
C 9.1 in.
D 9.8 in.

Drawing Dilation Images

Draw the dilation image $\triangle B'C'D'$ of $\triangle BCD$.

Steps
1. Use a straightedge to construct ray XB.
2. Use a compass to measure XB.
3. Construct XB' by constructing a congruent segment on ray XB so that XB' is twice the distance of XB.
4. Repeat steps 1-3 with points C and D.

Draw Each Dilation Image

a. $D_{0.5} (\triangle ABCD)$

b. $D_{0.5} (\triangle DEF)$

ANSWER

ANSWER

Dilations in the Coordinate Plane

Suppose a dilation is centered at the origin. You can find the dilation image of a point by multiplying its coordinates by the scale factor.

Scale factor 2, $(x, y) \rightarrow (2x, 2y)$

Notation
$D_2 (A) = A'$

Graphing Dilation Images

To dilate a figure from the origin, find the dilation images of its vertices. $\triangle HJK$ has vertices H(2, 0), J(-1, 0.5), and K(1, -2). What are the coordinates of the vertices of the image of $\triangle HJK$ for a dilation with center (0, 0) and a scale factor 3? Graph the image and the preimage.

Dilations NOT Centered at the Origin

In this example, the center of dilation is NOT the origin. The center of dilation $D(-2,-2)$ is a vertex of the original figure. This is a reduction with scale factor 1/2. Point D and its image are the same. It is important to look at the distance from the center of dilation D, to the other points of the figure.

If $AD = 6$, then $A'D' = 6/2 = 3$.

Also notice $AB = 4$ and $A'B' = 2$, etc.
**Dilations**

Draw the dilation image of \( \triangle DEF \) with the center of dilation at point \( D \) with a scale factor \( \frac{3}{4} \).

---

55 What is the y-coordinate of the image \((8, -6)\) under a dilation centered at the origin and having a scale factor of \(1.5\)?

- A -3
- B -8
- C -9
- D -12

---

56 What is the x-coordinate of the image \((8, -6)\) under a dilation centered at the origin and having a scale factor of \(1/2\)?

- A 4
- B 8
- C -6
- D -3

---

57 What is the y-coordinate of the image \((8, -6)\) under a dilation centered at the origin and having a scale factor of \(1/2\)?

- A 4
- B 8
- C -6
- D -3

---

58 What is the x-coordinate of the image \((8, -6)\) under a dilation centered at the origin and having a scale factor of \(3\)?

- A 8
- B -2
- C 24
- D -6

---

59 What is the x-coordinate of the image \((8, -6)\) under a dilation centered at the origin and having a scale factor of \(1.5\)?

- A 3
- B 8
- C 9
- D 12
60. What is the y-coordinate of the image of (8, -6) under a dilation centered at the origin and having a scale factor of 3?
   - 8
   - 2
   - 24
   - 18

61. What is the x-coordinate of (4, -2) under a dilation centered at (1, 3) with a scale factor of 2?
   - 7
   - 2
   - 7
   - 8

62. What is the y-coordinate of (4, -2) under a dilation centered at (1, 3) with a scale factor of 2?
   - 7
   - 2
   - 7
   - 8

Warm Up
1. Choose the correct choice to complete the sentence.
   Rigid motions and dilations both preserve angle measure / distance.

2. Complete the sentence by filling in the blanks.
   rigid motions dilations
   _______ preserve distance; _______ do not preserve distance.

3. Define similar polygons on the lines below.
   ________________________________
   ________________________________
   ________________________________

Drawing Transformations
Triangle GHI has vertices G(4, 2), H(-3, -3) and N(-1, 1). Suppose the triangle is translated 4 units right and 2 units up and then dilated by a scale factor of 2 with the center of dilation at the origin. Sketch the resulting image of the composition of transformations.

Step 1
Draw the original figure.

Step 2
T
σ
r

Step 3
D
σ
r

Similarity Transformations
**Drawing Transformations**

$\triangle LMN$ has vertices $L(0, 2)$, $M(2, 2)$, and $N(0, 1)$.

For each similarity transformation, draw the image.

1. $D_2 \circ R_{x-axis}$ ($\triangle LMN$)

2. $D_2 \circ r_{(270^\circ}, O)$ ($\triangle LMN$)

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**Describing Transformations**

What is a composition of transformations that maps trapezoid $ABCD$ onto trapezoid $MNHP$?

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**Describing Transformations**

For each graph, describe the composition of transformations that maps $\triangle ABC$ onto $\triangle FGH$.

1. 

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**Describing Transformations**

For each graph, describe the composition of transformations that maps $\triangle ABC$ onto $\triangle FGH$.

2. 

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**Similar Figures**

Two figures are similar if and only if there is a similarity transformation that maps one figure onto the other.

Identify the similarity transformation that maps one figure onto the other and then write a similarity statement.

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**Answer**

$ABCD \sim MNPQ$
63 Which similarity transformation maps ΔABC to ΔDEF?

- A $R_{x-axis} \circ D_{0.5}$
- B $R_{y-axis} \circ D_{2}$
- C $r_{(90^\circ, y)} \circ D_{0.5}$
- D $r_{(270^\circ, y)} \circ D_{2}$

64 Which similarity transformation does not map ΔPQR to ΔSTU?

- A $r_{(180^\circ, x)} \circ D_{2}$
- B $D_{2} \circ R_{x-axis} \circ R_{y-axis}$
- C $D_{2} \circ r_{(180^\circ, y)}$
- D $D_{2} \circ R_{x-axis} \circ r_{(90^\circ, y)}$

65 Which of the following best describes a similarity transformation that maps ΔJKP to ΔLMP?

- A a dilation only
- B a rotation followed by a dilation
- C a reflection followed by a dilation
- D a translation followed by a dilation