Topic 4
Transformations and
Similar Triangles

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Transformations

Transformations
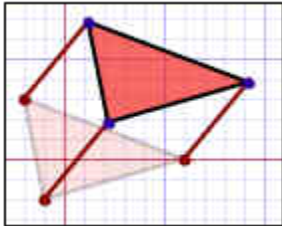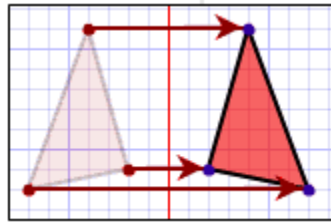
Translation	Reflection	Rotation	Dilation
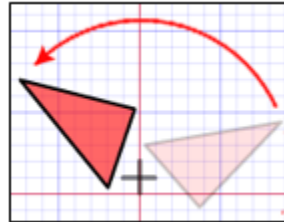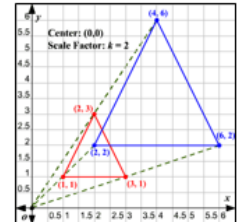
What is a RIGID MOTION?

Translation

Practice. Graph the image of each figure under the given translation and state the coordinates of the image figure.
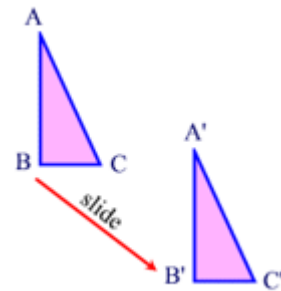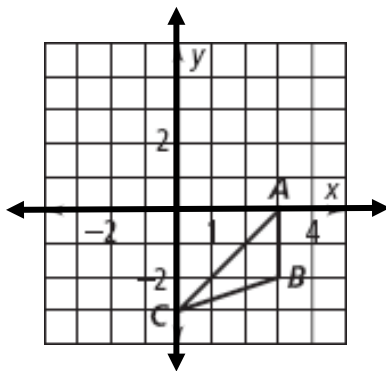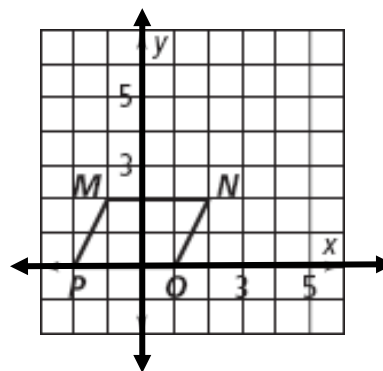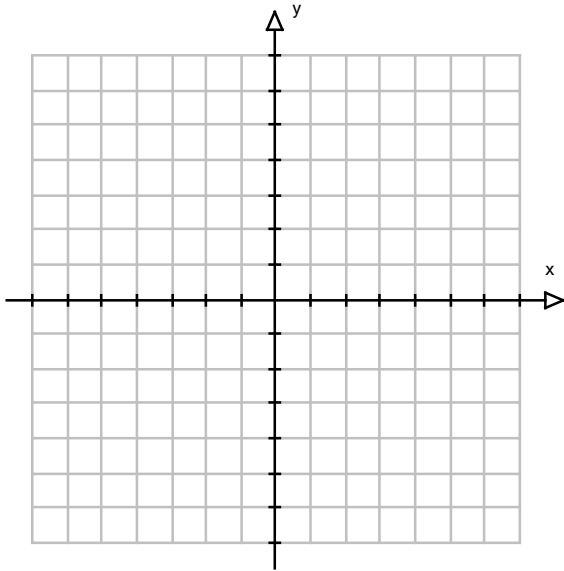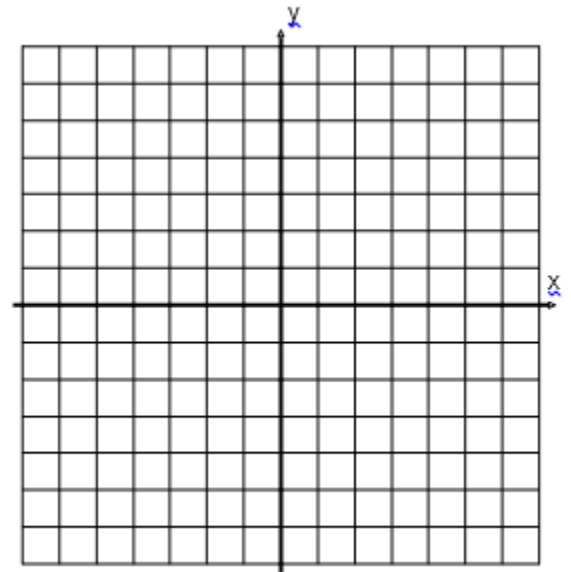
1. $T_{-1,4}(\triangle ABC)$

2. $T_{3,3}(MNOP)$

Is a translation a RIGID MOTION?

3. Given △*ABC* with coordinates *A*(2, 1), *B*(5, 1), and *C*(4, -3), state the coordinates of *A'B'C'*, the image of *ABC* after the translation *(x,y)* → *(x + 5, y − 1)*


4. The vertices of rectangle *MATH* are *M*(-4,2), *A*(-4,5), *T*(3,5) and *H*(3,2).

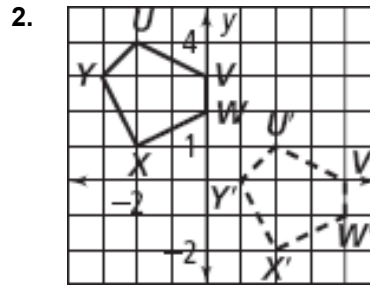**a.)** Find the area of rectangle *MATH* in square units.

b.) Translate the rectangle 3 units to the right and 4 units down. Find the area of rectangle *M'A'T'H'* in square units.

Writing a Translation Rule

Practice: The dashed-line figure is a translation image of the solid-line figure. Write a rule to describe each translation.
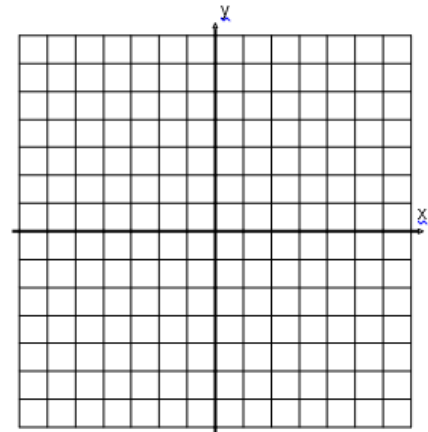
1.

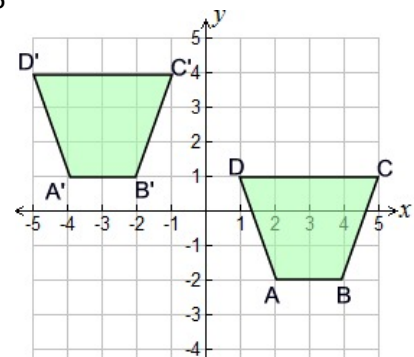**2.**
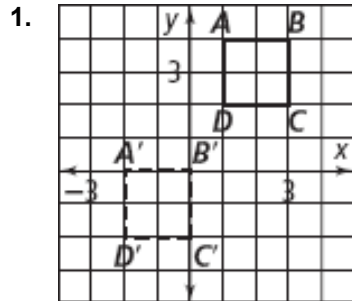
Rule: _____

Rule: _____

Practice

1. A translation function is defined by the rule
$(x,y) \rightarrow (x + 2, y - 5)$. What are the coordinates of the image of the point $(3,6)$ under this translation?

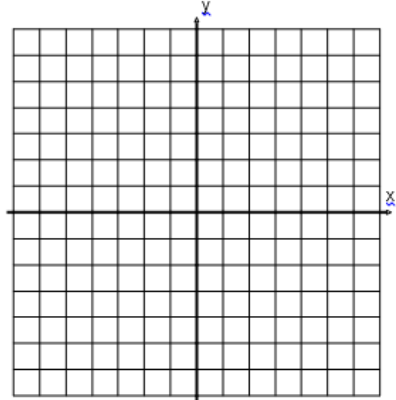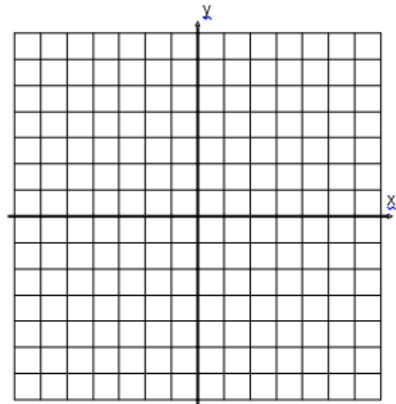**2.** Which translation mapping is shown in the graph to the right?

    a.) $(x, y) \rightarrow (x + 6, y - 3)$

    b.) $(x, y) \rightarrow (x - 3, y + 6)$

    c.) $(x, y) \rightarrow (x - 6, y + 3)$

    d.) $(x, y) \rightarrow (x + 3, y - 6)$
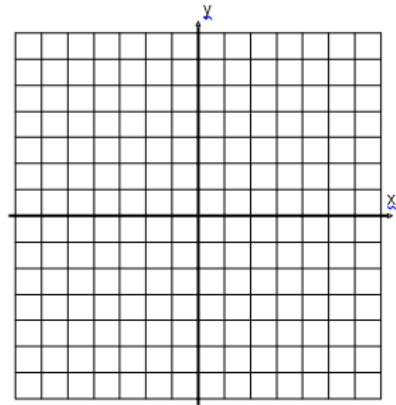
3. Find the coordinates of the image of point
   P$(-4, -7)$ after the transformation T$(-5, 2)$

4. A translation maps the origin to the point (-2,4).
   What is the image of point (-5,3) under this same
   translation?

5. Given ΔPQR with P(-2,3), Q(3,7), and R(7,2). Plot
   $\Delta P'Q'R'$, the image of ΔPQR after a translation of
   (x,y) → (x + 4, y − 3). Is the transformation of ΔPQR
   an example of rigid motion? Explain.

6. The vertices of triangle SPY are S(4,-2), P(-1,5), and
   Y(-1,-2).

   a.) Find the area of triangle SPY in square units.

   b.) Translate the triangle 3 units to the left and 4
       units down. Find the area of triangle S'P'Y' in
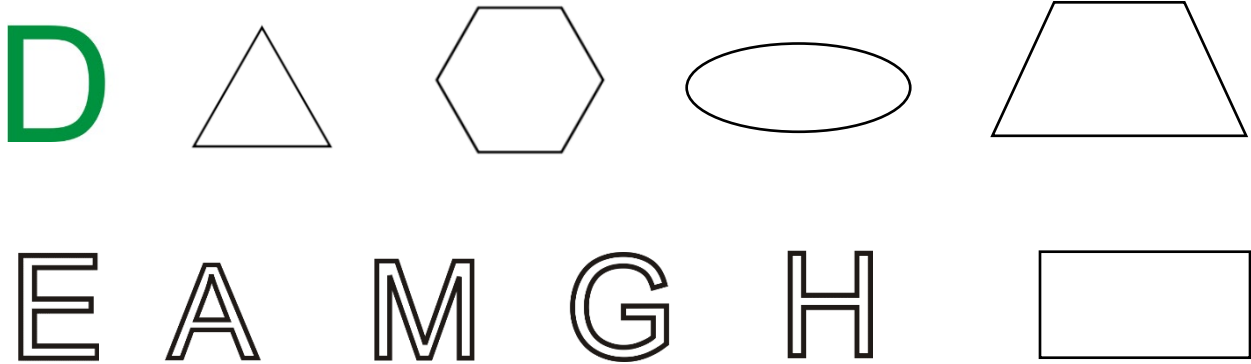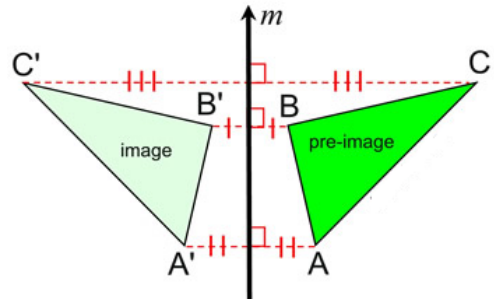   square units.
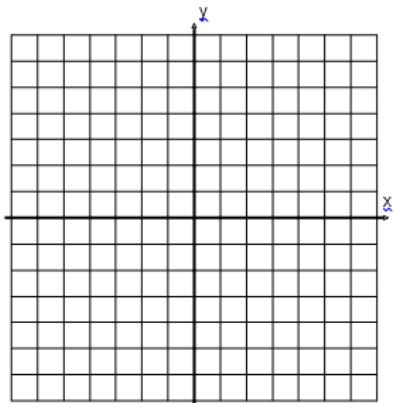
Symmetry

Line Symmetry / Reflection Symmetry: If there is a reflection for which the figure is its own image.

one line   two lines   five lines
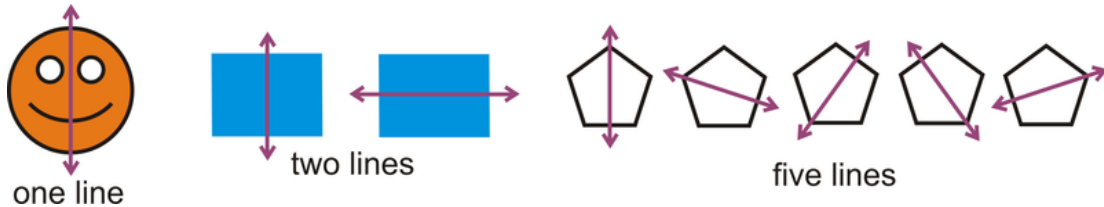
Find all lines of symmetry for the shapes/letters below:
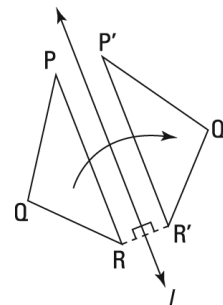

D △ ⬡ ⬭ ▱
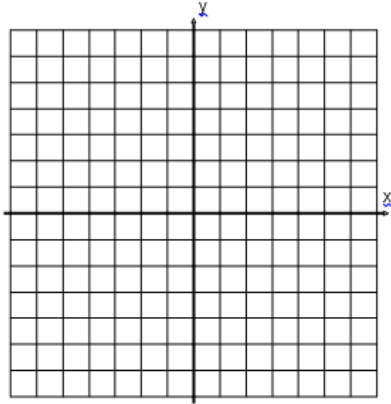
E A M G H ▭

Reflection

When you reflect a figure across a line, each point of the figure maps to another point the same distance from the line, but on the other side.
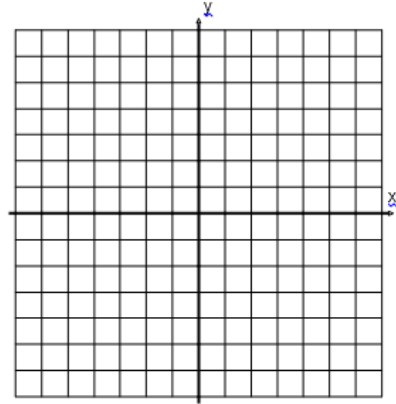
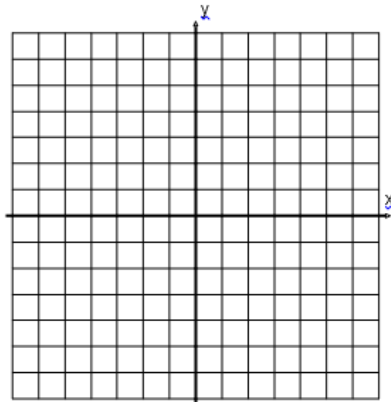The ***orientation*** of the figure reverses.

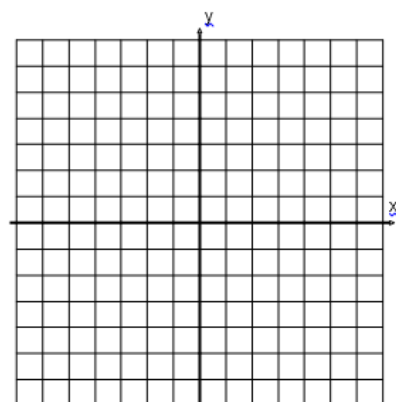1. Given points *M*(3, 3), *N*(5, 2), and *O*(4, 1), graph △*MNO* and its reflection image after $r_{x\text{-axis}}$. State the coordinates of the image.

2. Given points R(-1,-3), S(2,0), and T(-4,3), graph △RST and its reflection after $r_{y\text{-axis}}$. State the coordinates of the Image.

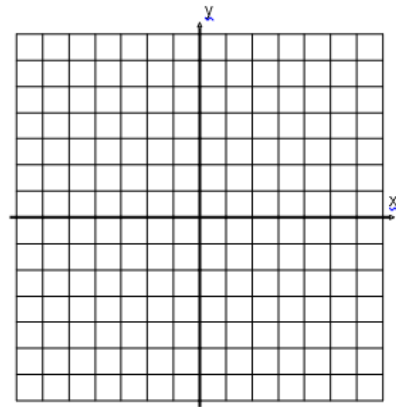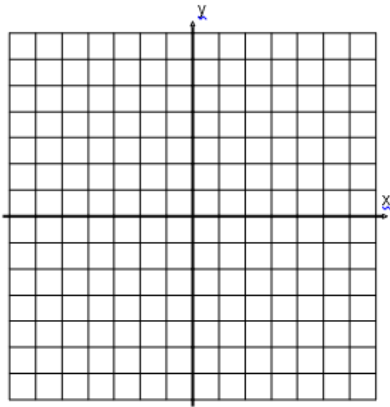3. Given points *V(-1,4), A(-4, 0),* and N(0,-4). Graph △V'A'N' the image of △VAN after $r_{x=1}$

4. Given points C(0,2), A(-3,4), and R(2,3). Graph △C'A'R' the image of △CAR after $r_{y=1}$

Is a reflection a RIGID MOTION?

# What about non-horizontal vertical lines?

1. Given points V(-1,4), A(-4, 0), and N(0,1). Graph △V'A'N' the image of ΔVAN after $r_{y=x}$

2. Given points C(-4,1), A(-3,4), and R(2,2). Graph ΔC'A'R' the image of ΔCAR after $r_{y=x}$

Practice

1. Given ΔABC with vertices A(3,5), B(-3,0) and C(7,-4), graph ΔA'B'C', the image of ΔABC after a reflection in the x-axis. Which vertex remains fixed?

2. ΔABC with A(1,6), B(2,10), and C(5,6) is reflected in a line to create image ΔA'B'C' with A'(1,0), B'(2,-4) and C'(5,0) What is the equation of the line of reflection?
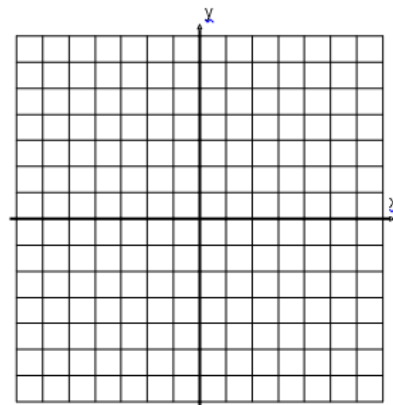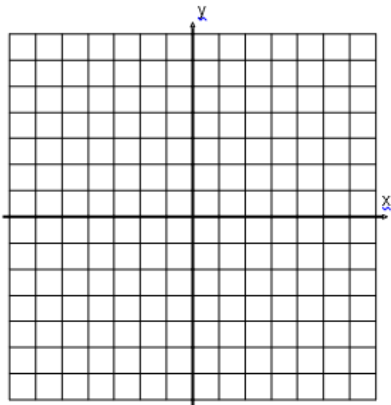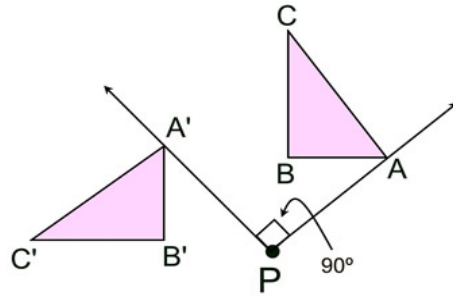
3. Triangle *XYZ*, shown in the diagram below, is reflected over the line $x = 2$. State the coordinates of $\triangle X'Y'Z'$, the image of $\triangle XYZ$.
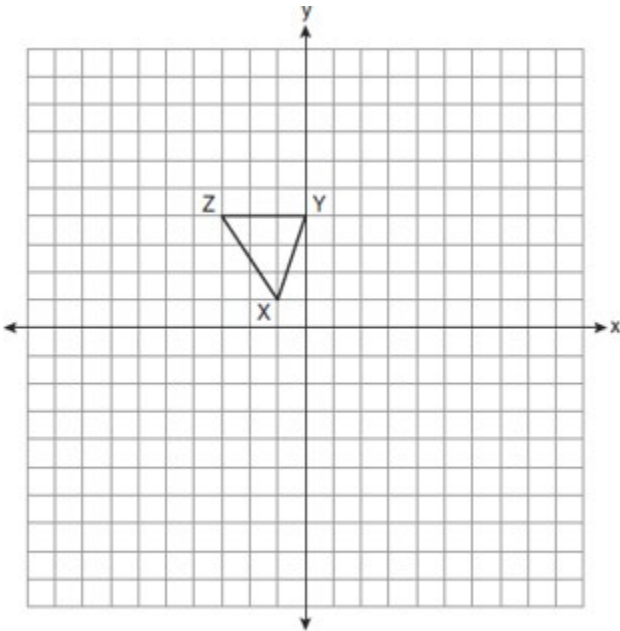
4. Triangle *ABC* has vertices $A(-1, 1)$, $B(1, 3)$, and $C(4, 1)$. The image of $\triangle ABC$ after the transformation $r_{y=x}$ is $\triangle A'B'C'$. State and label the coordinates of $\triangle A'B'C'$. [The use of the set of axes below is optional.]
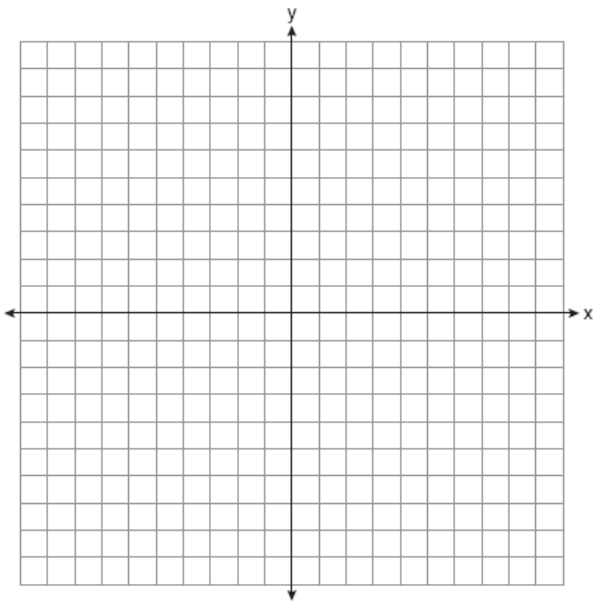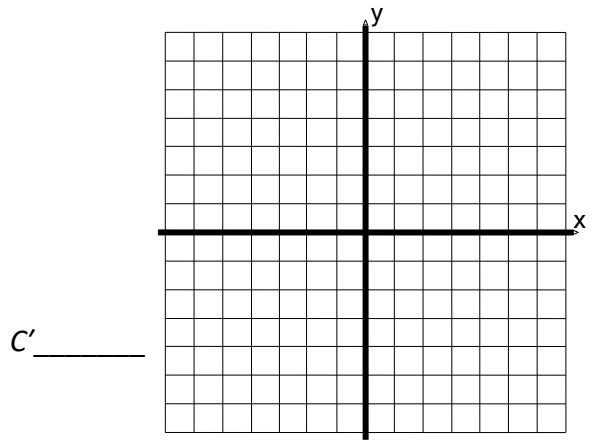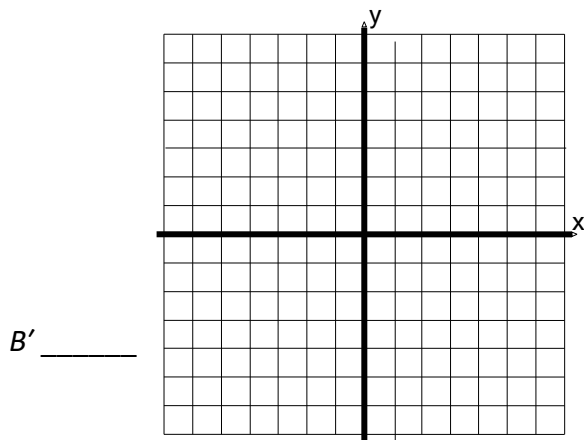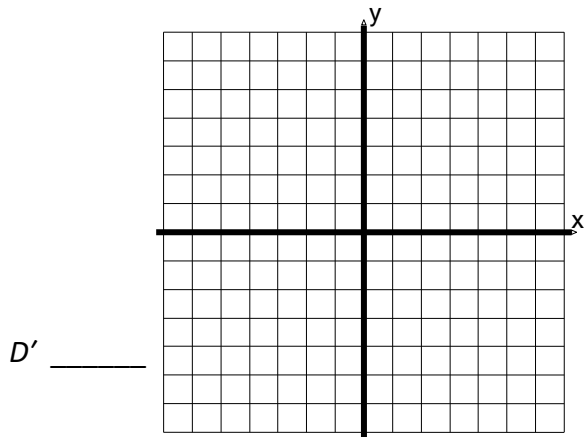
Rotation

Practice

Directions: Graph each pre-image, and new image, and state the appropriate coordinates.
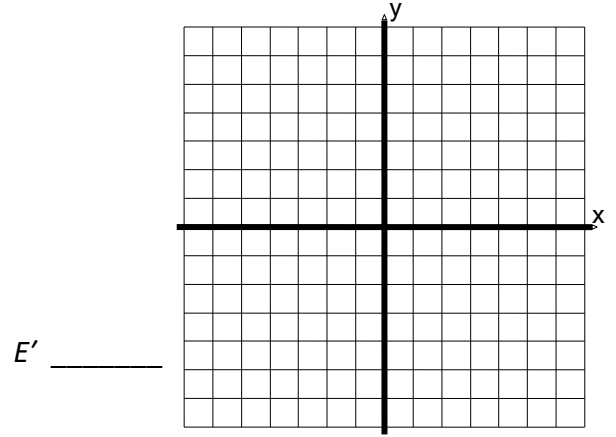
1. What are the coordinates of $B(1, 3)$ after a rotation of 180° about the origin?

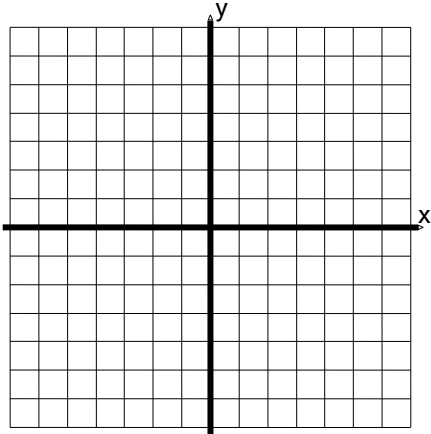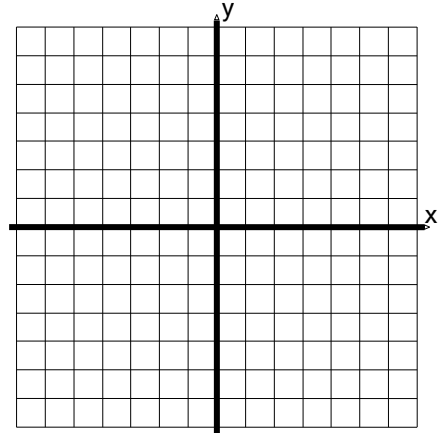2. What are the coordinates of $C(-5, -3)$ after a rotation of 270° about the origin?

B' _____

C' _____

3. What are the coordinates of $D(3, -1)$ after a rotation of 180° about the origin?

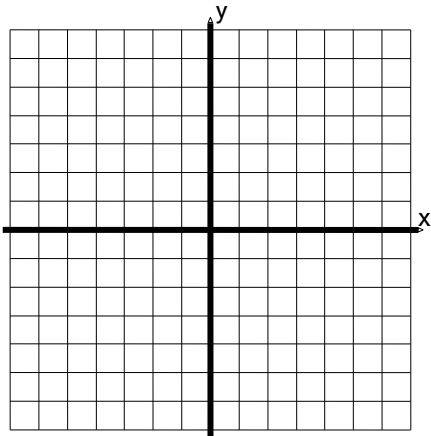4. What are the coordinates of $E(-4, -2)$ after $R_{O, 90°}$?

D' _____

E' _____

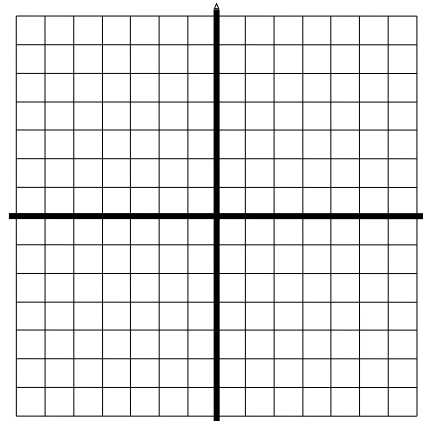**5.** What are the coordinates of F' if F(5,-2) is rotated -90° about the origin?

6. Find G', the image of G(-4, 3) after $R_{O,-270°}$.

7. $\triangle PQR$ has vertices $P(3,-5), Q(1,2)$ and $R(4,1)$. State the coordinates of $\triangle P'Q'R'$ after a 180° rotation.
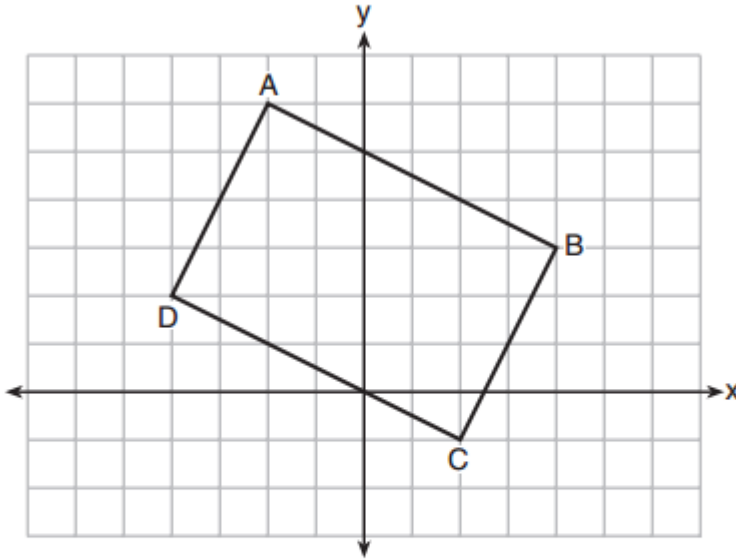
8. $\triangle CAT$ has vertices $C(0,4), A(-2,6)$ and $T(-7,3)$. State the coordinates of $\triangle C'A'T'$ after a $-90°$ rotation.

Is a rotation RIGID MOTION?

Practice

**1.** Quadrilateral *ABCD* is graphed on the set of axes below.

When *ABCD* is rotated 90° in a counterclockwise direction about the origin, its image is quadrilateral *A′B′C′D′*. Is distance preserved under this rotation, and which coordinates are correct for the given vertex?

(1) no and *C′*(1,2)　　　　(3) yes and *A′*(6,2)

(2) no and *D′*(2,4)　　　　(4) yes and *B′*(−3,4)

2. Find the image of the point K(6,3) after it is rotated 270°

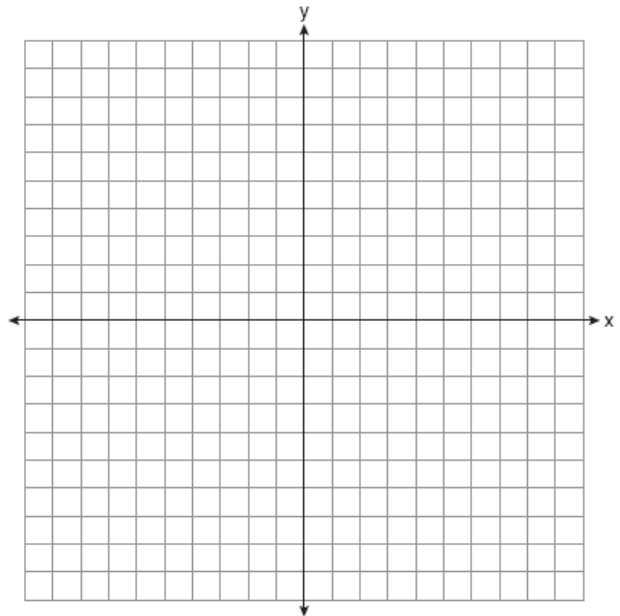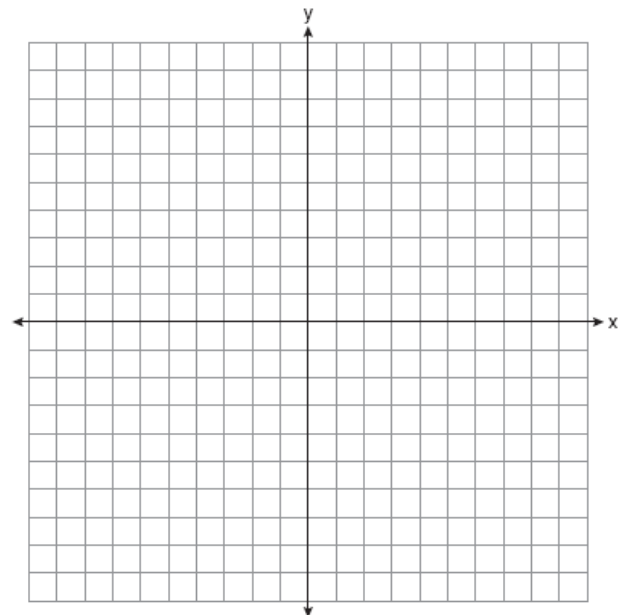**3.** Find the image of the point P(-4,1) after it is rotated 90°
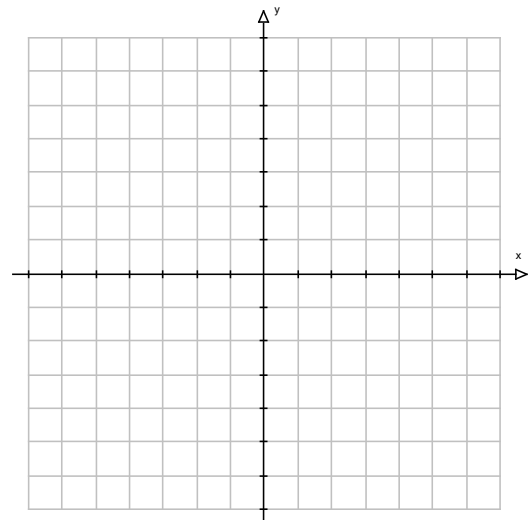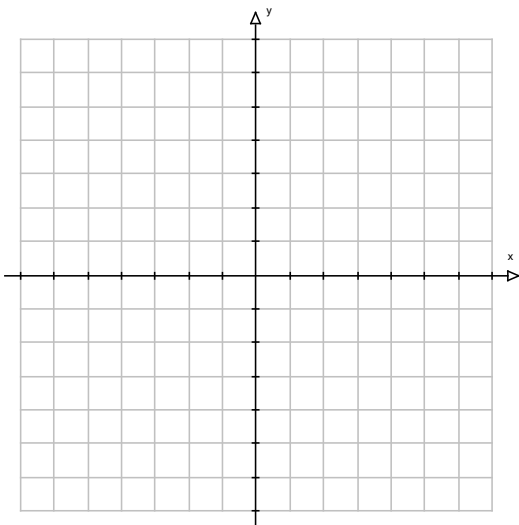
Dilation
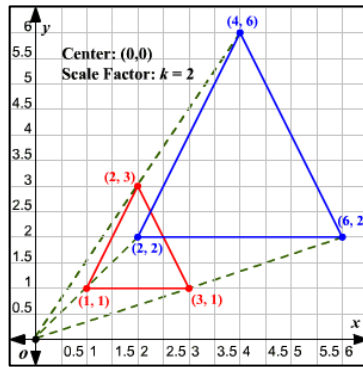
Practice

1. Triangle *ABC* has coordinates *A*(–2,1), *B*(3,1) and *C*(0,–3). On the set of axes below, graph and label △*A*'B'C', the image of △*ABC* after a dilation of 2 centered at the origin.

2. The coordinates of the endpoints of $\overline{AB}$ are *A*(2,3) and *B*(5,–1). Determine the length of $\overline{A'B'}$, the image of $\overline{AB}$ after a dilation of $\dfrac{1}{2}$ centered at the origin.
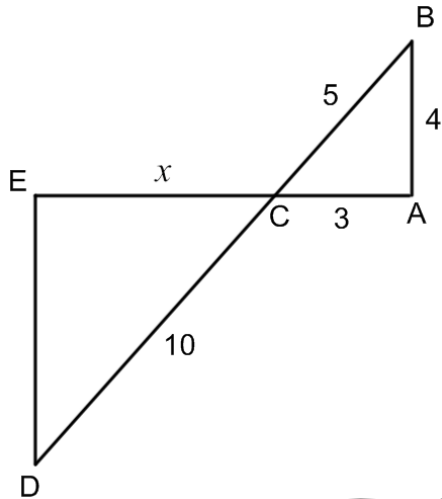
Is a Dilation RIGID MOTION?
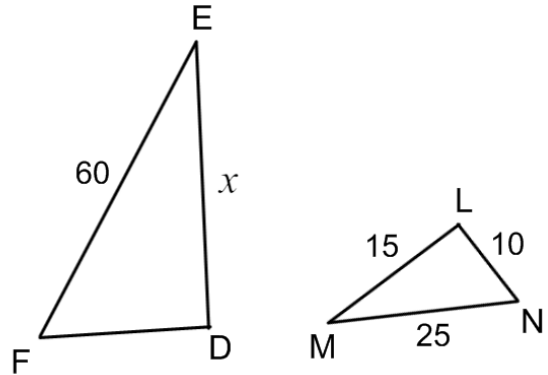
Dilations make **similar** figures!

Similar Triangles

Each of the following are examples of similar triangles. For each example, solve for the given variable.
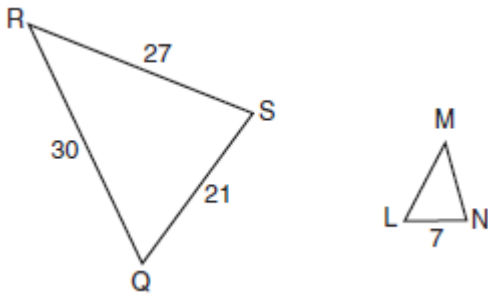
1. $\triangle ABC \sim \triangle EDC$

2. $\triangle DEF \sim \triangle LMN$
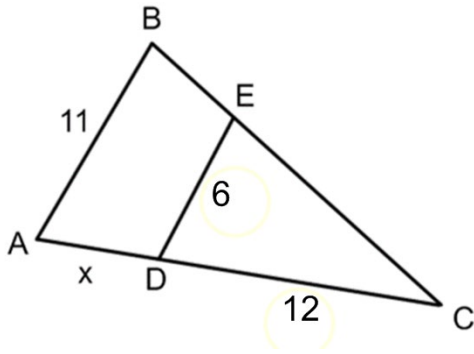
Re-draw, it helps.

3. In the accompanying diagram, $\triangle QRS$ is similar to $\triangle LMN$. What is the length of $\overline{ML}$?
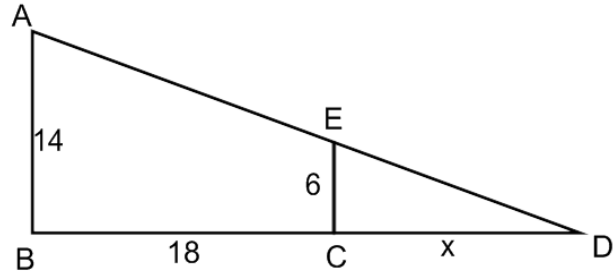
4. A 15 foot building casts a 9 foot shadow. How tall is the building that casts a 30 ft shadow at the same time? (Draw a picture of this scenario).
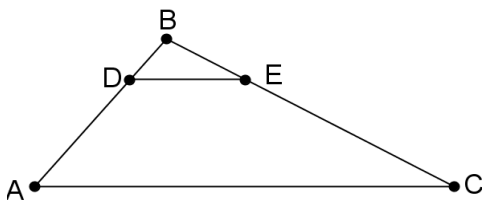
Triangles within triangles

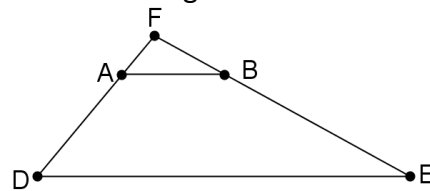**1.** $\overline{AB} \parallel \overline{DE}$. Find the value of x.

B

E

11

6

A

x   D

12   C

2. $\overline{AB} \parallel \overline{EC}$. Solve for x.

A

E

14

6

B   18   C   x   D

3. In the accompanying diagram of △ABC, $\overline{DE} \parallel \overline{AC}$, *BD* = 2, *BE* = 4, and *DA* = 5. Find the length of $\overline{BC}$.
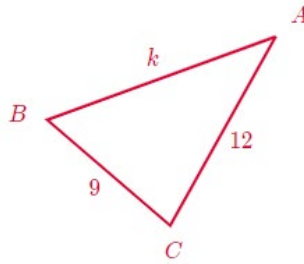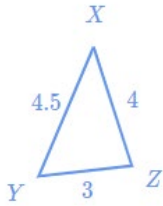
B

D   E

A   C

4. In the accompanying diagram of △DEF, $\overline{AB} \parallel \overline{DE}$, *AF* = 4, *DA*= 12, and *DE* = 20. What is the length of $\overline{AB}$?
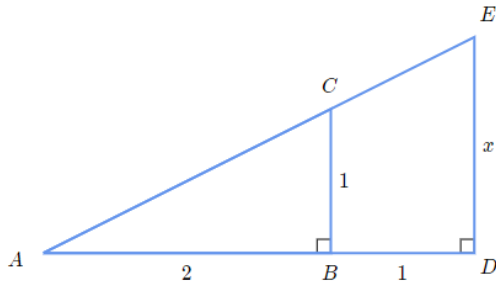
F

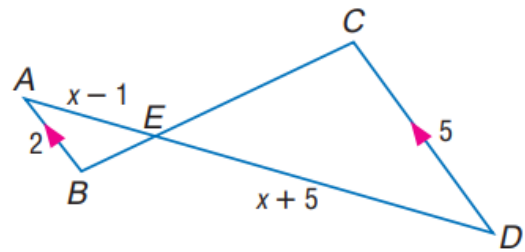A   B

D   E

Practice

1. Find the value of k if $\Delta XYZ \sim \Delta ABC$

2. Solve for x.

3. Find the length of DE

4. Nina was curious about the height of the Eiffel Tower. She used a 1.2 meter model of the tower and measureed its shadow at 2 p.m. The length of the shadow was 0.9 meter. The she measured the Eiffel Tower's shadow, and it was 240 meters. What is the height of the Eiffel Tower?

5. Find the length of AC.