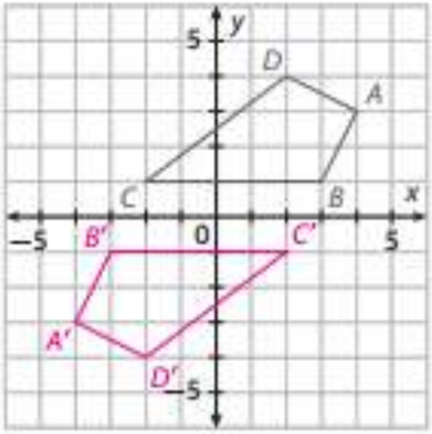
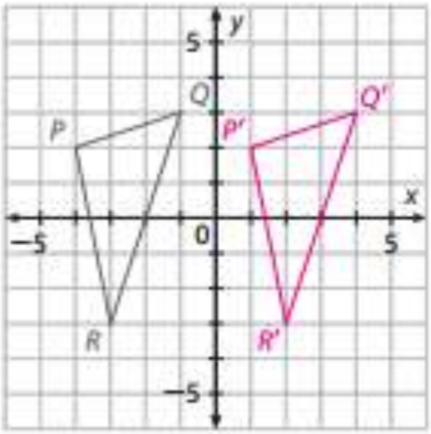
1. $(x, y) \to (-x, -y)$



$A(4, 3) \to A'(-4, -3) = A'(-4, -3)$
$B(3, 1) \to B'(-3, -1) = B'(-3, -1)$
$C(-2, 1) \to C'(-(-2), -1) = C'(2, -1)$
$D(2, 4) \to D'(-2, -4) = D'(-2, -4)$

rotation of 180° around the origin

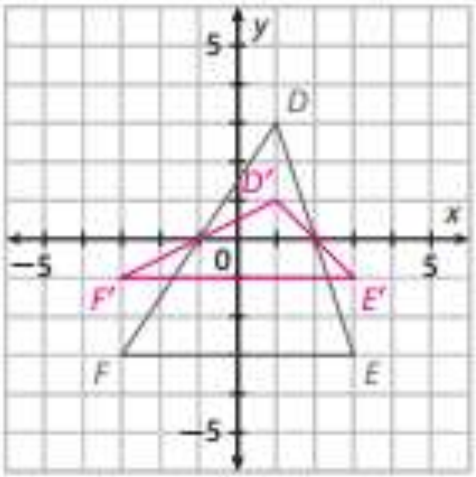
2. $(x, y) \to (x + 5, y)$



$P(-4, 2) \to P'(-4 + 5, 2) = P'(1, 2)$
$Q(-1, 3) \to Q'(-1 + 5, 3) = Q'(4, 3)$
$R(-3, -3) \to R'(-3 + 5, -3) = R'(2, -3)$

translation 5 units right

3. $(x, y) \rightarrow \left(x, \frac{1}{3}y\right)$



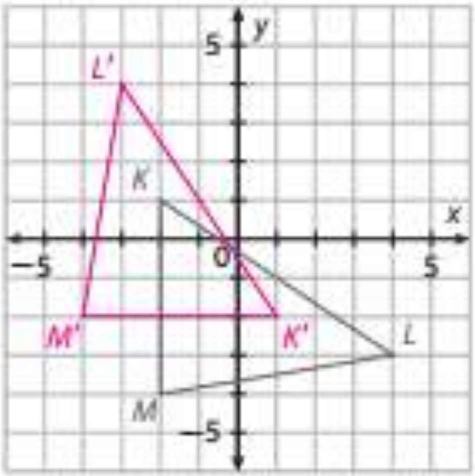
$D(1, 3) \rightarrow D'\left(1, \frac{1}{3} \cdot 3\right) = D'(1, 1)$

$E(3, -3) \rightarrow E'\left(3, \frac{1}{3} \cdot -3\right) = E'(3, -1)$

$F(-3, -3) \rightarrow F'\left(-3, \frac{1}{3} \cdot -3\right) = F'(-3, -1)$

vertical compression by a factor of $\frac{1}{3}$

4. $(x, y) \rightarrow (y, x)$



$K(-2, 1) \rightarrow K'(1, -2)$

$L(4, -3) \rightarrow L'(-3, 4)$

$M(-2, -4) \rightarrow M'(-4, -2)$

reflection across the line $y = x$

5. **Preimage** → **Image**

Preimage		Image
$A(-4, 4)$	→	$A'(4, 4)$
$B(-1, 2)$	→	$B'(2, 1)$
$C(-4, 1)$	→	$C'(1, 4)$

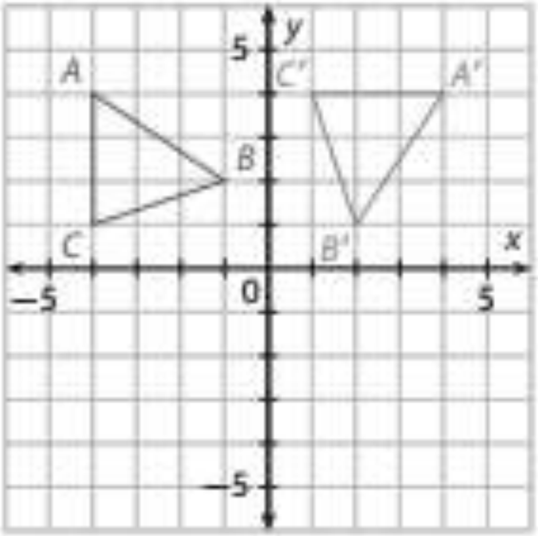
$(x, y) \rightarrow (y, -x)$; rotation of 90° clockwise around the origin

$AB = A'B' = \sqrt{13}$ $\quad$ $m\angle A = m\angle A' = 56°$

$BC = B'C' = \sqrt{10}$ $\quad$ $m\angle B = m\angle B' = 52°$

$AC = A'C' = 3$ $\quad$ $m\angle C = m\angle C' = 72°$

The transformation preserves length and angle measure.



6. **Preimage** → **Image**

Preimage		Image
$J(0, 3)$	→	$J'(-3, 0)$
$K(4, 3)$	→	$K'(-3, -4)$
$L(2, 1)$	→	$L'(-1, -2)$

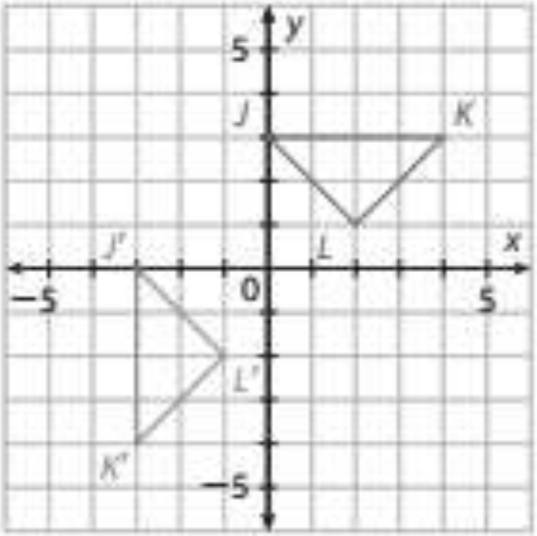
$(x, y) \rightarrow (-y, -x)$; reflection across the line $y = -x$

$JK = J'K' = 4$ $\quad$ $m\angle J = m\angle J' = 45°$

$KL = K'L' = \sqrt{8}$ $\quad$ $m\angle K = m\angle K' = 45°$

$JL = J'L' = \sqrt{8}$ $\quad$ $m\angle L = m\angle L' = 90°$

The transformation preserves length and angle measure.



Use coordinate notation to write the rule that maps each preimage to its image.

10. Use the points $A(2, 3)$ and $B(2, -3)$.

a. Describe segment AB and find its length.

Segment *AB* is a vertical segment that is 6 units long.

b. Describe the image of segment AB under the transformation $(x, y) \rightarrow (x, 2y)$.

$$A(2, 3) \rightarrow A'(2, 2 \cdot 3) = A'(2, 6)$$

$$B(2, -3) \rightarrow B'(2, 2 \cdot (-3)) = B'(2, -6)$$

The image of segment *AB* is a vertical segment that is 12 units long.

c. Describe the image of segment AB under the transformation $(x, y) \rightarrow (x + 2, y)$.

$$A(2, 3) \rightarrow A'(2 + 2, 3) = A'(4, 3)$$

$$B(2, -3) \rightarrow B'(2 + 2, -3) = B'(4, -3)$$

The image of segment *AB* is a vertical segment two units to the right of the original segment that is 6 units long.

d. Compare the two transformations.

Possible answer: $(x, y) \rightarrow (x + 2, y)$ is rigid, because it does not change the length of the segment. $(x, y) \rightarrow (x, 2y)$ is not rigid because it doubles the length of the segment. The segment remains vertical under both transformations.

Objective

Identify and draw translations.

WHAT IS A TRANSLATION?

Ohio State Marching Band

- https://www.youtube.com/watch?v=v3vp7H3eEfs
- Work on Translation WS with group!

What kind of Translation is this?

$(x, y) \rightarrow (x + 5, y)$ 5 units right

$(x, y) \rightarrow (x - 3, y)$ 3 units left

$(x, y) \rightarrow (x, y + 2)$ 2 units up

$(x, y) \rightarrow (x, y - 4)$ 4 units down

$(x, y) \rightarrow (x - 6, y + 8)$ 6 units left, 8 units up

Patty Paper Time!

- Draw a triangle that is smaller than a fourth of the size of the patty paper on your blank piece of paper. Label the vertices of the triangle.
- Copy the triangle onto the patty paper.
- Using your patty paper, translate your triangle to somewhere else on your paper. Label your new points with prime marks.

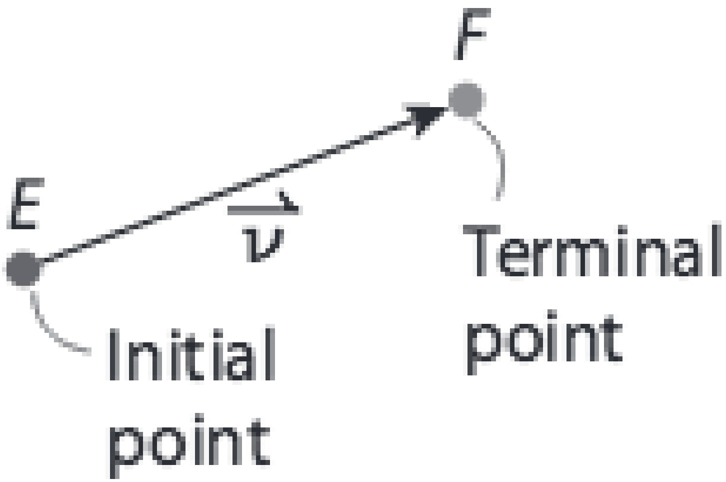
Patty Paper Time!

- Using your ruler, connect the preimage vertices to the image vertices.
- Measure each of these segments.
- What do you notice?
- Are these segments parallel, perpendicular, or neither?

These "segments" are… pg. 834

Vectors!

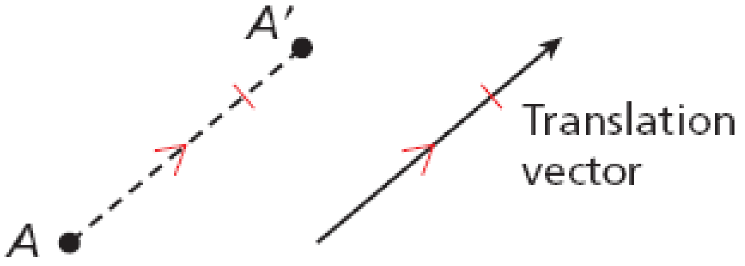
- A quantity that has both direction and magnitude.
- The initial point of a vector is the starting point.
- The terminal point is the ending point.

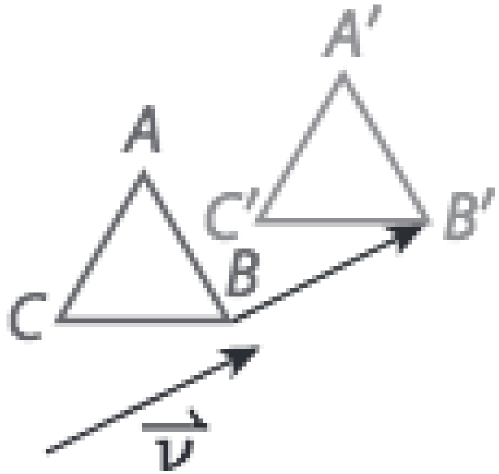


named $\overrightarrow{EF}$ or $\overrightarrow{v}$.

Translations

A translation is a transformation along a vector such that each segment joining a point and its image has the same length as the vector and is parallel to the vector.





Vector Video

- https://www.youtube.com/watch?v=A05n32Bl0aY

pg. 836

A vector in the coordinate plane can be written as <*a*, *b*>, where *a* is the horizontal change and *b* is the vertical change from the initial point to the terminal point. (this is component form)

How does this connect to the Pythagorean Theorem?

What would the vector be?

(x, y) → (x + 5 , y) $< 5, 0 >$

(x, y) → (x – 3 , y) $< -3, 0 >$

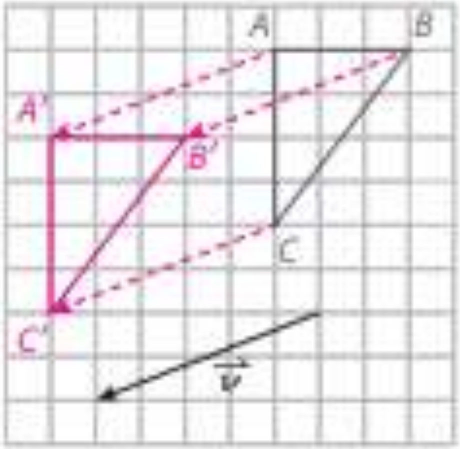
(x, y) → (x , y + 2) $< 0, 2 >$

(x, y) → (x , y – 4) $< 0, -4 >$

(x, y) → (x – 6, y + 8) $< -6, 8 >$

Your Turn

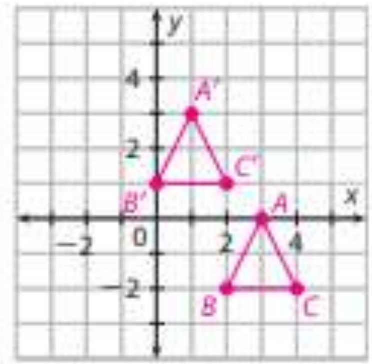
4. Draw the image of $\triangle ABC$ after a translation along $\vec{v}$.



(B) Preimage coordinates: $A(3, 0)$, $B(2, -2)$, and $C(4, -2)$. Vector $\langle -2, 3\rangle$

Prediction: The image will be in Quadrant 1

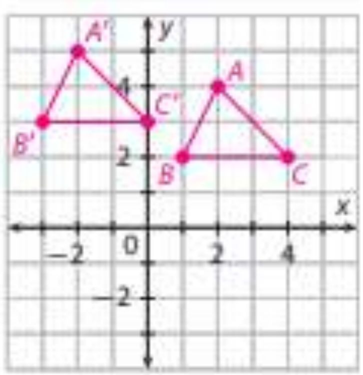
Preimage coordinates (x, y)	Image $(x - 2, y + 3)$
$(3, 0)$	$(1, 3)$
$(2, -2)$	$(0, 1)$
$(4, -2)$	$(2, 1)$



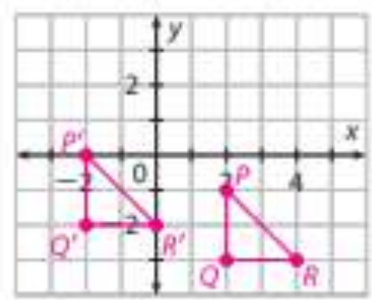
Your Turn

Draw the preimage and image of each triangle under a translation along $\langle -4, 1\rangle$.

5. Triangle with coordinates: $A(2, 4)$, $B(1, 2)$, $C(4, 2)$.

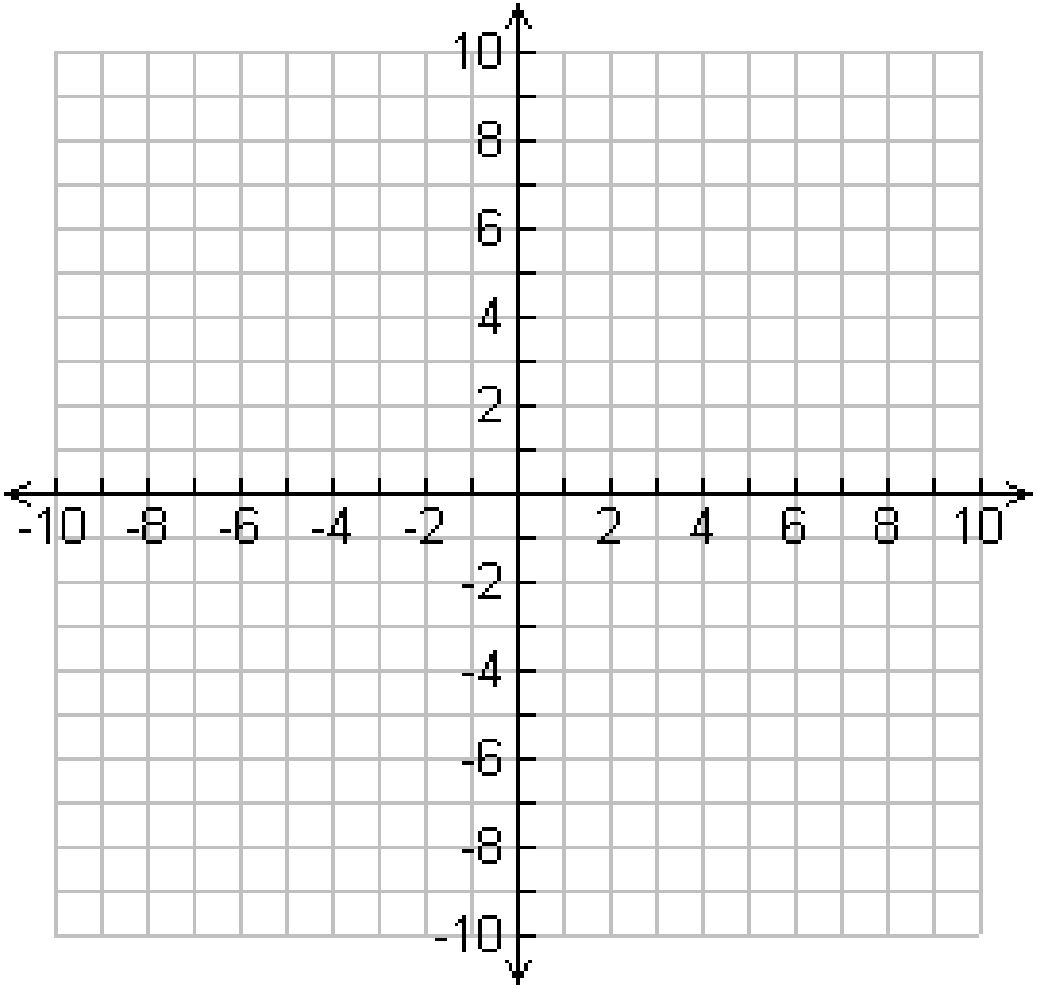


6. Triangle with coordinates: $P(2, -1)$, $Q(2, -3)$, $R(4, -3)$.



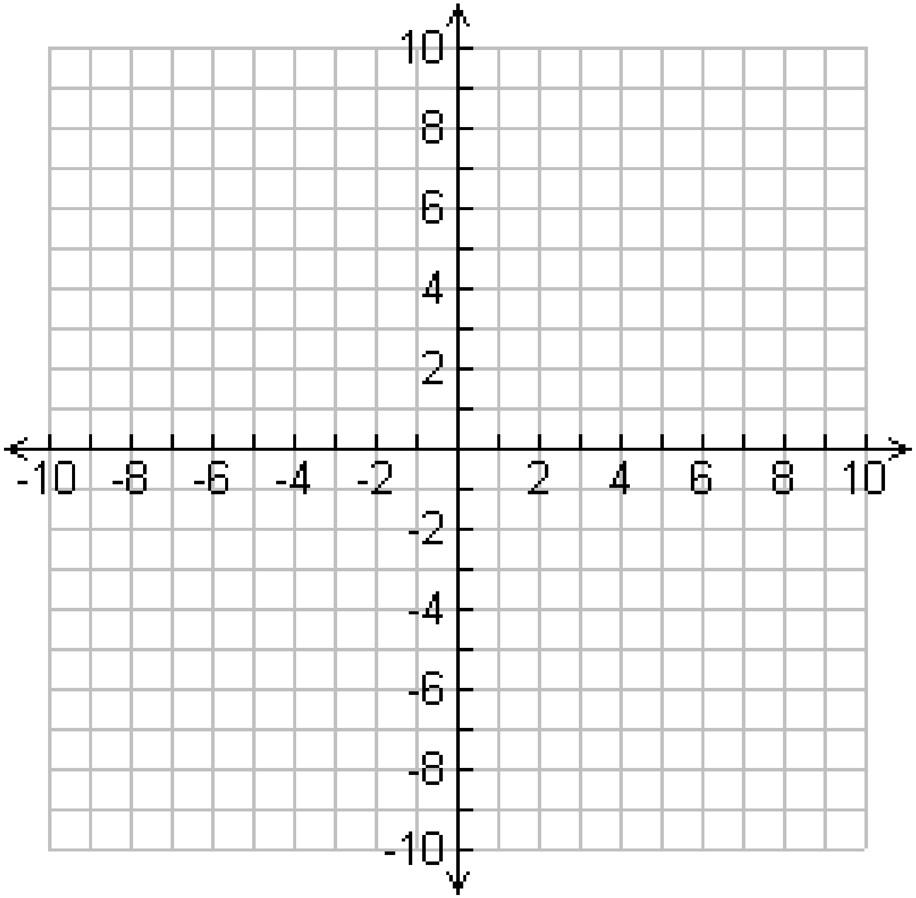
Try It Out!

- Draw a Triangle with coordinates T (5, 5) R (5, 7) and Y (8, 5)
- Use the Vector $< -6, -6 >$ to translate the triangle



Try It Out!

- Draw a Triangle with coordinates B (1, 1) O (3, 2) and L (5, 1)
- Use the Vector $< -3, -4 >$ to translate the triangle



Try It Out!

- Make your own triangle and vector!

Exit Ticket

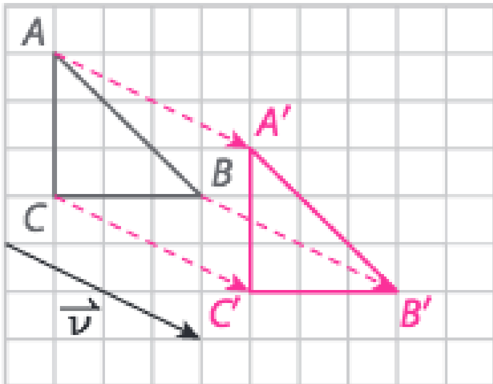
- What did you learn today?
- What mistakes were you making?

HOMEWORK

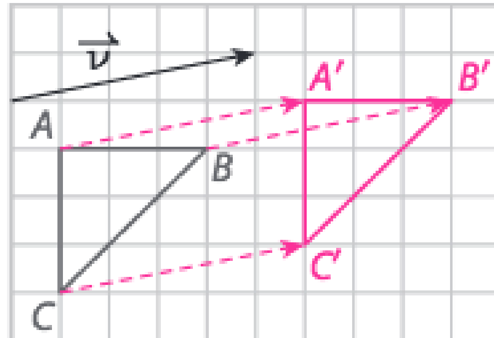
pg. 839 (1-10)

Draw the image of $\triangle ABC$ after a translation along $\vec{v}$.

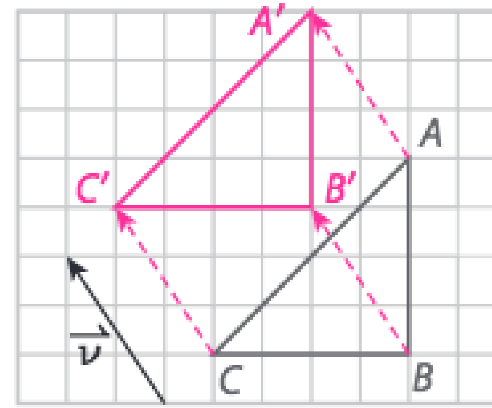
1.



2.

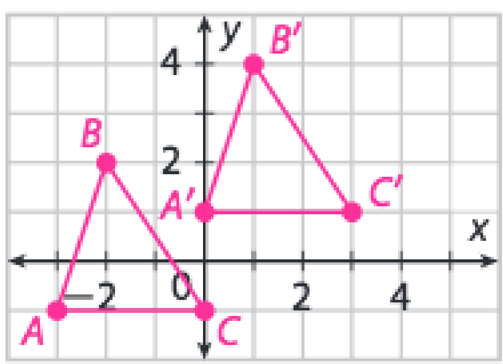


3.

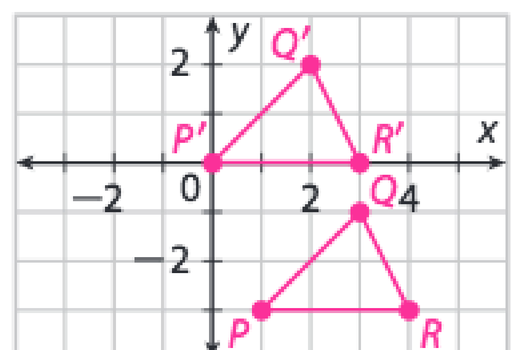


4. Line segment $\overline{XY}$ was used to draw a copy of $\triangle ABC$. $\overline{XY}$ is 3.5 centimeters long. What is the length of $AA' + BB' + CC'$?
10.5 cm

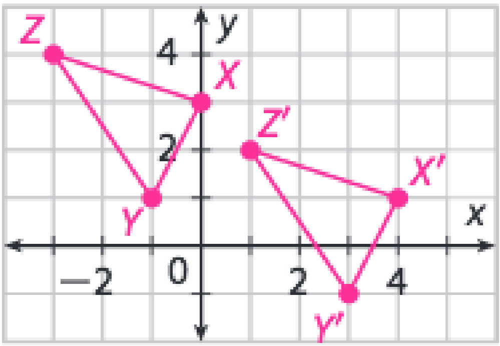
5. Triangle: $A(-3, -1)$; $B(-2, 2)$; $C(0, -1)$; Vector: $\langle 3, 2 \rangle$



6. Triangle: $P(1, -3)$; $Q(3, -1)$; $R(4, -3)$; Vector: $\langle -1, 3 \rangle$



7. Triangle: $X(0, 3)$; $Y(-1, 1)$; $Z(-3, 4)$; Vector: $\langle 4, -2 \rangle$



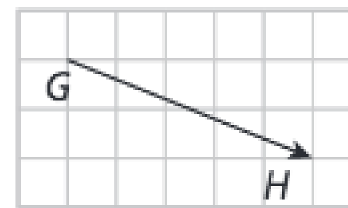
8. Find the coordinates of the image under the transformation $\langle 6, -11 \rangle$.

$(x, y) \rightarrow (x + 6, y - 11)$ $\quad (2, -3) \rightarrow (8, -14)$

$(3, 1) \rightarrow (9, -10)$ $\quad (4, -3) \rightarrow (10, -14)$

9. Name the vector. Write it in component form.

$\overrightarrow{GH}$, $\langle 5, -2 \rangle$



10. Match each set of coordinates for a preimage with the coordinates of its image after applying the vector $\langle 3, -8 \rangle$. Indicate a match by writing a letter for a preimage on the line in front of the corresponding image.

A. $(1, 1)$; $(10, 1)$; $(6, 5)$ — C — $(6, -10)$; $(6, -4)$; $(9, -3)$

B. $(0, 0)$; $(3, 8)$; $(4, 0)$; $(7, 8)$ — D — $(1, -6)$; $(5, -6)$; $(-1, -8)$; $(7, -8)$

C. $(3, -2)$; $(3, 4)$; $(6, 5)$ — A — $(4, -7)$; $(13, -7)$; $(9, -3)$

D. $(-2, 2)$; $(2, 2)$; $(-4, 0)$; $(4, 0)$ — B — $(3, -8)$; $(6, 0)$; $(7, -8)$; $(10, 0)$