

Translations

Vector: a quantity that has both direction and magnitude, or size, and is represented in the coordinate plane by an arrow drawn from one point to another

Initial point: starting point

Terminal point: ending point

Component form: combines the horizontal and vertical components $\langle \ , \ \rangle$

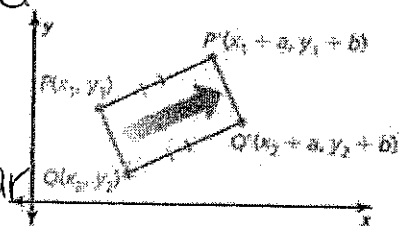
Translation: a transformation that moves every point of a figure the same distance in the same direction

- A translation maps or moves the points P and Q of a plane figure along a vector $\langle a, b \rangle$ to the points P' and Q' , so that one of the following statements are true.

○ $PP' = QQ'$ and $\overline{PP'} \parallel \overline{QQ'}$

○ $PP' = QQ'$ and

$\overline{PP'} \subseteq \overline{QQ'}$ are collinear



- * ● Translations map lines to parallel lines and segments to parallel segments.

Example 1:

In the diagram to the right, the vertices of $\triangle ABC$ are

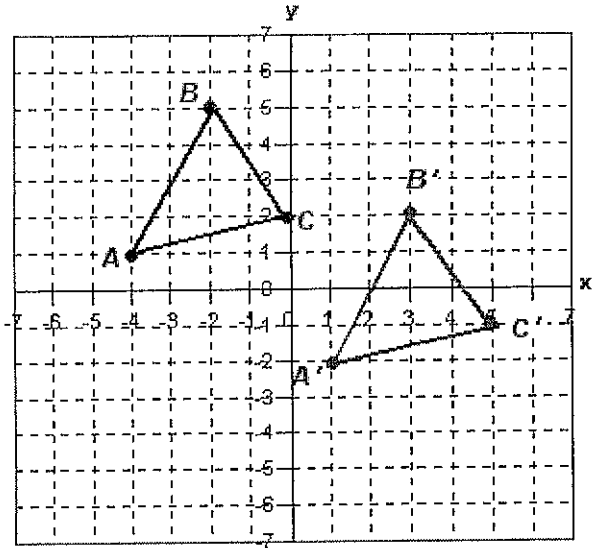
$A(-4, 1)$ $B(-2, 5)$ $C(0, 2)$

We get the image of $\triangle ABC$ by translating the preimage using the vector $\langle 5, -3 \rangle$.

The image $\triangle A'B'C'$ has vertices at $A'(1, -2)$

$B'(3, 2)$

$C'(5, -1)$



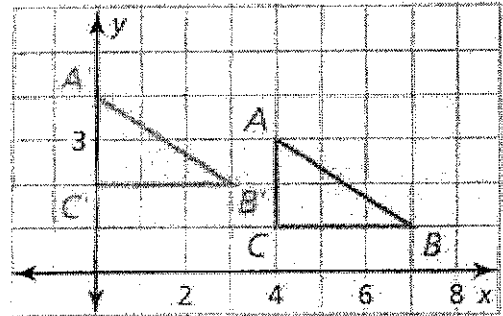
- You can also express a translation along the vector $\langle a, b \rangle$ using a rule, which has the following notation:

$(x+5, y-3)$ or $T_{5, -3}$

Example 2:

Find the rule for the translation of $\triangle ABC$ to its image $\triangle A'B'C'$.

$(x-4, y+1)$



Example 3:

Find the rule for the translation of quadrilateral ABCD to its image $A'B'C'D'$.

$T_{3, -1}$

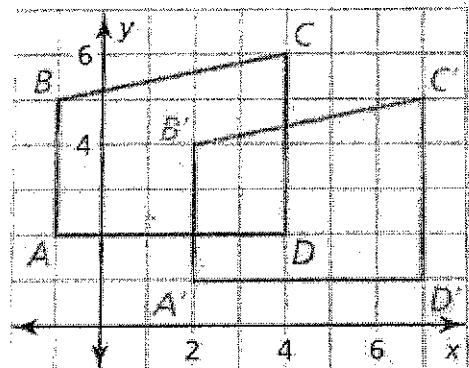
Use the rule to write each of the vertices of quadrilateral ABCD and its image after the translation.

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

$B(-1, 5) \rightarrow B'(2, 4)$

$C(4, 6) \rightarrow C'(7, 5)$

$D(4, 2) \rightarrow D'(7, 1)$



Practice problems:

In 1 -4, find the coordinates of the point or figure after the following translations.

1. $T_{\langle 3, -2 \rangle}(-4, 5)$

$(-1, 3)$

2. $T_{\langle -6, 4 \rangle}(10, 1)$

$(4, 5)$

3. $\triangle DEF$

$D(-5, 0)$

$E(-7, -6)$

$F(1, -3)$

4. $\triangle QRS$

$Q(3, 7)$

$R(0, 2)$

$S(4, 1)$

Translated along the vector $\langle 4, -1 \rangle$

$D'(-1, -1)$

$E'(-3, -7)$

$F'(5, -4)$

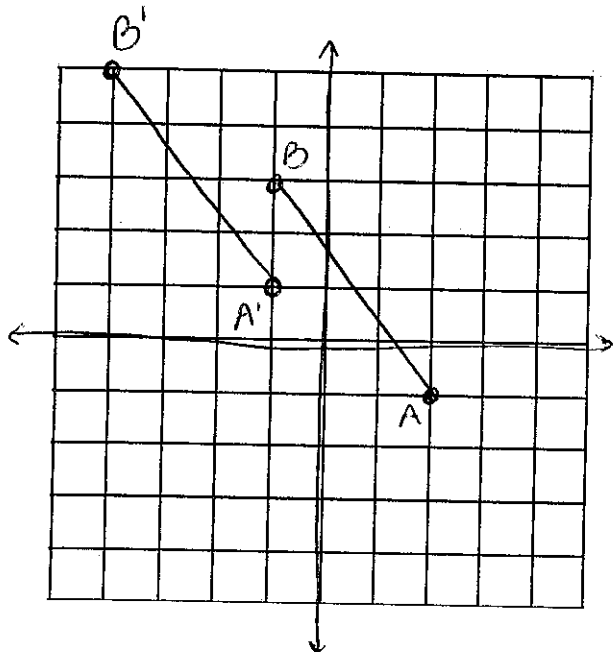
Translated along the vector $\langle 2, -5 \rangle$

$Q'(5, 2)$

$R'(2, -3)$

$S'(6, -4)$

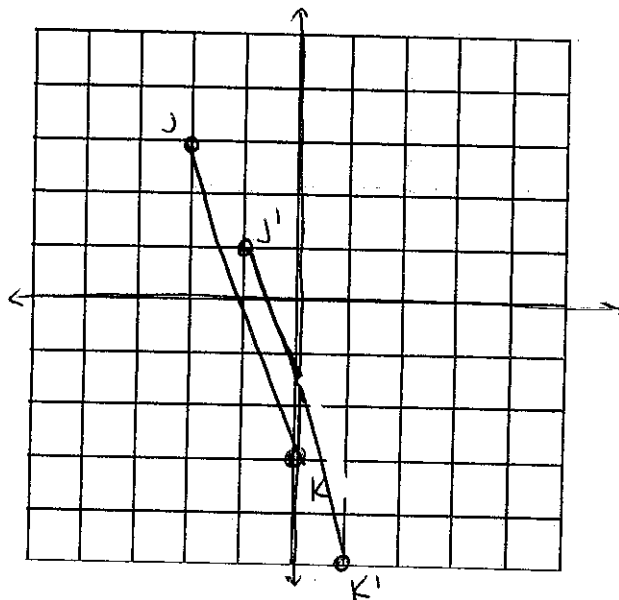
5. Use the translation $(x, y) \rightarrow (x - 3, y + 2)$ to find the image of line segment AB with $A(2, -1)$ and $B(-1, 3)$.



$A'(-1, 1)$

$B'(-4, 5)$

6. Use the translation $(x, y) \rightarrow (x + 1, y - 2)$ to find the image of line segment JK with $J(-2, 3)$ and $K(0, -3)$.



$J'(-1, 1)$

$K'(1, -5)$

Find the vector that translates the following preimages to their images.

7. $P(4, 1) \rightarrow P'(-2, 4)$

$$\langle -6, 3 \rangle$$
$$\overline{T}_{-6, 3}$$
$$(x-6, y+3)$$

9. $\triangle CDE \rightarrow \triangle C'D'E'$
 $C(-1, 3) \quad C'(1, -1)$
 $D(2, 0) \quad D'(4, -4)$
 $E(0, -1) \quad E'(2, -5)$

$$\langle 2, -4 \rangle$$
$$\overline{T}_{2, -4}$$
$$(x+2, y-4)$$

8. $A(-2, 8) \rightarrow A'(-4, 0)$

$$\langle -2, -8 \rangle$$
$$\overline{T}_{-2, -8}$$
$$(x-2, y-8)$$

10. $\triangle XYZ \rightarrow \triangle X'Y'Z'$
 $X(5, -1) \quad X'(2, 0)$
 $Y(2, -2) \quad Y'(-1, -1)$
 $Z(-1, 4) \quad Z'(-4, 5)$

$$\langle -3, 1 \rangle$$
$$\overline{T}_{-3, 1}$$
$$(x-3, y+1)$$

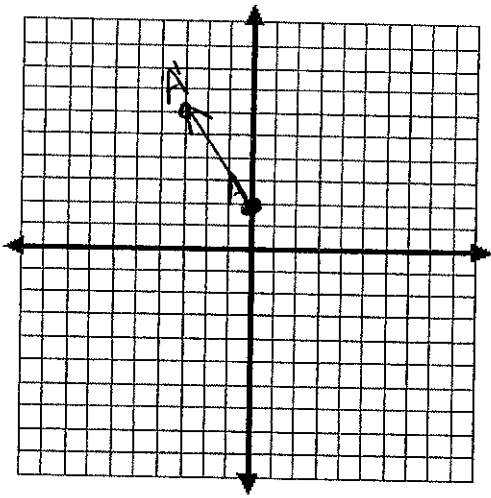
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Name: _____

Date: _____

Translations

A. Plot the point $(0, 2)$ and label it A.



B. Slide the point three units to the left and 4 units up. Graph and label the image A' .

C. Draw a vector from the pre-image, A, to the image, A' .

D. Write the rule of the translation

$$(x, y) \longrightarrow (x - 3, y + 4)$$

$$(0, 2) \xrightarrow{T} (-3, 6)$$

E. Write the translation as a vector in component form.

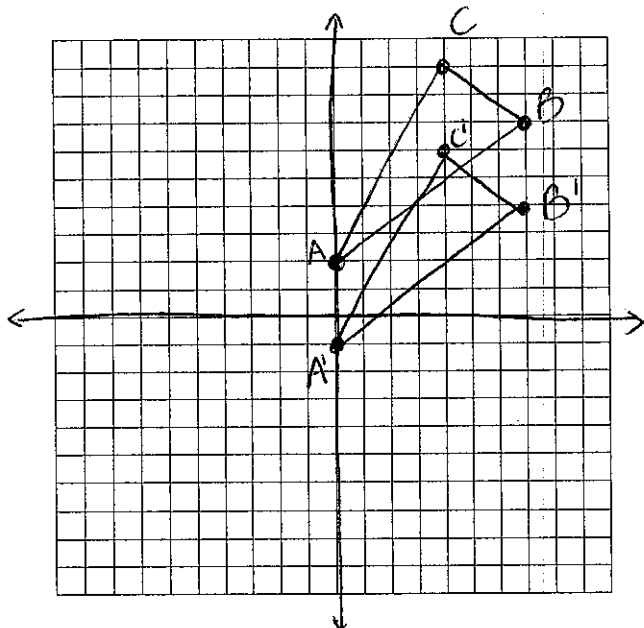
$$\langle -3, 4 \rangle$$

1. Find the image of the point $(2, -5)$ under the translation $(x, y) \longrightarrow (x - 7, y + 2)$.

$$(-5, -3)$$

2. Triangle ABC has coordinates $A(0, 2)$, $B(7, 7)$, and $C(4, 9)$.

A. Graph triangle ABC.



B. On the same set of axes, graph triangle $A'B'C'$, the image of triangle ABC under a translation of $T_{0, -3}$.

$$\begin{aligned} A' &(0, -1) \\ B' &(7, 4) \\ C' &(4, 6) \end{aligned}$$

3. What is the image of $(1, 0)$ after a translation 2 units right and 5 units down?

$$\langle 2, -5 \rangle$$

$$(3, -5)$$

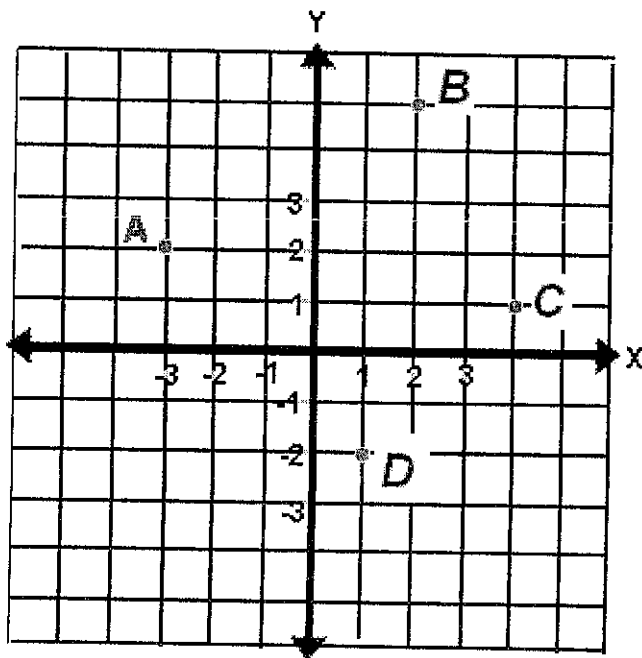
4. A. A translation moves $P(2, 3)$ to $P'(-1, 5)$. Write the translation as a vector in component form.

$$\langle -3, 2 \rangle$$

B. What are the coordinates of $S(-1, 3)$, under the same translation?

$$(-4, 5)$$

5. If A is represented by $(-3, 2)$. Which letter represents A after a translation of $(x + 7, y - 1)$?



C

6. The coordinates of the vertices of quadrilateral ABCD are A(3, -3), B(6, 1), C(3, 2), and D(1,2).

A. Graph quadrilateral ABCD.

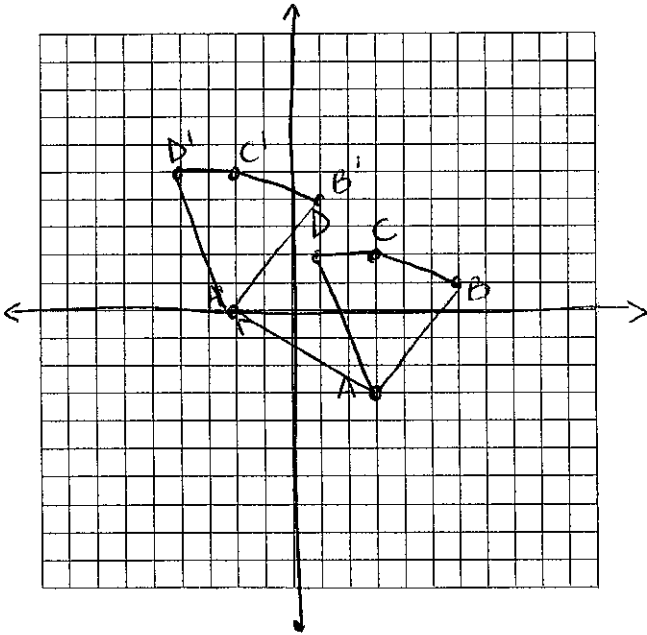
B. Find the coordinates of the vertices of quadrilateral A'B'C'D', the image of ABCD under $T_{-5,3}$.

C. Draw a vector illustrating this translation.

D. Write the rule of the translation as a vector in component form.

$\langle -5, 3 \rangle$

E. Find the area of quadrilateral A'B'C'D'.



7. A design was constructed by using two rectangles $ABDC$ and $A'B'D'C'$. Rectangle $A'B'D'C'$ is the result of a translation of rectangle $ABDC$. The table of translations is shown below. Find the coordinates of points B and D' .

Rectangle $ABDC$	Rectangle $A'B'D'C'$
A (2,4)	A' (3,1)
B (-6,4)	B' (-5,1)
C (2,-1)	C' (3,-4)
D (-6,-1)	D' (-5,-4)

$T_{1,-3}$

8. Triangle ABC has vertices $A(1,3)$, $B(0,1)$, and $C(4,0)$. Under a translation, A' , the image point of A , is located at $(4,4)$. Under this same translation, what are the coordinates of point C' ?

$$A(1,3) \rightarrow A'(4,4) \quad \langle 3,1 \rangle$$

$$C(4,0) \rightarrow C'(7,1)$$

9. A. Triangle TAP has coordinates $T(-1,4)$, $A(2,4)$, and $P(2,0)$. On the set of axes below, graph and label $\Delta T'A'P'$, the image of ΔTAP after the translation $(x,y) \rightarrow (x-5,y-1)$.

B. Graph the vector that illustrates this translation.

