Graph △XYZ with vertices X(−4, −4), Y(−3, −1), and Z(2, −2). Then graph the image of △XYZ after each translation, and write the coordinates of its vertices. (Example 1)

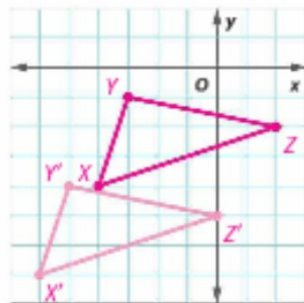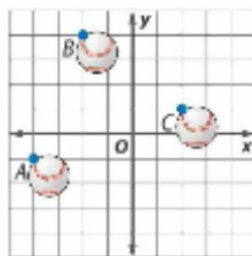**1.** 3 units right and 4 units up

X'(−1, 0), Y'(0, 3), Z'(5, 2)
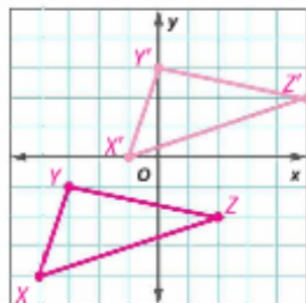
2. 2 units left and 3 units down

X'(−6, −7), Y'(−5, −4), Z'(0, −5)

3. The baseball at the right was filmed using stop-motion animation so it appears to be thrown in the air. Use translation notation to describe the translation from point A to point B. (Example 3)

(x + 2, y + 5)

4. Quadrilateral DEFG has vertices at D(1, 0), E(−2, −2), F(2, 4), and G(6, −3). Find the vertices of D'E'F'G' after a translation of 4 units right and 5 units down. (Example 2)

Sample answer: D'(5, −5), E'(2, −7), F'(6, −1),

and G'(10, −8)

5. ⊜ **Building on the Essential Question** How are figures translated on the coordinate plane?

Sample answer: They are slid up or down and right

or left.

Rate Yourself!

Are you ready to move on?
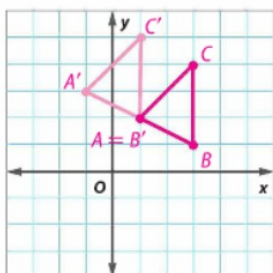Shade the section that applies.

YES   ?   NO

Graph each figure with the given vertices. Then graph the image of the figure after the indicated translation, and write the coordinates of its vertices. (Example 1)
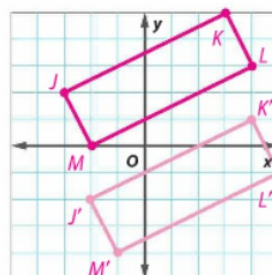
1. $\triangle ABC$ with vertices $A(1, 2)$, $B(3, 1)$, and $C(3, 4)$ translated 2 units left and 1 unit up

$A'(-1, 3)$, $B'(1, 2)$, $C'(1, 5)$

2. rectangle $JKLM$ with vertices $J(-3, 2)$, $K(3, 5)$, $L(4, 3)$, and $M(-2, 0)$ translated 1 unit right and 4 units down

$J'(-2, -2)$, $K'(4, 1)$, $L'(5, -1)$, $M'(-1, -4)$

Triangle PQR has vertices $P(0, 0)$, $Q(5, -2)$, and $R(-3, 6)$. Find the vertices of $P'Q'R'$ after each translation. (Example 2)

3. 6 units right and 5 units up $P'(6, 5)$, $Q'(11, 3)$, $R'(3, 11)$

4. 8 units left and 1 unit down $P'(-8, -1)$, $Q'(-3, -3)$, $R'(-11, 5)$

Use the image of the race car at the right. (Example 3)
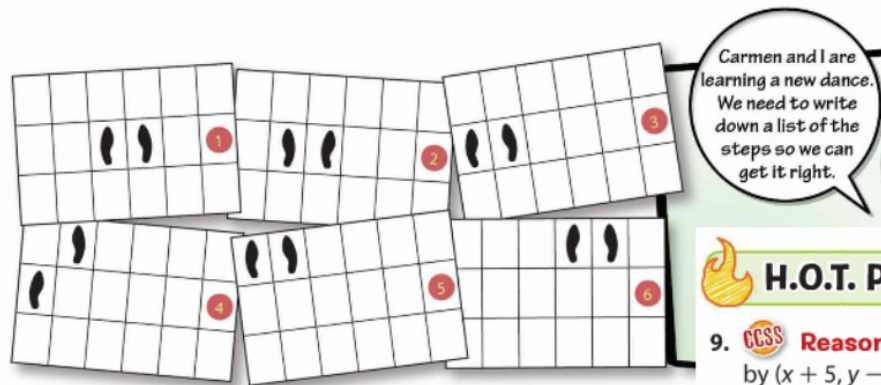
5. Use translation notation to describe the translation from point A to point B. $(x - 3, y - 3)$

6. Use translation notation to describe the translation from point B to point C. $(x - 2, y - 4)$
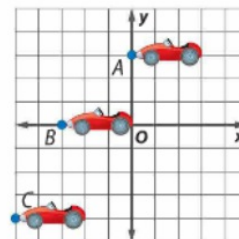
7. Quadrilateral $KLMN$ has vertices $K(-2, -2)$, $L(1, 1)$, $M(0, 4)$, and $N(-3, 5)$. It is first translated by $(x + 2, y - 1)$ and then translated by $(x - 3, y + 4)$. When a figure is translated twice, a double prime symbol is used. Find the coordinates of quadrilateral $K''L''M''N''$ after both translations.

$K''(-3, 1)$, $L''(0, 4)$, $M''(-1, 7)$, $N''(-4, 8)$

8. **CCSS** **Model with Mathematics** Refer to the graphic novel frame below. List the five steps the girls should take and identify any transformations used in the dance steps. **Sample answer: right crosses over left; left crosses behind right; right forward one step; left forward one step; both hop three to the right; Steps and hops are translations.**

Carmen and I are learning a new dance. We need to write down a list of the steps so we can get it right.

H.O.T. Problems Higher Order Thinking

9. **CCSS** **Reason Inductively** A figure is translated by $(x - 5, y + 7)$, then by $(x + 5, y - 7)$. Without graphing, what is the final position of the figure? Explain your reasoning to a classmate. **the same as the original position of the figure; Sample answer: Since −5 and 5 are opposites, and −7 and 7 are opposites, the translations cancel each other out.**

10. **CCSS** **Persevere with Problems** What are the coordinates of the point (x, y) after being translated m units left and n units up? **$(x − m, y + n)$**

11. **CCSS** **Reason Inductively** Determine whether each of the following statements is *always*, *sometimes*, or *never* true. Justify your reasoning.

a. A translation preserves orientation. **always; Sample answer: Each point moves the same distance and in the same direction.**

b. A preimage and its translated image are the same size, but not the same shape. **never; Sample answer: A preimage and image in a translation will always have the same size and shape.**