

## Notes 9.1 Translations

A **transformation** maps an initial figure, called a preimage, onto a final figure, called an image. Below are some of the types of transformations. The red lines show some corresponding points.

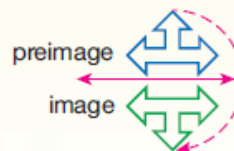
### translation

A figure can be slid in any direction.



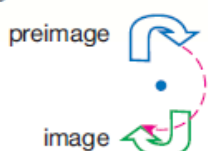
### reflection

A figure can be flipped over a line.



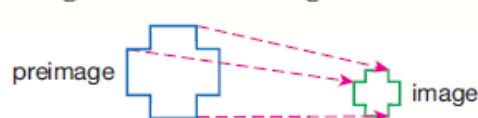
### rotation

A figure can be turned around a point.



### dilation

A figure can be enlarged or reduced.



**TRANSLATIONS USING COORDINATES** A **translation** is a transformation that moves all points of a figure the same distance in the same direction. Translations on the coordinate plane can be drawn if you know the direction and how far the figure is moving horizontally and/or vertically. For the fixed values of  $a$  and  $b$ , a translation moves every point  $P(x, y)$  of a plane figure to an image  $P'(x + a, y + b)$ . One way to symbolize a transformation is to write  $(x, y) \rightarrow (x + a, y + b)$ .

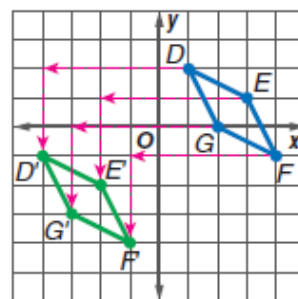
In the figure, quadrilateral  $DEFG$  has been translated 5 units to the left and three units down. This can be written as  $(x, y) \rightarrow (x - 5, y - 3)$ .

$$D(1, 2) \rightarrow D'(1 - 5, 2 - 3) \text{ or } D'(-4, -1)$$

$$E(3, 1) \rightarrow E'(3 - 5, 1 - 3) \text{ or } E'(-2, -2)$$

$$F(4, -1) \rightarrow F'(4 - 5, -1 - 3) \text{ or } F'(-1, -4)$$

$$G(2, 0) \rightarrow G'(2 - 5, 0 - 3) \text{ or } G'(-3, -3)$$



### Example 1 Translations in the Coordinate Plane

Rectangle  $PQRS$  has vertices  $P(-3, 5)$ ,  $Q(-4, 2)$ ,  $R(3, 0)$ , and  $S(4, 3)$ . Graph  $PQRS$  and its image for the translation  $(x, y) \rightarrow (x + 8, y - 5)$ .

This translation moved every point of the preimage 8 units right and 5 units down.

$$P(-3, 5) \rightarrow P'(-3 + 8, 5 - 5) \text{ or } P'(5, 0)$$

$$Q(-4, 2) \rightarrow Q'(-4 + 8, 2 - 5) \text{ or } Q'(4, -3)$$

$$R(3, 0) \rightarrow R'(3 + 8, 0 - 5) \text{ or } R'(11, -5)$$

$$S(4, 3) \rightarrow S'(4 + 8, 3 - 5) \text{ or } S'(12, -2)$$

Plot the translated vertices and connect to form rectangle  $P'Q'R'S'$ .

