Study Guide – Rules for Transformations on a Coordinate Plane

Translations: one type of transformation where a geometric figure is "**slide"** horizontally, vertically, or both. Sliding a polygon to a new position without turning it. When translating a figure, every point of the original figure is moved the same distance and in the same direction.

Rules: A **positive** integer describes a translation **right or up** on a coordinate plane.
A **negative** integer describes a translation **left or down** on a coordinate plane.
*A movement **left or right** is on the **x**-axis. A movement **up or down** is on the **y**-axis.

Example 1: Translate trapezoid HIJK 3 units left and 5 units up. This can also be written as (-3, 5), or (x - 3, y + 5)

Example 2: Translate triangle ABC 5 units left and 1 unit up. This can be written as (-5, 1), or (x – 5, y + 1)

Example 3: Trapezoid GHIJ has vertices G(-4,1), H(-4,3), I(-2,3), and J(-1,1). Find the vertices of trapezoid G'H'I'J' after a translation of 5 units right and 3 units down. Then graph the figure and its translated image.

G(-4,1)	(x + 5, y – 3)	G'(-4 + 5, 1 – 3)	G'(1, -2)
H(-4,3)	(x + 5, y – 3)	H'(-4 + 5, 3 – 3)	H' (1,0)
I(-2,3)	(x + 5, y – 3)	I' (-2 + 5, 3 – 3)	I' (3,0)
J(-1,1)	(x + 5, y – 3)	J' (-1 + 5, 1 – 3)	J' (4,-2)

Reflections: A type of transformation where a figure is **"flipped"** over a line of symmetry. A reflection produces a mirror image of a figure.

Rules: **Reflect a figure over the x-axis**- when reflecting over the x-axis, change the y-coordinates to their opposites. **(x, -y)**
Reflect a figure over the y-axis- when reflecting over the y-axis, change the x-coordinates to their opposites. **(-x, y)**

Example 1: Triangle ABC has vertices A(5,2), B(1,3), and C(-1,1). Find the coordinates of ABC after a reflection over the x-axis.

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

Example 2: Quadrilateral KLMN has vertices K(2,3), L(5,1), M(4,-2), and N(1,-1). Find the coordinates of KLMN after a reflection over the y-axis. Then graph the figure and its reflected image.

K(2,3)	(-x, y)	K'(-2,3)
L(5,1)	(-x, y)	L'(-5, 1)
M(4,-2)	(-x, y)	M'(-4,-2)
N(1,-1)	(-x, y)	N'(-1,-1)

<u>Rotations:</u> A transformation that **"turns"** a figure about a fixed point at a given angle and a given direction.

Rules: **90 degree** clockwise rotation around the origin (0,0), use: **(y, -x)**
180 degree rotation around the origin (0,0), use: **(-x, -y)**
270 degree clockwise rotation around the origin (0,0), use: **(-y, x)**

Example 1: Triangle NPQ has vertices N(0,0), P(4,-1), and Q(4,2). Rotate clockwise 90 degrees.

N(0,0)	(y, -x)	N'(0 ,0)
P(4,-1)	(y, -x)	P'(-1, -4)
Q(4,2)	(y, -x)	Q'(2, -4)

Example 2: Triangle KLM has vertices K(1,0), L(4,2), and M(3,4). Rotate 180 degrees.

K(1,0)	(-x, -y)	K'(-1,0)
L(4,2)	(-x, -y)	L'(-4,-2)
M(3,4)	(-x, -y)	M'(-3,-4)

Example 3: Quadrilateral DEFG has vertices D(-1,0), E(-4,1), F(-3,3), and G(0,4). Rotate clockwise 270 degrees. Graph DEFG and D'E'F'G'.

D(-1,0)	(-y, x)	D'(0, -1)
E(-4,1)	(-y, x)	E'(-1, -4)
F(-3,3)	(-y, x)	F'(-3, -3)
G(0,4)	(-y, x)	G'(-4, 0)

<u>Dilations:</u> a transformation that changes the size of a figure, but not the shape.

Rule: To dilate a figure, always **MULTIPLY** the coordinates of each of its points by the percent of dilation.

****First change the percent to a decimal (move the decimal point <u>TWO</u> places to the <u>LEFT.</u>**

****Next, multiply each of the coordinates by that number.**

Example 1: Triangle ABC has vertices A(-2, 2), B(-1, -2), C(-6, 1). What are the new coordinates after a dilation of 150%?

Change the percent to a decimal: <u>150% = 1.50</u>

A'(-2 x 1.5, 2 x 1.5) B'(-1 x 1.5, -2 x 1.5) C'(-6 x 1.5, 1 x 1.5)

A'(-3, 3) B'(-1.5, -3) C'(-9, 1.5)

Example 2: Triangle XYZ has vertices X(-4, 3), Y(2, 3), Z(-3, 1). What are the new coordinates after a dilation of 75%?

Change the percent to a decimal, then multiply: <u>75% = .75</u>

X'(-4 x .75, 3 x .75) Y'(2 x .75, 3 x .75) Z'(-3 x .75, 1 x .75)

X'(-3, 2.25) Y'(1.5, 2.25) Z'(-2.25, .75)

Example 3: Triangle XYZ has vertices X(12, 20), Y(24, 4), Z(4, 16). If the new coordinates after a dilation are X'(3, 5), Y'(6, 1), Z'(1, 4), what was the percent of dilation?

Rule: Divide the coordinates of the image by the coordinates of the original figure to determine the percent of dilation.

X (3/12, 5/20) Y (6/24, 1/4) Z(1/4, 4/16)

Percent of Dilation: 25%