## Integrated Algebra A
### Packet 1

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“Your grades reflect your hard work!”
COORDINATE PLANE

Let's label the axes, quadrants, and signs on the following grid:

The x-axis is the __________________________ axis.

The y-axis is the __________________________ axis.

Another name for the point (0, 0) is the __________________________.

Using the grid below, let's plot the following points and label them with the letter:

a) (2, 1)  
b) (0, 0)  
c) (-4, 3)  
d) (-2, -5)  
e) (1, -3)  
f) (0, 4)  
g) (-5, 1)  
h) (-2, 0)

Give the quadrant each set of coordinates lies in:

a) (1, 5) _______  b) (-2, 4) _______  c) (-3, 2) _______  d) (4, -4) _______
Classwork:

1. Graph each point on a coordinate plane. Label the points A-D.

   \[ \begin{align*}
   &A (2, 5) \\
   &B (0, 4) \\
   &C (-1, 2) \\
   &D (2, -3)
   \end{align*} \]

2. Give the coordinates of the following points:

   \[ \begin{align*}
   &A ( , ) \\
   &B ( , ) \\
   &C ( , ) \\
   &D ( , ) \\
   &E ( , ) \\
   &F ( , ) \\
   &G ( , ) \\
   &H ( , )
   \end{align*} \]

3. Give the quadrant that the following points lie in:

   a) \((2, -7)\) ________  d) \((1, 4)\) ________
   
   b) \((-6, -5)\) ________  e) \((-3, 2)\) ________
   
   c) \((2, 5)\) ________  f) \((10, -15)\) ________
1. Setup the given grid with axes and labels. Label all the quadrants.

2. Setup the graph with the axes. Graph the following points and label them on the graph with the given letter.

   I (0, 0)
   L (3, 4)
   O (-6, 4)
   V (3, -2)
   E (0, 5)
   M (-2, -1)
   A (-3, 0)
   T (1, 1)
   H (0, -2)

Turn over and complete other side
Graphing Ordered Pairs

(x, y) = (1, -2) Over 1 and down 2
(x, y) = (-3, 4) Over 3 and up 4
(x, y) = (2, -2) Over 2 and down 2

Label the following points.

A (-1, -6)  B (-3, -3)  C (-6, 1)  D (-4, 2)  E (-6, 2)  F (-5, 6)  G (-1, 3)  H (2, -8)  I (6, -4)  J (-9, 5)  K (-1, -1)  L (-1, 0)  M (6, 6)
CONNECTING POINTS TO MAKE FIGURES

Sometimes, when you connect points, they make a figure, like a square, rectangle, triangle, etc.! Let’s try...

1) a) Plot the following points on the grid below: A(3, 2), B(-3, 2), C(-3,-2), and D(3,-2).

b) Now, connect them.

c) What kind of shape do they make?

_____________________

d) Can you find the area of this figure?

Note: Points A and B have the same ____-coordinate.

Also, Points A and D have the same ____-coordinate.

2) a) Plot the following points on the grid below: A(4, 1), B(1, 5), and C(-2, 1).

b) Now, connect them.

c) What type of polygon do they make?

_____________________

d) Find the area of this figure:
3) Graph the points A(1, 1), B(5, 1), C(5, 4). What must be the coordinates of point D if ABCD is a **rectangle**?

![Graph of points A(1, 1), B(5, 1), C(5, 4)]

D( , )

4) Graph the points P(-2, -4) and Q(2, -4). What are the coordinates of R and S if PQRS is a **square**? (Two answers are possible).

![Graph of points P(-2, -4) and Q(2, -4)]

R( , )
S( , )

**Review:**
Write the ordered pairs that correspond to the points labeled A, B, C, and D in the coordinate plane.

<table>
<thead>
<tr>
<th>1) A( , )</th>
<th>2) A( , )</th>
<th>3) A( , )</th>
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<tr>
<td>B( , )</td>
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<td>C( , )</td>
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<td>D( , )</td>
<td>D( , )</td>
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Question 1:
Which is true of all points in the second quadrant?

(1) positive x-coordinate; positive y-coordinate
(2) negative x-coordinate; negative y-coordinate
(3) negative x-coordinate; positive y-coordinate
(4) positive x-coordinate; negative y-coordinate

Question 2:
Which point lies in the third quadrant?

(1) P(0,-5) (2) Q(-5,-11)
(3) R(-5,0) (4) T(-5,11)

Question 3:
a) Graph and connect the given points: A(1,7), B(1,2), and C(5,2).
b) Identify the figure (shape):

_________________________________

c) Find the area of the figure:

Question 4:
a) Graph and connect the given points: P(-1,3), Q(5,3), R(5,-2), and S(-1,-2).
b) Identify the figure (shape):

_________________________________

c) Find the area of the figure:
Find the missing point.

Write the names of the missing points. The first shape is supposed to be a square. There are only three points on the graph. How many points would you need to draw a square? A square has four corners. So the graph needs one more point to finish the square. Connect the points already on the graph to begin drawing the square. Where should the fourth point be placed to make the fourth corner? Each graph has part of a shape. Finish the shape. Write the names of the missing points.

1. Shape: Square
   Missing Point: (____, ____)

2. Shape: Rectangle
   Missing Point: (____, ____)

3. Shape: Square
   Missing Point: (____, ____)

4. Shape: Rectangle
   Missing Point: (____, ____)

5. Shape: Square
   Missing Point: (____, ____)

6. Shape: Rectangle
   Missing Points: (____, ____)
   (____, ____)

   Shape: Rectangle
   Missing Points: (____, ____)
   (____, ____)}
**Transformation Terms**

1) **Preimage** – ____________________________________________________________

2) **Image** – ____________________________________________________________

3) **Transformation** – __________________________________________________

4) **Translation** – ________________________________________________________

5) **Reflection** – _________________________________________________________

6) **Dilation** – ___________________________________________________________

7) **Congruent** – _________________________________________________________

**Symmetry Terms**

1) **Line Symmetry** – ______________________________________________________

2) **Point Symmetry** – ____________________________________________________
Translation: a “slide” of the figure
-every point shifts the same distance, in the same direction

1. a. On the graph, draw and label ΔABC, whose vertices have the coordinates A(1, 1), B(6, 2), and C(4, 4).
   b. Under the translation (x, y) → (x - 4, y + 2), on the same graph, draw and label ΔA'B'C'.
   c. Map the Translation
      A(1, 1) →
      B(6, 2) →
      C(4, 4) →

   Another way of notating a translation is with a capital T:
   RULE: \( T_{a,b}(x, y) = (x + a, y + b) \)

2. a. Graph the original triangle and the image of ΔDEF under the translation \( T_{3,-1} \).
   b. Rewritten as:
   c. Map the translation:
      D(0, 2) →
      E(1, -3) →
      F(3, -1) →

3. Rewrite the translation in a different form:
   a. \( T_{-2,5} \) - ____________________
   b. \( (x, y) \rightarrow (x + 4, y - 1) \) - __________

4. Does the image remain congruent after a translation? Explain your answer.
5. The rule for the translation so the image of A is $A\rightarrow A'$ is: $A(2, 5) \rightarrow A'(-1, 1)$

- a) $T_{1,-4}$
- b) $T_{3,-4}$
- c) $T_{3,4}$
- d) $T_{-1,4}$

6. Which point is the image of $P(4, -3)$ under the translation $P(x, y) \rightarrow P'(x - 4, y)$?

- a) $P'(-8, 0)$
- b) $P'(8, -3)$
- c) $P'(0, -3)$
- d) $P'(0, 0)$

7. a. Graph
   
   b. $T_{2,-3}$
   
   - $H(-2, 0) \rightarrow$
   - $O(0, 0) \rightarrow$
   - $T(0, 4) \rightarrow$
1. a. The coordinates of ΔABC are A(0, -2), B(3, 1), and C(4, -3).
   Graph and label these points.
   
   b. Under the translation 
   \((x, y) \rightarrow (x + 1, y - 3)\), draw and label 
   ΔA'B'C'.
   
   c. Map the Translation

2. a. Graph the image of ΔBUG under the translation T_{2, 4}.
   
   b. Map the translation:
   B(-2, -3) \rightarrow
   U(1, 0) \rightarrow
   G(3, -4) \rightarrow

3. Which of the following is the rule of the translation in which every point moves 6 units to the right on a graph?
   a) \((x, y) \rightarrow (x, y + 6)\)  
   b) \((x, y) \rightarrow (x + 6, y)\)  
   c) \((x, y) \rightarrow (x + 6, y + 6)\)  
   d) \((x, y) \rightarrow (x - 6, y)\)

4. Which quadrant does the point (-2, 4) lie in? _____
**Reflections** [“Flips” or “Mirror”]

**Line Reflection:**
Pre-image to Image
A → _____
E → _____
D → _____

**Reflection in the (Y-axis):**
Plot the following points and connect them, making a triangle.

A (1,2) → A’ (                )
B (3,4) → B’ (                )
C (1,5) → C’ (                )

The _____-coordinate stays the same, while the _____-coordinate is the opposite.

**Note:**
- A reflection like this can also be written as \( r_{y\text{-axis}} \).

Is a shape congruent after a reflection? __________
**Reflection in the X-axis:**

Plot the following points and connect them, making a triangle.

A (1,2) → A' (   )
B (3,4) → B' (   )
C (1,5) → C' (   )

The ____-coordinate stays the same, while the ____-coordinate is the opposite.

**NOTE:**
- A reflection like this can also be written as $r_{x\text{-axis}}$.

**Practice Exercise:** On the grid below:

Label all points on graph!!!

a) Plot A (3,-1).
b) Plot A', the image of A under a reflection in the y-axis, and write its coordinates.
c) Plot B (-2, -5).
c) Plot B', the image of B under the reflection in the x-axis, and write its coordinates.
1. Graph and write the coordinates of the image of point P(5, -4) under each transformation:

   a) a reflection in the x-axis: (       ,       )

   b) a reflection in the y-axis: (       ,       )

   c) a translation that moves the point 3 units to the left and 6 units up: (       ,       )

2. On the grid below, draw \( \triangle ABC \) whose vertices are A(1, 1), B(7, 1), and C(4, 5).

   a) Draw \( \triangle A'B'C' \), the image of \( \triangle ABC \) under a reflection in the y-axis.

   b) Write the coordinates of \( A', B', \) and \( C' \):

      \[
      A'(     ) \\
      B'(     ) \\
      C'(     )
      \]
3. Draw rectangle PQRS whose vertices are P(-5,-2), Q(5,-2), R(5,-6), and S(-5,6). What are the coordinates of the vertices of rectangle $P'Q'R'S'$, the image of the original rectangle after a reflection in the x-axis? [Hint: Take each point one at a time!!]

\[ P' ( ) \]
\[ Q' ( ) \]
\[ R' ( ) \]
\[ S' ( ) \]

4. Another word for the point (0,0) is the ____________________.

5. a. A short hint word to describe translations is a “__________”.
   b. A short hint word to describe reflections is a “__________”.

6. Another way of writing “reflection in the y-axis” is ________________.

7. A shortcut way of writing the following translation: $(x, y) \rightarrow (x-1, y+2)$ is ________.

8. True or False (circle one): Translations preserve congruence of the original image.

9. True or False (circle one): Reflections preserve congruence of the original image.

**BONUS:**

\[ P(1,5) \overset{r_{x-axis}}{\rightarrow} P' \overset{T_{3,-2}}{\rightarrow} P'' \overset{r_{y-axis}}{\rightarrow} P''' \]
**Line Symmetry**

1. Can you draw one straight line or many straight lines of symmetry through each picture so that it looks the same on both sides of the line? (It is also possible to have zero lines of symmetry).

   a. ![Arrow]
   b. ![Smiley Face]
   c. ![Lightning Bolt]
   d. ![Star]

   How many lines of symmetry does each one have? a.__ b.__ c.__ d.__

2. Use the letters of the alphabet displayed here to answer the following questions:

   A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

   a. Which letters have vertical line symmetry? _______________________
   b. Which letters have horizontal line symmetry? _______________________
   c. Which letters have both vertical and horizontal line symmetry? ______
   d. Which letters have neither? ________________________________

**Point Symmetry**

*Figures with point symmetry look exactly the same when flipped completely upside-down.

1. Which shapes have point symmetry? ________________________________

   ![Star]  ![Diamond]  ![Heart]  ![Sun]  ![Octagon]

2. Circle the ones below that have point symmetry! **Challenge:** Do any of these words also have line symmetry? ________________________________

   WOW   OTTO   un   SOS   OHHO
   pop   mom   SWIMS
1. Which letter has point symmetry?
   a) A  b) N  c) L  d) W

2. Which letter has line symmetry but not point symmetry?
   a) H  b) J  c) K  d) R

3. Draw all lines of symmetry on the figures below.
   a)  
   b)  
   c)  

4. Graph the following points on the given graph.
   A (-3, 0)
   B (6, 5)
   C (0, 0)
   D (-3, 3)
   E (0, -2)

5. Which quadrant does the point (15, 26) lie in? ________

6. Rewrite (x, y) \to (x - 5, y) in another form: ________

7. What does $r_{x-axis}$ stand for when working with transformations? ____________________
DILATIONS

Translations and reflections are transformations that do ________ change the size or shape of a figure [the image is __________________ to the pre-image].

A dilation is a transformation that changes the size, but not the shape, of a figure. A dilation can “enlarge” or “reduce” a figure.

Examples: The eye doctor may put drops in your eyes to dilate your pupils.

Scale Factor: Describes how much a figure is enlarged or reduced. This number is multiplied by the original coordinates (or measurements) to come up with the new coordinates. [See Examples 1 and 2 below.]

Simple Example:

EXAMPLE 1: Enlargement (Scale Factor is greater than 1):

1. a. Plot and connect the following points to make \( \triangle ABC \):
   
   A(4, 8), B(3, 2), and C(5, 2).

   b. Dilate the figure by a scale factor of 2 [notated as \( D_2 \)].

   c. List the vertices of the image:
      
      A(4, 8) \( \rightarrow \) \( A' \) (                   )

      B(3, 2) \( \rightarrow \) \( B' \) (                   )

      C(5, 2) \( \rightarrow \) \( C' \) (                   )

What is the scale factor here? _____
EXAMPLE 2: Reduction (Scale Factor is less than 1; it is a fraction):

2. a. Plot and connect the following points to make $\triangle ABC$: A(6, 10), B(8, 6), and C(10, 8).

b. Dilate the figure by a scale factor of $\frac{1}{2}$.

c. List the vertices of the image:

\[
\begin{align*}
A(6, 10) & \rightarrow A'( \quad ) \\
B(8, 6) & \rightarrow B'( \quad ) \\
C(10, 8) & \rightarrow C'( \quad )
\end{align*}
\]

3. Is the image congruent to the pre-image? Explain your answer.

4. Dilate the following points by the scale factors given:

\[
\begin{align*}
D_4 & \\
A(5, -1) & \rightarrow \\
B(0, -1) & \rightarrow \\
C(-2, -3) & \rightarrow \\
\end{align*}
\]

\[
\begin{align*}
D_{\frac{1}{3}} & \\
A(6, 3) & \rightarrow \\
B(-9, 0) & \rightarrow \\
C(12, 15) & \rightarrow
\end{align*}
\]
1. a. Graph a rectangle with the vertices of A (2,1), B(2,5), C(5,5) and D(5,1).
   b. State the coordinates after a dilation with a scale factor of 3 \([D_3]\).
   c. Map the transformation.

2. The perimeter of a square is 16cm. If the square is dilated by a scale factor of 2, what is the length of each side of the new square?
   **Hint:** A square has four equal sides. So, try to figure out the length of each side of the original square first. **SHOW YOUR WORK AND DRAW PICTURES!!!**
   a) 3 cm    b) 4 cm    c) 16cm    d) 8 cm

3. **Review:**
   If a point moves **4 units to the right** and **2 units down**, how would you write the rule to this translation? [There are two ways to write it]