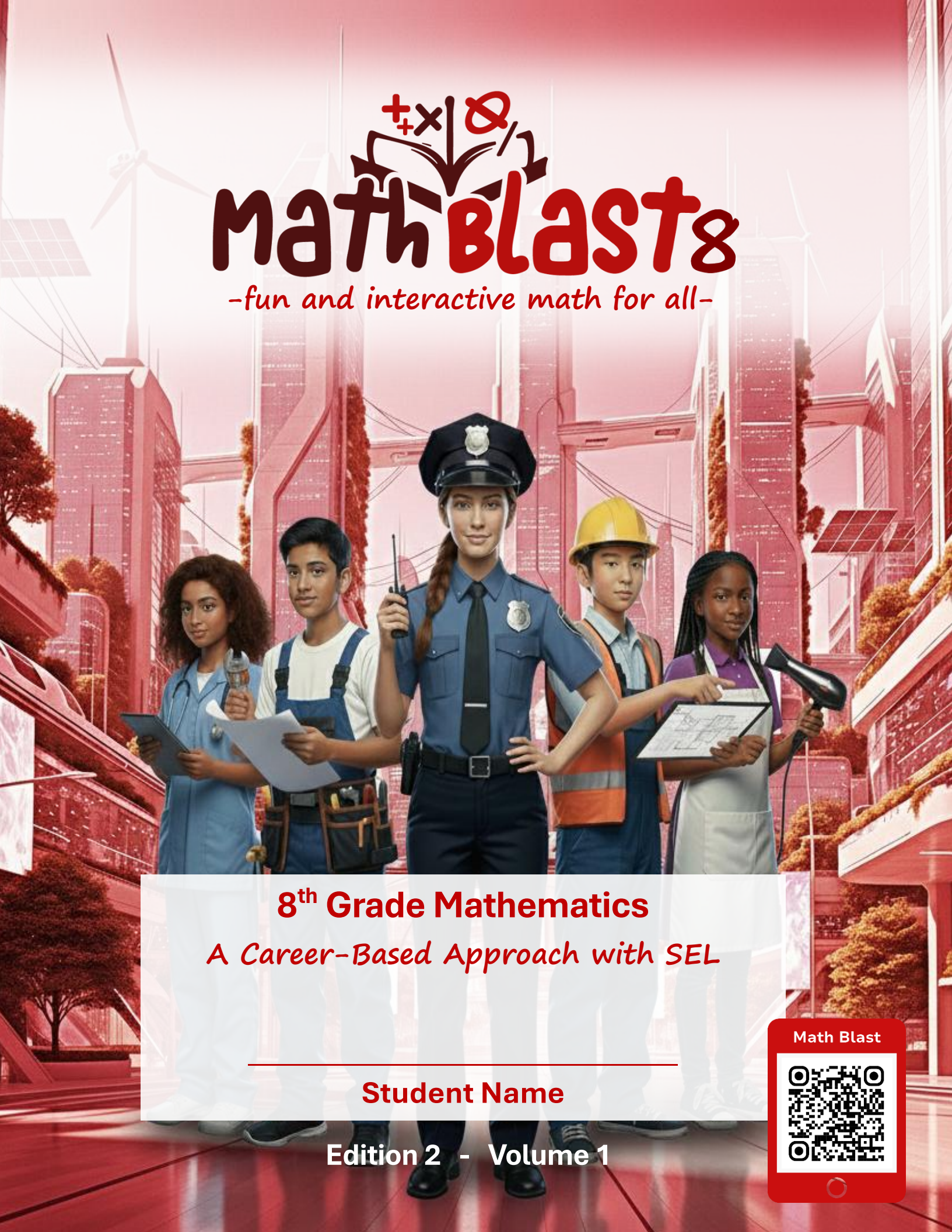
Math Blast 8

-fun and interactive math for all-



8th Grade Mathematics

A Career-Based Approach with SEL

Student Name

Edition 2 - Volume 1

Math Blast

8th Grade Mathematics

A Career-Based Approach

with Social-Emotional Learning

Edition 2

Volume 1

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fun and engaging math for all

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8th Grade Mathematics

North Carolina 8th Grade Math Standards

Unit 1

Understand congruence and similarity using physical models, transparencies, or geometry software.	
NC.8.G.2	Use transformations to define congruence. • Verify experimentally the properties of rotations, reflections, and translations that create congruent figures. • Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations. • Given two congruent figures, describe a sequence that exhibits the congruence between them.

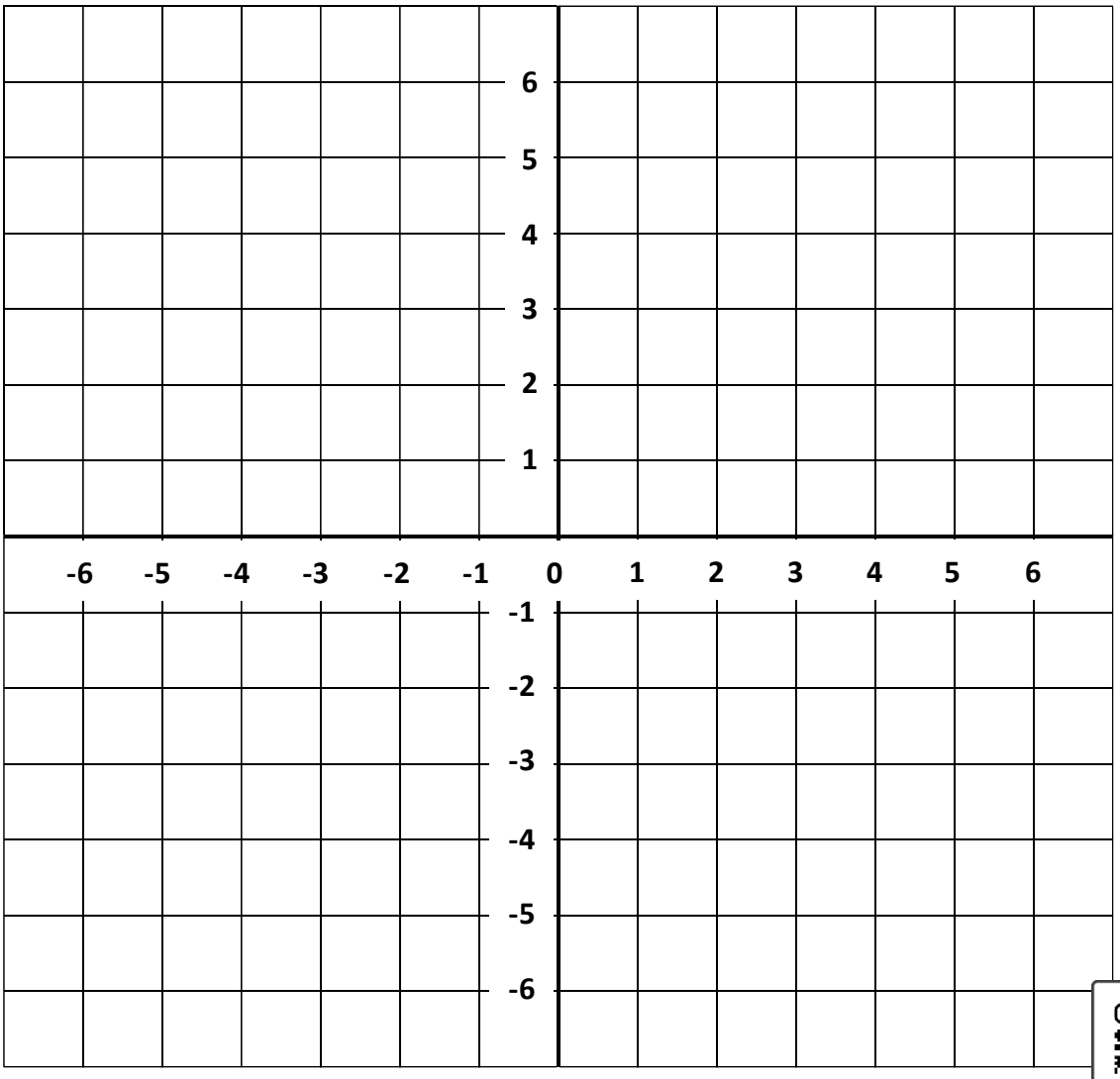
1.1 Translation of Figures

Warm-Up

Write all you know about translations.

Main Topic **Translation of Figures**

Use the cutout. Trace the shape on the Cartesian plane with vertices at $A(-4,-2), B(-3,3)\ and\ C(2,-2)$. Label the vertices.

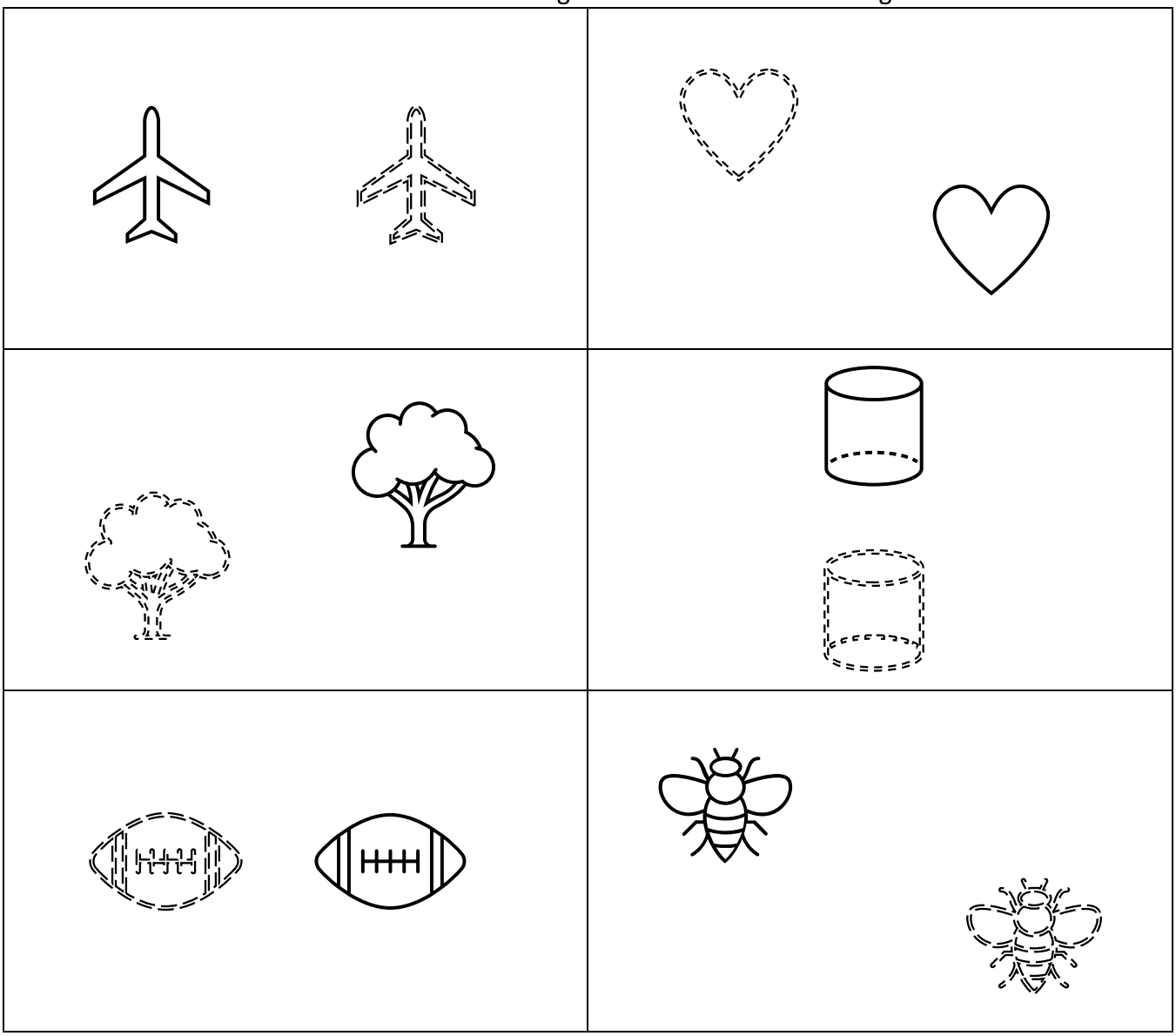


Need Help?

In your own words, write the definition of translation.

Translation

Describe the translations from the solid outline figure to the dashed outline figure.



TASK 1

- Plot and connect points

  $A(5,1), B(5,4), C(1,2).$

- Translate the figure 7 units to the left.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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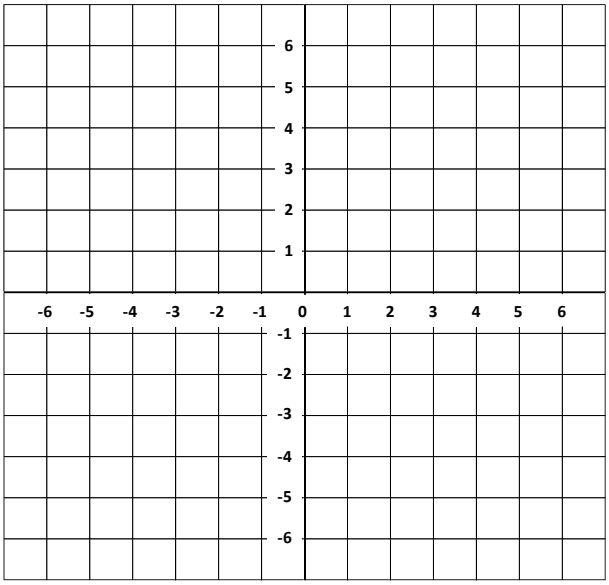

TASK 2

- Plot and connect points

  $A(-5,0), B(-3,4), C(-1,0).$

- Translate the figure 5 units to the right.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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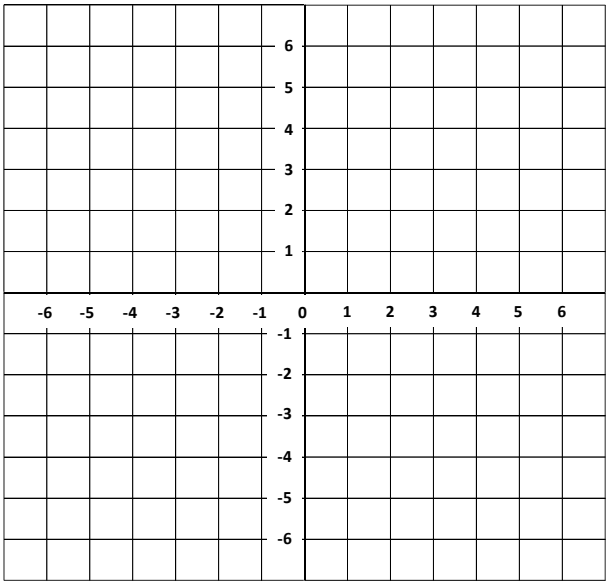

Determine the vertices of the translated figure.

$L(-5,-1), M(-3,4), N(-1,4), O(2,-1)$ Translated 4 units to the right.	$L(-5,-1), M(-3,4), N(-1,4), O(2,-1)$ Translated 4 units to the left.

TASK 3

- Plot and connect points

  $A(5,1), B(5,4), C(1,2).$

- Translate the figure 7 units down.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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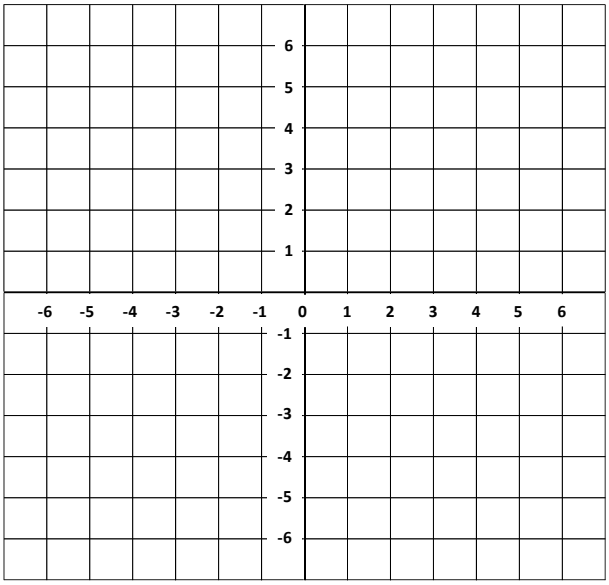

TASK 4

- Plot and connect points

  $A(-5,0), B(-3,4), C(-1,0).$

- Translate the figure 2 units up.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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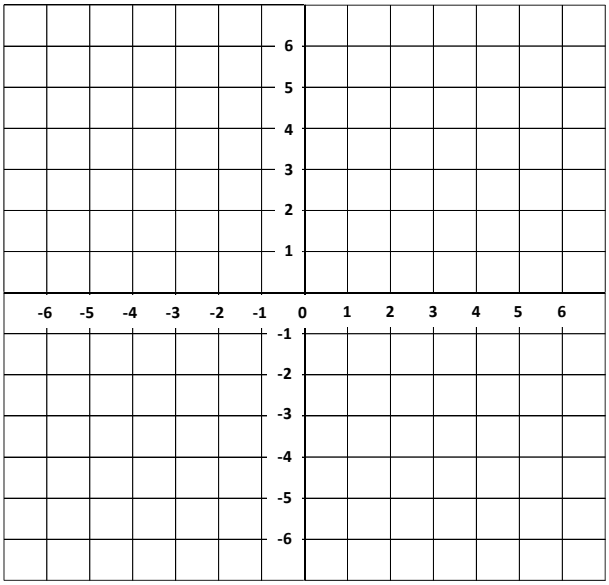
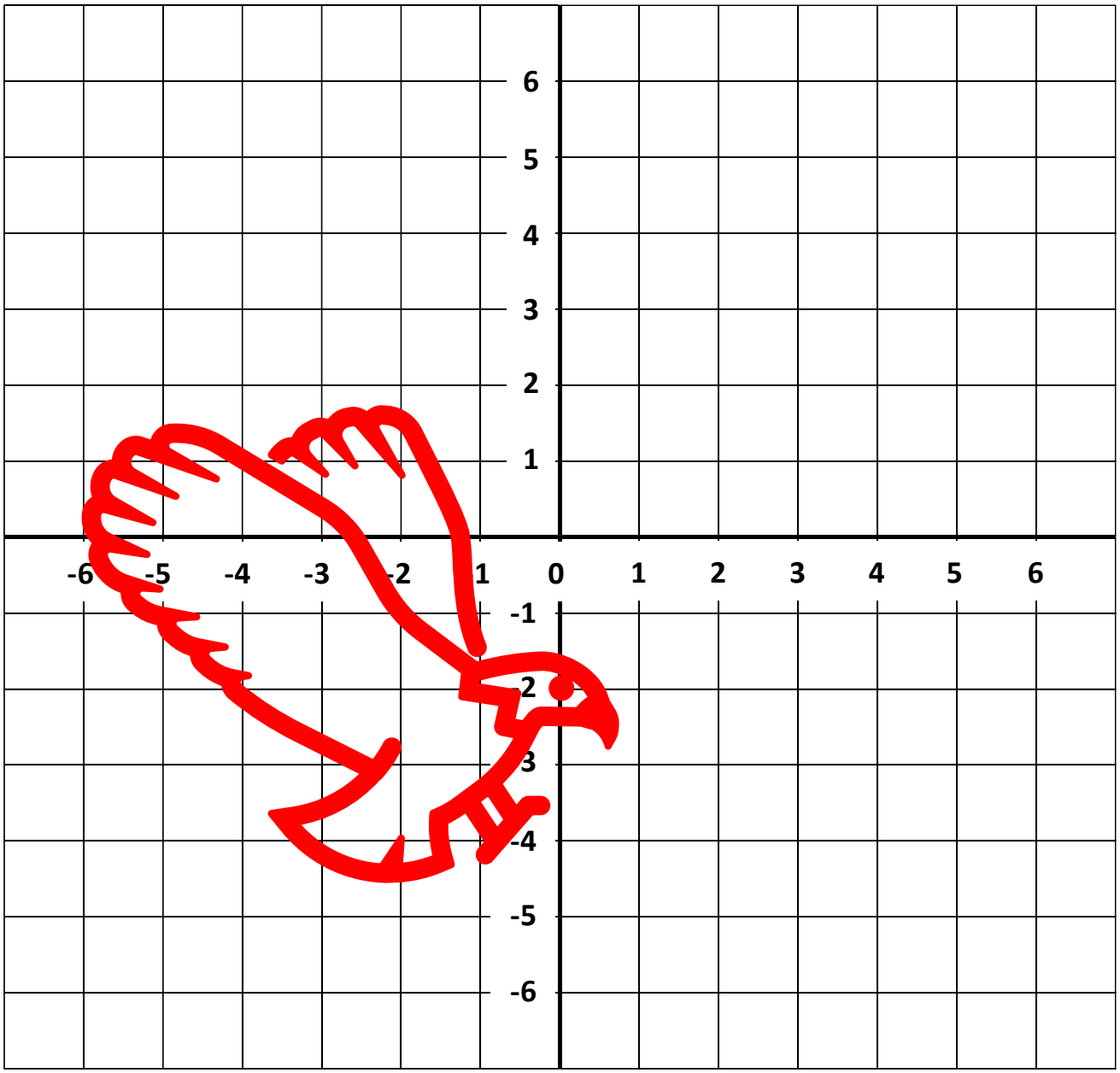


Determine the vertices of the translated figure.

$L(-5,-1), M(-3,4), N(-1,4), O(2,-1)$ Translated 4 units down.	$L(-5,-1), M(-3,4), N(-1,4), O(2,-1)$ Translated 4 units up.

Translation of Figure

Translate the image 5 units to the right and 4 units up.



The School Fair Banner

A student graphic designer is creating a large, rectangular banner for the school fair. The banner's design requires the club's logo to be placed precisely in the upper-left corner and then copied to the lower-right corner without changing its size or orientation.

The Coordinate Grid Setup

The designer models the banner space on a coordinate plane, where one unit equals one inch.

- The total banner size is **120 inches wide** (x-axis) and **40 inches tall** (y-axis).
- The original placement of the club's logo is defined by its top-left corner, which is set at **Point A (10, 30)**.
- The designer wants to place the copied logo's top-left corner at a new location, **Point A' (90, 5).**

Finding the Precise Translation Vector

The designer must determine the exact directional movement (the **translation vector**) needed to move the logo from its original position (Point A) to its final position (Point A') without using the mouse to drag and drop, which could be inaccurate.

1. **Horizontal Change (Δx):** How many inches must the logo be shifted horizontally (left or right)?

2. **Vertical Change (Δy):** How many inches must the logo be shifted vertically (up or down)?

The Conceptual Questions:

1. **Defining the Translation:** What single mathematical operation (subtraction) must be performed on the x-coordinates and the y-coordinates to find the translation vector?

2. **Directional Meaning:** Since the x-change is positive and the y-change is negative, describe the resulting movement of the logo in simple directional terms (e.g., up/down and left/right).

3. **Rigidity:** Why is it crucial that the movement of the logo be a **rigid transformation** (specifically, a translation) in this design context? What would happen if the movement were *not* rigid?

4. **Applying the Vector:** If the logo is a small square defined by the vertices (10, 30), (20, 30), (20, 20), and (10, 20), list the new coordinates of all four vertices after the required translation is applied.

Honors Level

Explain, using precise geometric language, what makes a translation different from other rigid transformations like rotation or reflection.

Why is translation classified as a rigid transformation?
What key properties (size, shape, orientation) are *always* preserved?

If you are given the pre-image coordinate A(2, 7) and the image coordinate A'(-4, 1), how do you algebraically determine the translation vector?

If a line segment has a slope of m, what is the slope of the translated image of that segment, and why?

If a figure is reflected and then translated, why is the resulting transformation not equivalent to a single translation?

SEL Activity

The Identity Slide

Self-Awareness & Relationship Skills

Step 1: The Personal Vector

Think about your "Total Self"—your hobbies, your sense of humor, and your values. Now, think about three different "planes" you move through in a day:

1. **Plane A:** At home with family.
2. **Plane B:** In the hallway with friends.
3. **Plane C:** In this math classroom.

Step 2: Reflective Prompt

Answer the following:

- When you "translate" from Plane B (friends) to Plane C (math class), what part of your "shape" stays exactly the same?

- Does your "orientation" ever change? (e.g., Do you feel you have to hide certain parts of yourself to "fit" into the coordinates of a specific group?)

Step 3: The "Vector of Growth"

If you could translate yourself toward a goal (like being more confident or more kind), what would that "shift" look like on a graph?

- *Example:* Moving +5 units in "Patience" and +3 units in "Participation."

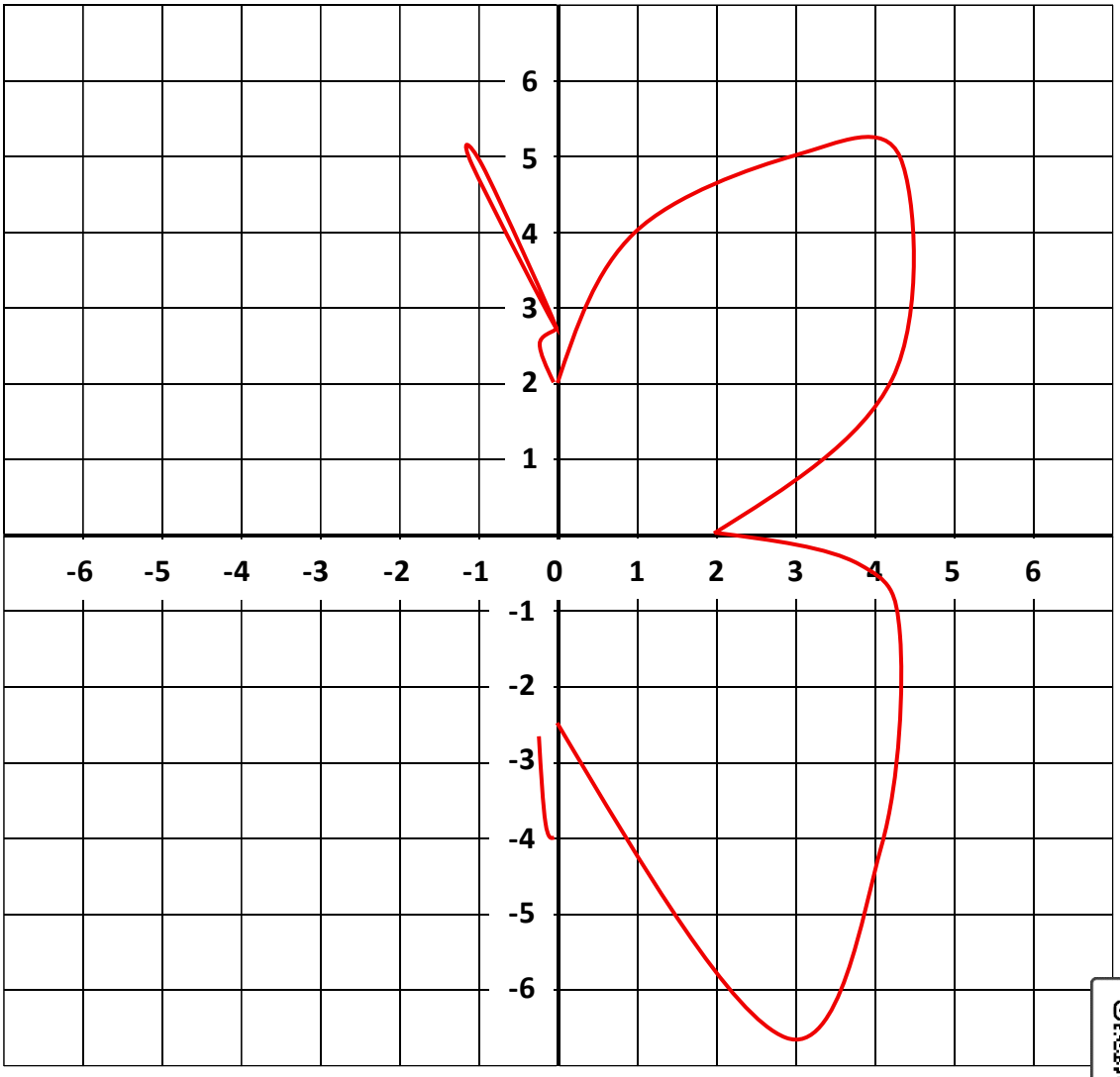
1.2 Reflection of Figures

Warm-Up

Write all you know about reflections.

Main Topic **Reflection of Figures**

Reflect the figures over the y-axis.

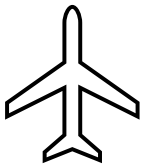
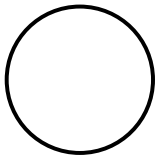
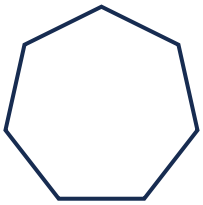
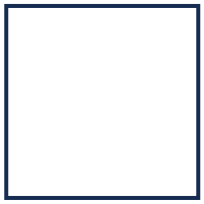


Need Help?

In your own words, write the definition of reflection.

Reflection	

Draw a line that divides the image into equal parts.

TASK 1

- Plot and connect points

  $A(5,1), B(5,4), C(1,2).$

- Reflect the figure of the x-axis.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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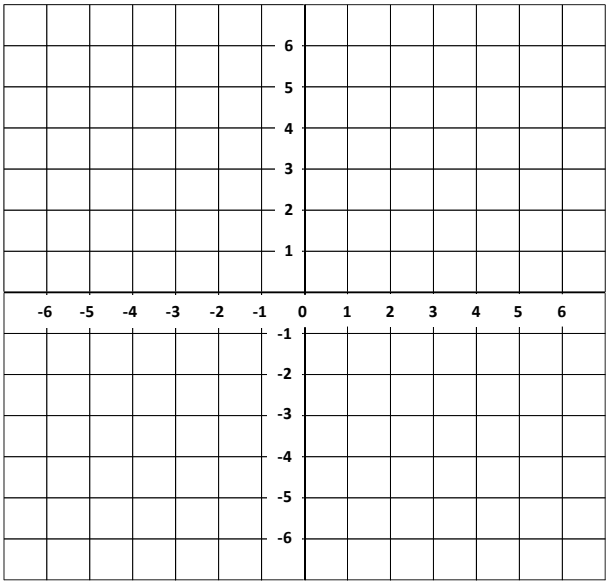

TASK 2

- Plot and connect points

  $A(5,1), B(5,4), C(1,2).$

- Reflect the figure over the y-axis.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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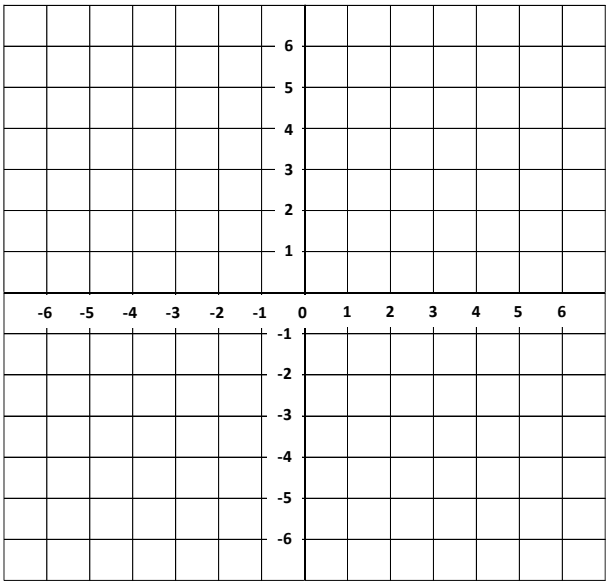

Determine the vertices of the reflected figure.

$L(-5,-1), M(-3,4), N(-1,4), O(-2,-2)$ Reflected over the y-axis	$P(-3,-1), Q(1,-2), R(2,-5), S(-4,-4)$ Reflected over the x-axis

TASK 3

- Plot and connect points

  $A(-4,-2), B(-1,4), C(4,1).$

- Reflect the figure over the x-axis.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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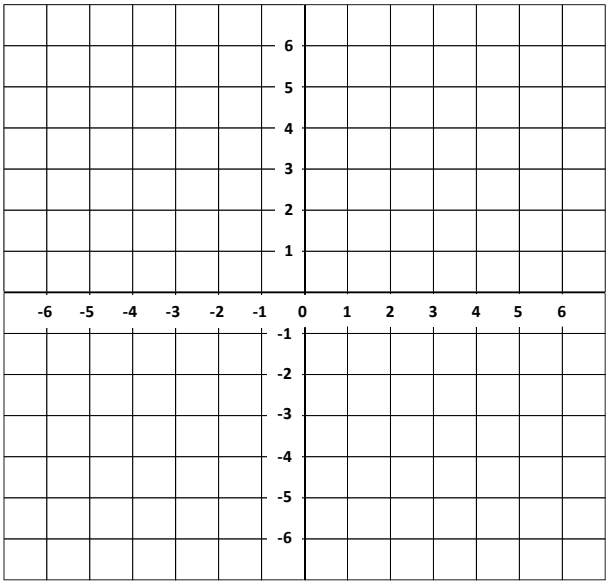

TASK 4

- Plot and connect points

  $A(-4,-2), B(-1,4), C(4,1).$

- Reflect the figure over the y-axis.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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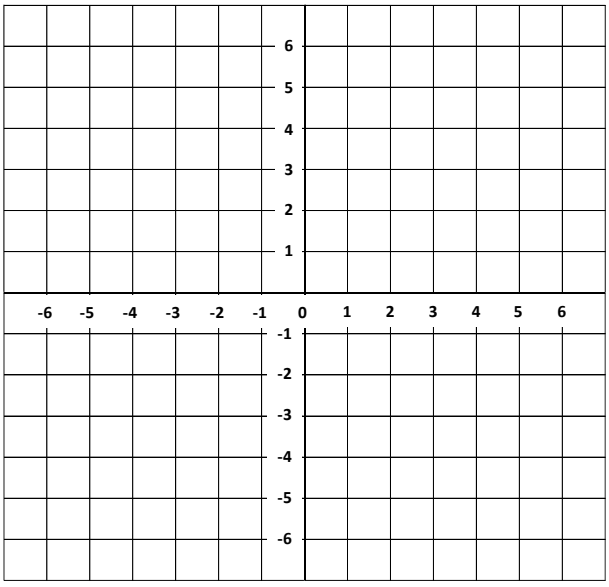
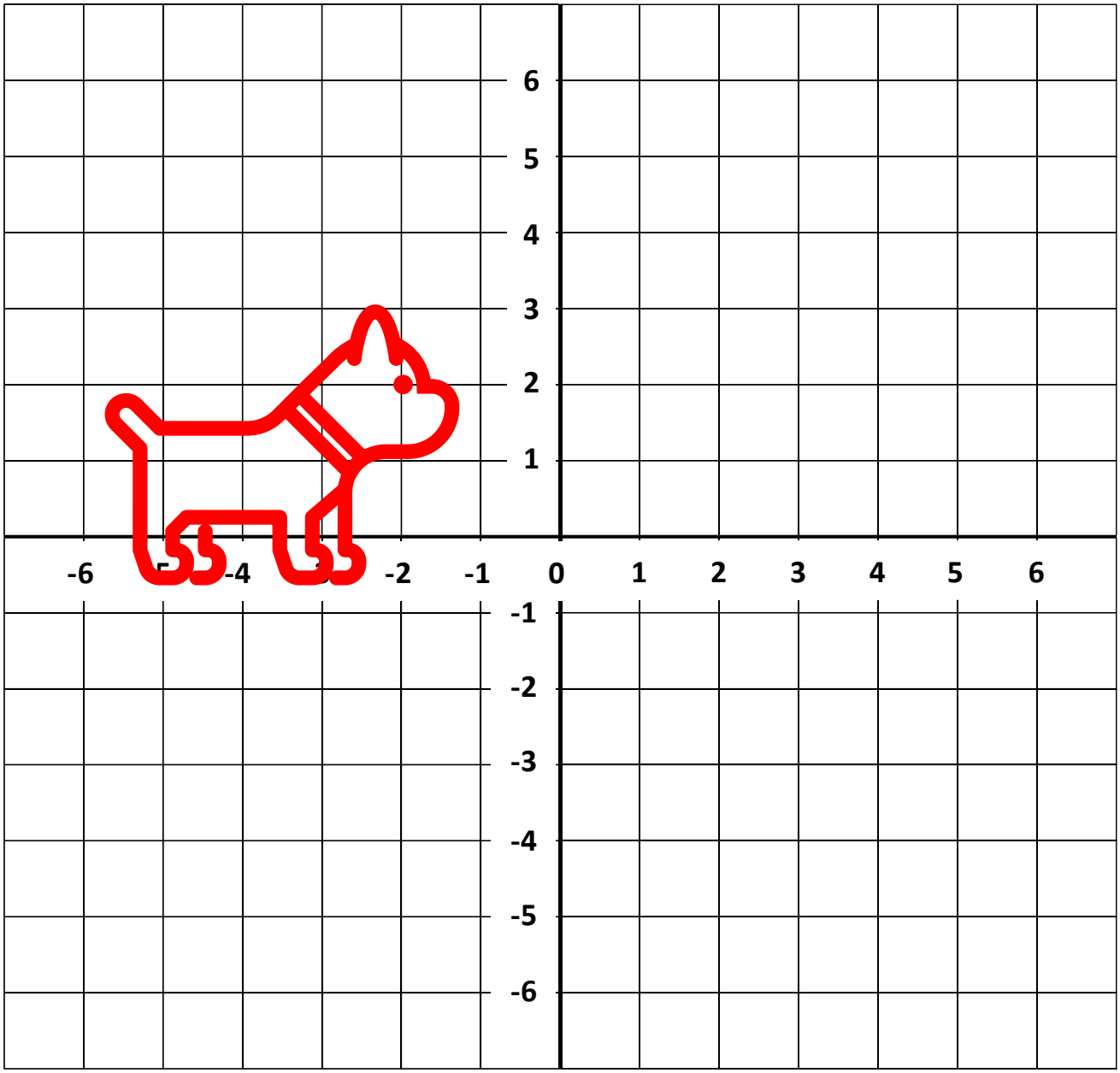


Determine the vertices of the reflected figure.

$L(-3,2), M(2,4), N(5,-3), O(0,-4)$ Reflected over the x-axis	$L(-3,2), M(2,4), N(5,-3), O(0,-4)$ Reflected over the y-axis

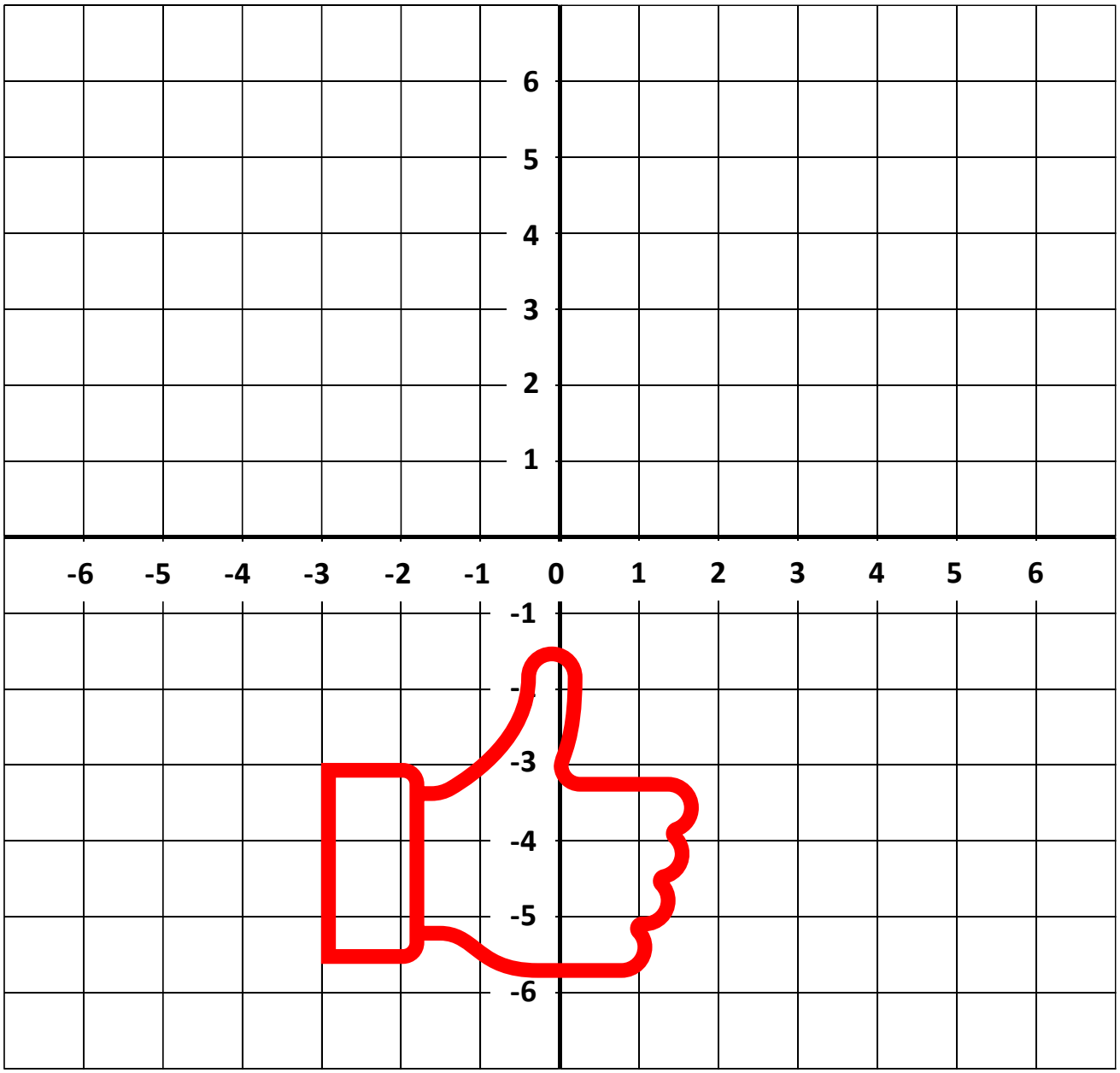
Reflection of Figure

Reflect the image over the y-axis.



Reflection of Figure

Reflect the image over the x-axis.



Honors Level

Explain what makes a reflection fundamentally different from a translation (slide) or a rotation (turn) in terms of the way the figure moves.

Why must the line segment connecting any pre-image point (A) to its image point (A') always be perpendicular to the line of reflection?

Is it possible to define a reflection without first defining a line of reflection? Explain.

Why is reflection classified as an isometry? What key properties of the figure are preserved?

Explain how the concept of reflection is used to define reflectional symmetry in a figure.

SEL Activity

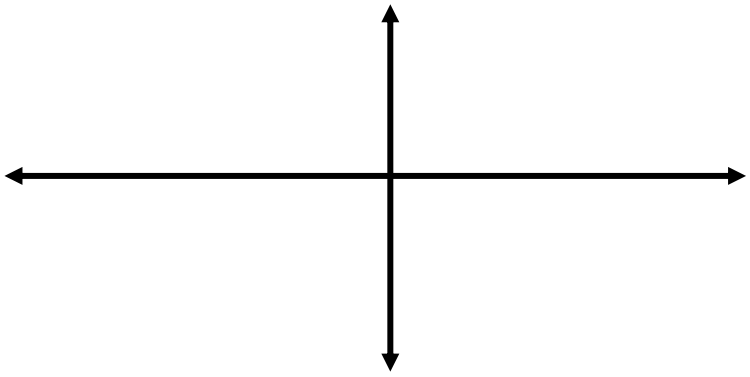
The Mirror Effect

Self-Awareness & Social Awareness

The Concept: In math, a reflection flips a figure over a line. In life, we often "reflect" our moods or behaviors based on the people around us.

Activity:

1. Imagine the y-axis is a "Social Mirror."
2. On the left side (Quadrant II), list three traits you show when you are **alone** (e.g., quiet, creative, messy).



3. "Reflect" those traits across the axis into Quadrant I. Do they look different when you are **around others**? Explain.
4. **Reflection Prompt:** Is the 'image' you show the world a true reflection of your 'pre-image' (your true self)? Explain.

1.3 Rotation of Figures

Warm-Up

Write all you know about rotations.

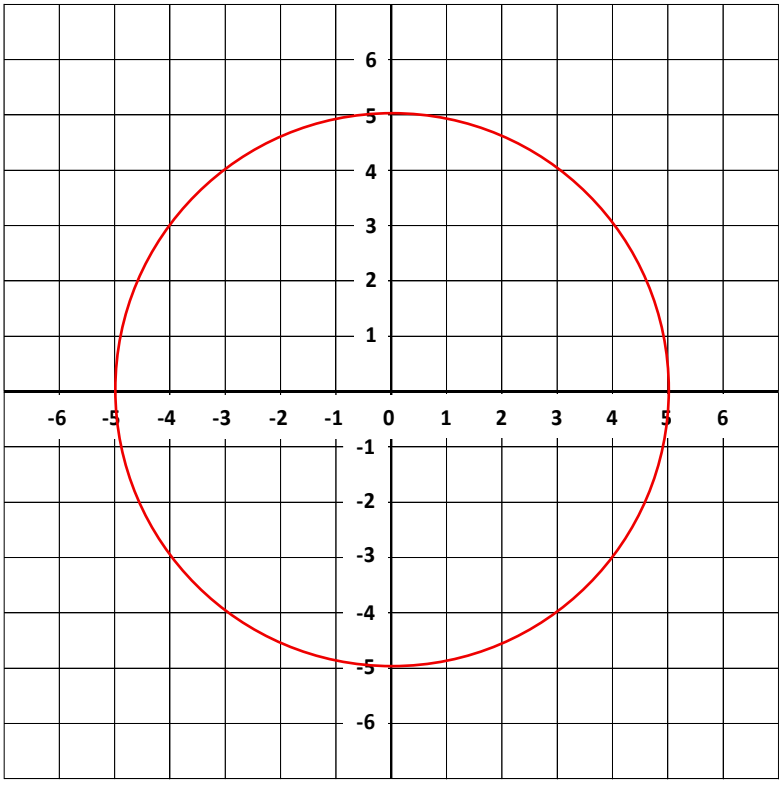
Main Topic **Rotation of Figures**

The Symmetrical Seal

A student designer is creating a circular seal for the school's math club. The seal requires a small triangular arrow element to be repeated seven times around the center point, forming a perfectly symmetrical, spoke-like design.

The designer sets the center of the circular seal at the **origin, O(0, 0)**, of the coordinate plane.

- The original arrow element is a small triangle defined by its vertices: P(5, 1), Q(6, 0), and R(5, -1).
- To create a six-spoke design, the element needs to be rotated multiple times around the origin until it completes a full circle.

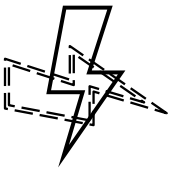
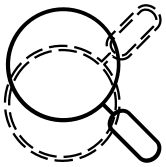
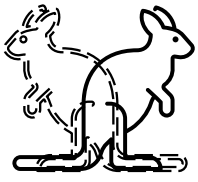


Need Help?

In your own words, write the definition of rotation.

Rotation

Describe the rotation from the solid outline figure to the dashed outline figure.

TASK 1

- Plot and connect points

  $A(-1,1), B(-4,1), C(-1,5).$

- Rotate the shape $90°$ clockwise about the origin.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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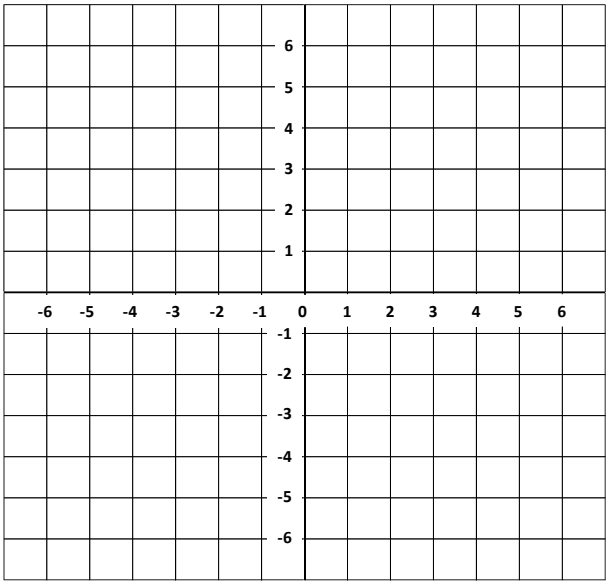

TASK 2

- Plot and connect points

  $A(-1,1), B(-4,1), C(-1,5).$

- Rotate the shape $90°$ counterclockwise about the origin.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

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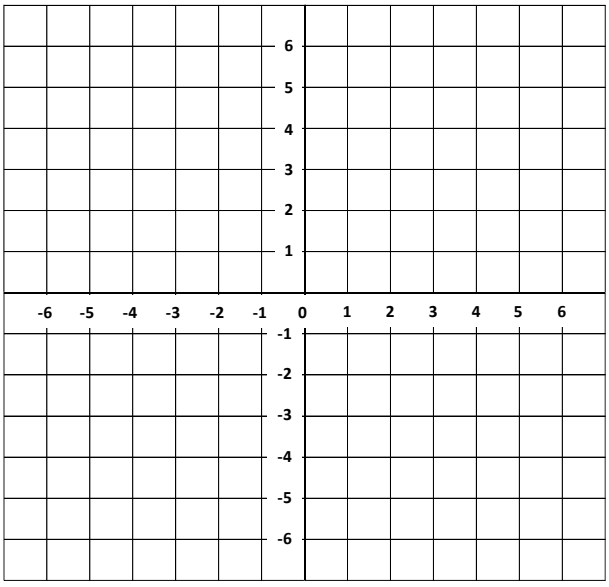

Determine the vertices of the rotated figure.

$L(1,-1), M(3,-1), N(3,-5), O(1,-5)$ Rotated $90°$ clockwise about the origin.	$L(1,-1), M(3,-1), N(3,-5), O(1,-5)$ Rotated $90°$ counterclockwise about the origin.

TASK 3

- Plot and connect points
  $A(-1,1), B(-4,1), C(-1,5).$
- Rotate the shape $180°$ clockwise about the origin.
  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$
- Create a rule or formula.

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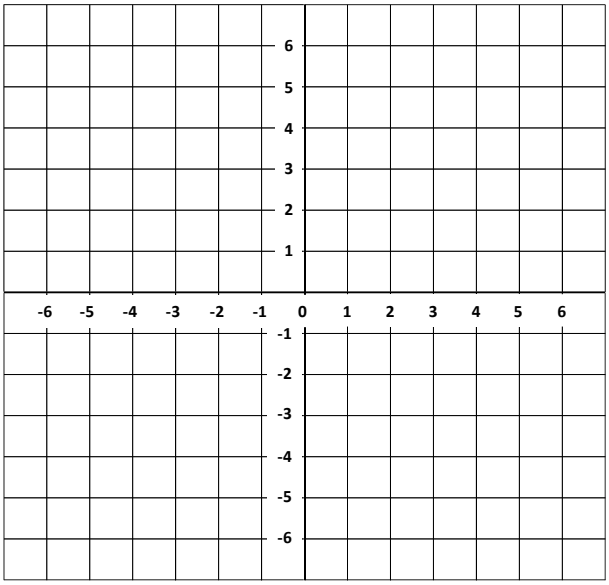

TASK 4

- Plot and connect points
  $A(-1,1), B(-4,1), C(-1,5).$
- Rotate the shape $180°$ counterclockwise about the origin.
  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$
- Create a rule or formula.

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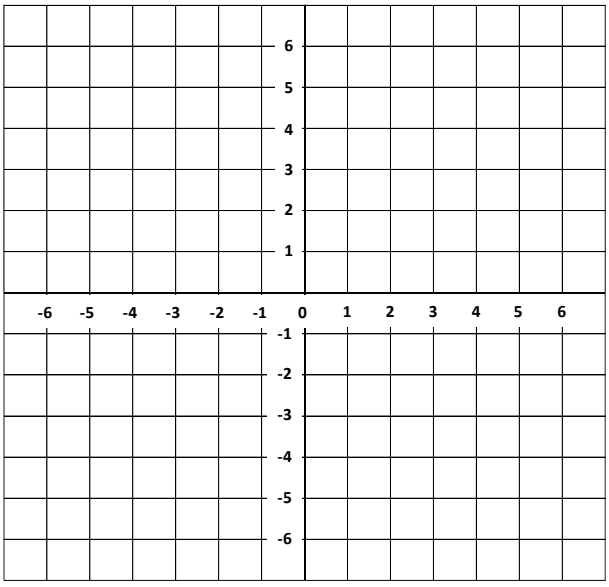
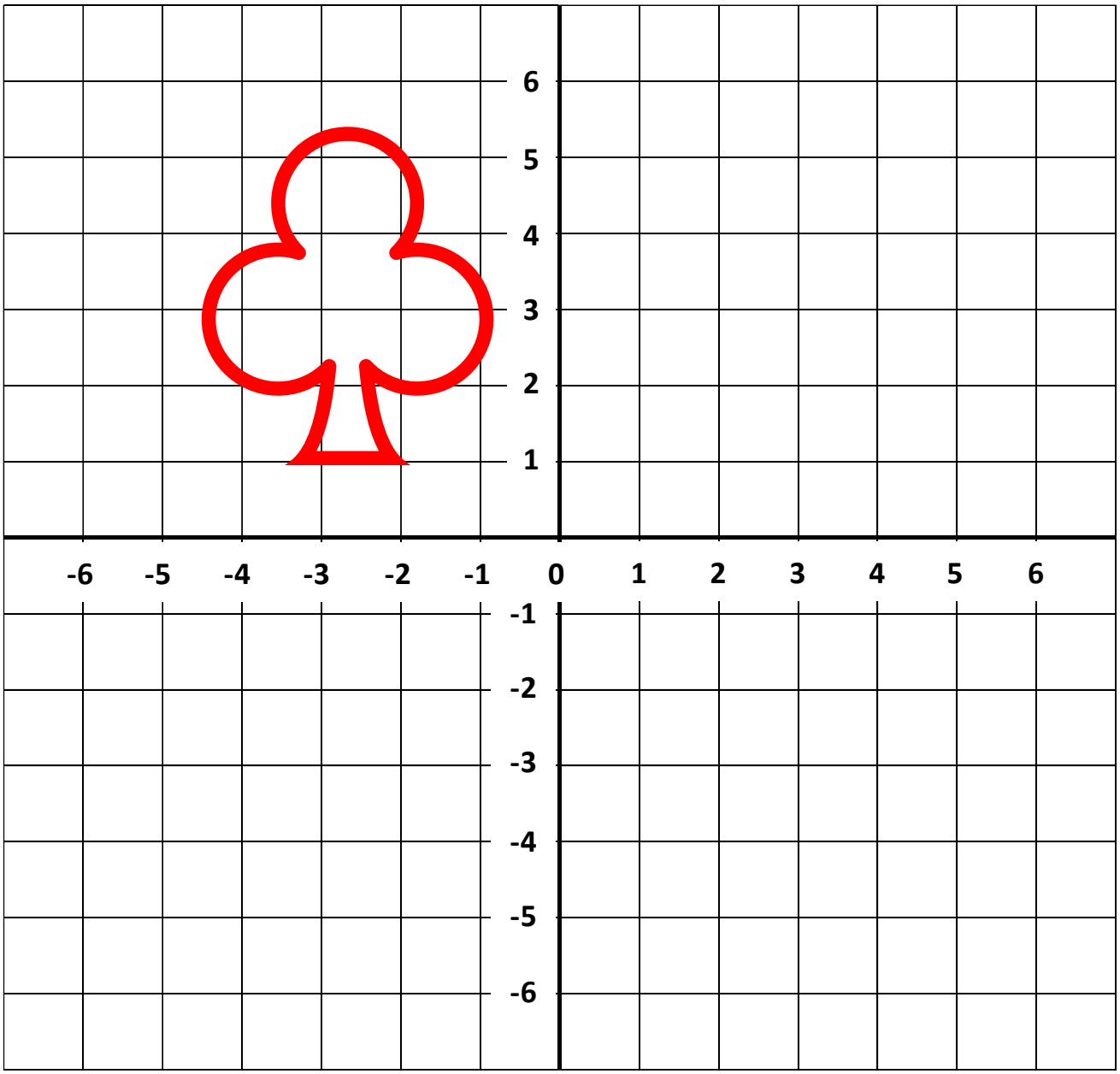


Determine the vertices of the rotated figure.

$L(1,-1), M(3,-1), N(3,-5), O(1,-5)$ Rotated $180°$ clockwise about the origin.	$L(1,-1), M(3,-1), N(3,-5), O(1,-5)$ Rotated $180°$ counterclockwise about the origin.

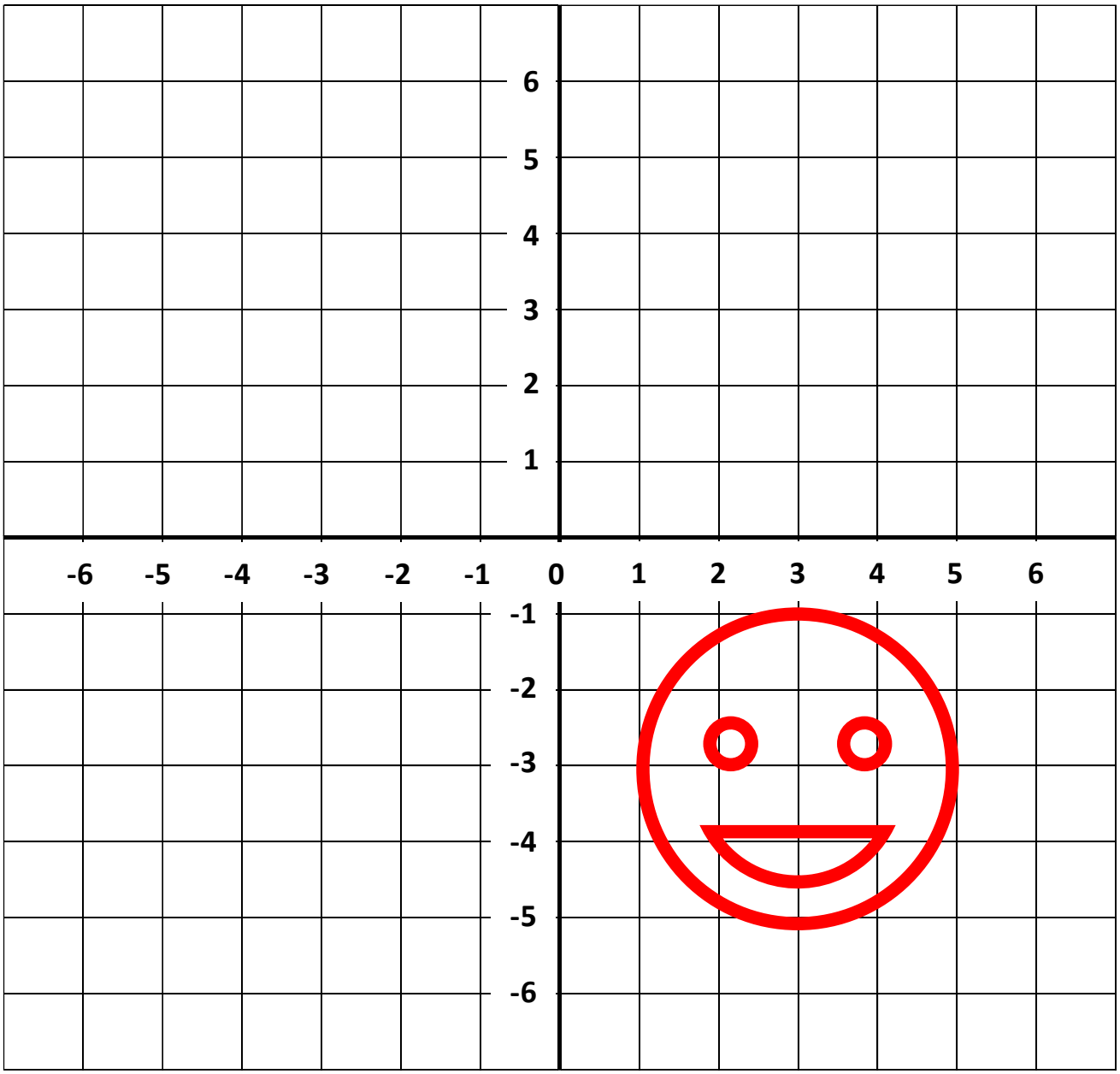
Rotation of Figure

Rotate the image 90° clockwise about the origin.



Rotation of Figure

Rotate the image $180°$ about the origin.



Main Topic **Transformations of Figures Applications**

Icon Alignment: A designer places a square icon with vertices at A(1, 1), B(3, 1), C(3, 3), D(1, 3). They need to rotate it $90°$ counter-clockwise about the origin to fit a horizontal toolbar. What are the new coordinates?

Arrowhead Direction: An arrow tip is at P(4, 2). The designer needs the arrow to point straight down instead of right. What are the new coordinates after a $270°$ counter-clockwise rotation about the origin?

Tiled Background: A tile design starts with a small shaded rectangle at R(2, 5). To create a repeating L-shape pattern, the designer rotates the rectangle $90°$ clockwise about the origin. What are the new coordinates?

Yin-Yang Element: A designer is working on a Yin-Yang style graphic. The top-left element is defined by E(-4, 6). The bottom-right element must be created by a $180°$ rotation about the origin. What is the image point E'?

Logo Corner: A logo's main element has a corner at V(-5, 3). The client demands the element be turned one quarter turn clockwise. What is the image point V' after a $90°$ clockwise rotation about the origin?

Honors Level

What three pieces of essential information are required to define any specific rotation of a figure?

What is the conceptual significance of the center of rotation?
What happens to a point that lies exactly on this center during the transformation?

Why is rotation considered a rigid transformation (isometry)?
What properties of the figure are preserved during a rotation?

Unlike reflection, rotation preserves the figure's orientation.
What does this mean in terms of the clockwise/counter-clockwise order of the vertices?

When a line segment is rotated $90°$ about the origin, how does the slope of the image segment relate to the slope of the pre-image segment? (Hint: Think about perpendicular lines).

SEL Activity

The Power of Perspective

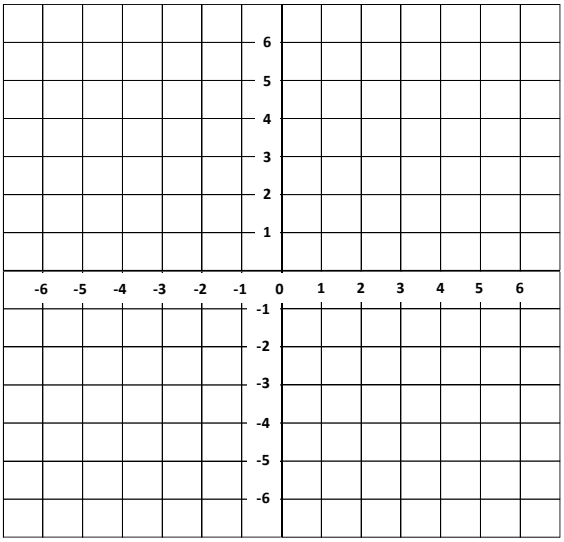
Social Awareness & Cognitive Flexibility

The Concept: Every rotation needs a fixed center. If the center moves, the whole rotation changes.

Activity:

1. In the center of a small coordinate plane, the origin (0,0) represents your **Core Values** (e.g., honesty, kindness, or hard work). Write at least 3 core values you have.

2. Plot a "Challenge Shape" in (e.g., a triangle representing a difficult project or a disagreement with a friend).



3. **Reflective Prompt:** When things get dizzying or stressful, what is your (0,0)? What is the one value that stays fixed and keeps you grounded no matter how much the world turns around you?

1.4 Dilation of Figures

Warm-Up

Write all you know about dilations.

Main Topic **Dilation of Figures**

Using a separate sheet of paper, cut a right triangle whose base is 6 inches and height is 4 inches. Using the cutout, figure out a method to shrink the shape half its size.

Scale Factor

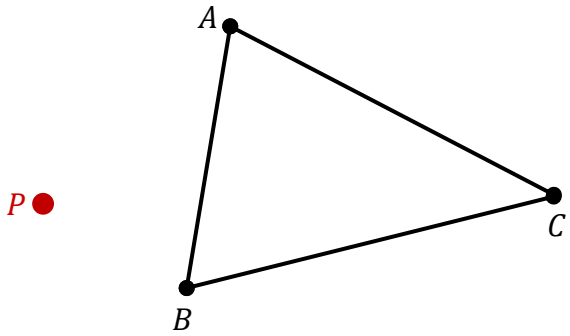
It tells you how much to stretch or shrink a figure around a center point.

In your own words, write the definition of dilation.

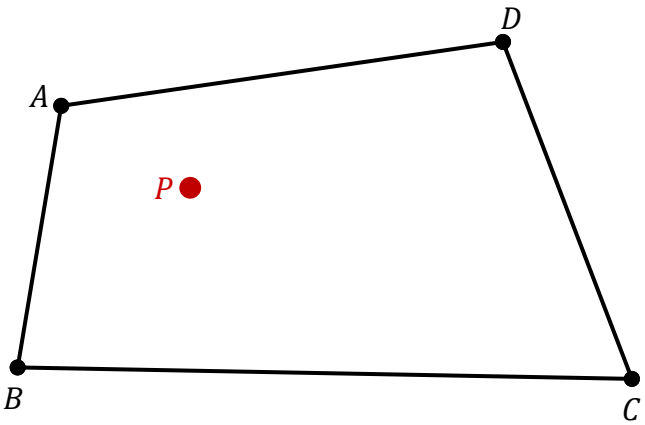
Dilation

Dilate the figure from the center of dilation, P.

Scale Factor: 2

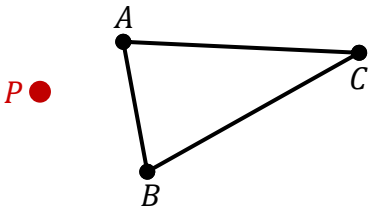


Scale Factor: ½

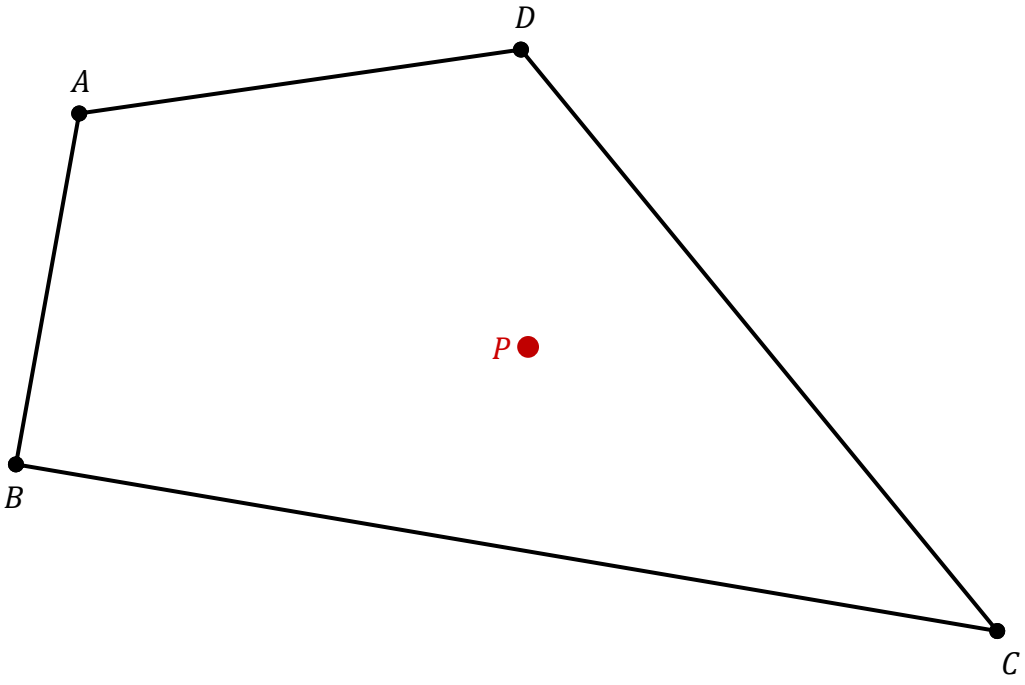


Dilate the figure from the center of dilation, P.

Scale Factor: 3



Scale Factor: 1/3



TASK 1

- Plot and connect points

  $A(-2,0), B(3,3), C(2,-2).$

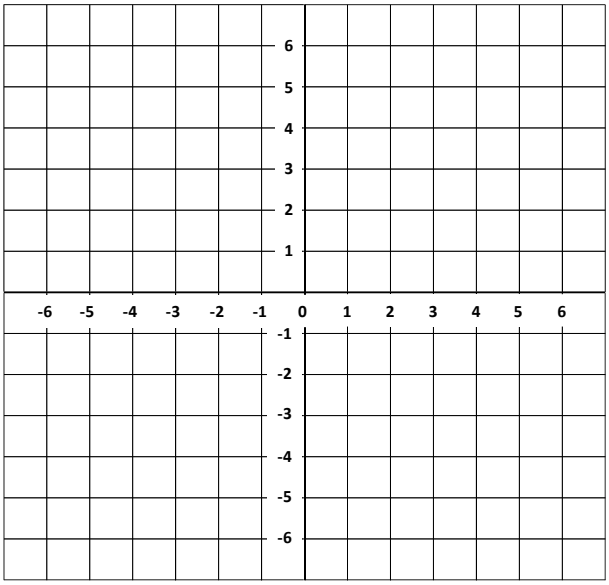
- Dilate the shape by a scale factor of 2 from the origin.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

  _____

  _____



TASK 2

- Plot and connect points.

  $A(-2,0), B(3,3), C(2,-2).$

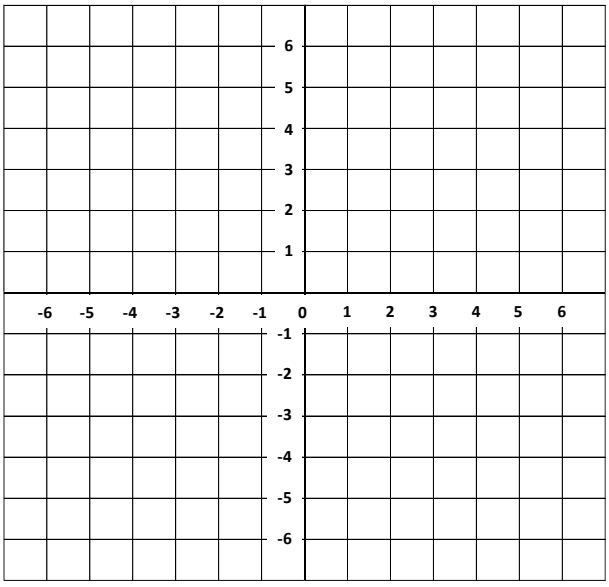
- Dilate the shape by a scale factor of ½ from the origin.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

  _____

  _____



Determine the vertices of the dilated figure.

$L(-8,2), M(-4,4), N(12,4), O(16,-8)$ Dilate the figure by a scale factor of ¼ from the origin.	$L(1,-1), M(3,-1), N(3,-5), O(1,-5)$ Dilate the figure by a scale factor of 5 from the origin.

TASK 3

- Plot and connect points

  $A(1,-1), B(1,-2), C(2,-2)$

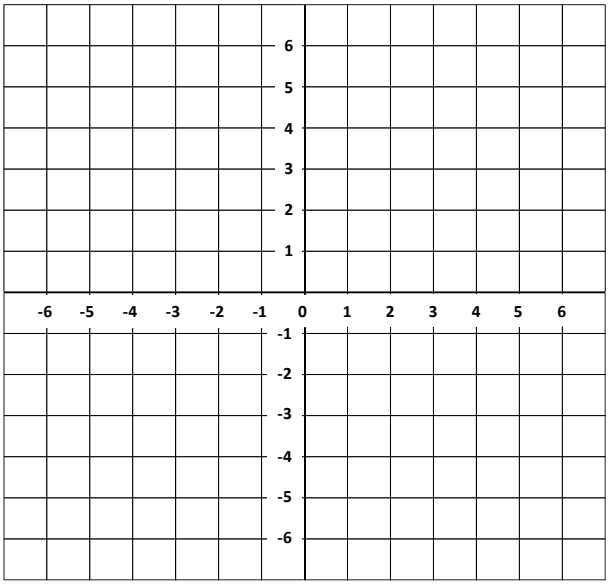
- Dilate the shape by a scale factor of 3 from the origin.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

  _____

  _____



TASK 4

- Plot and connect points

  $A(3,3), B(-3,6), C(0,-6)$

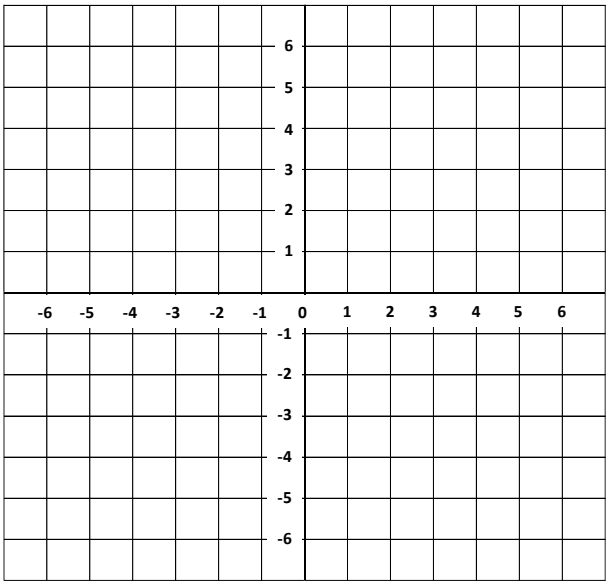
- Dilate the shape by a scale factor of 1/3 from the origin.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Create a rule or formula.

  _____

  _____

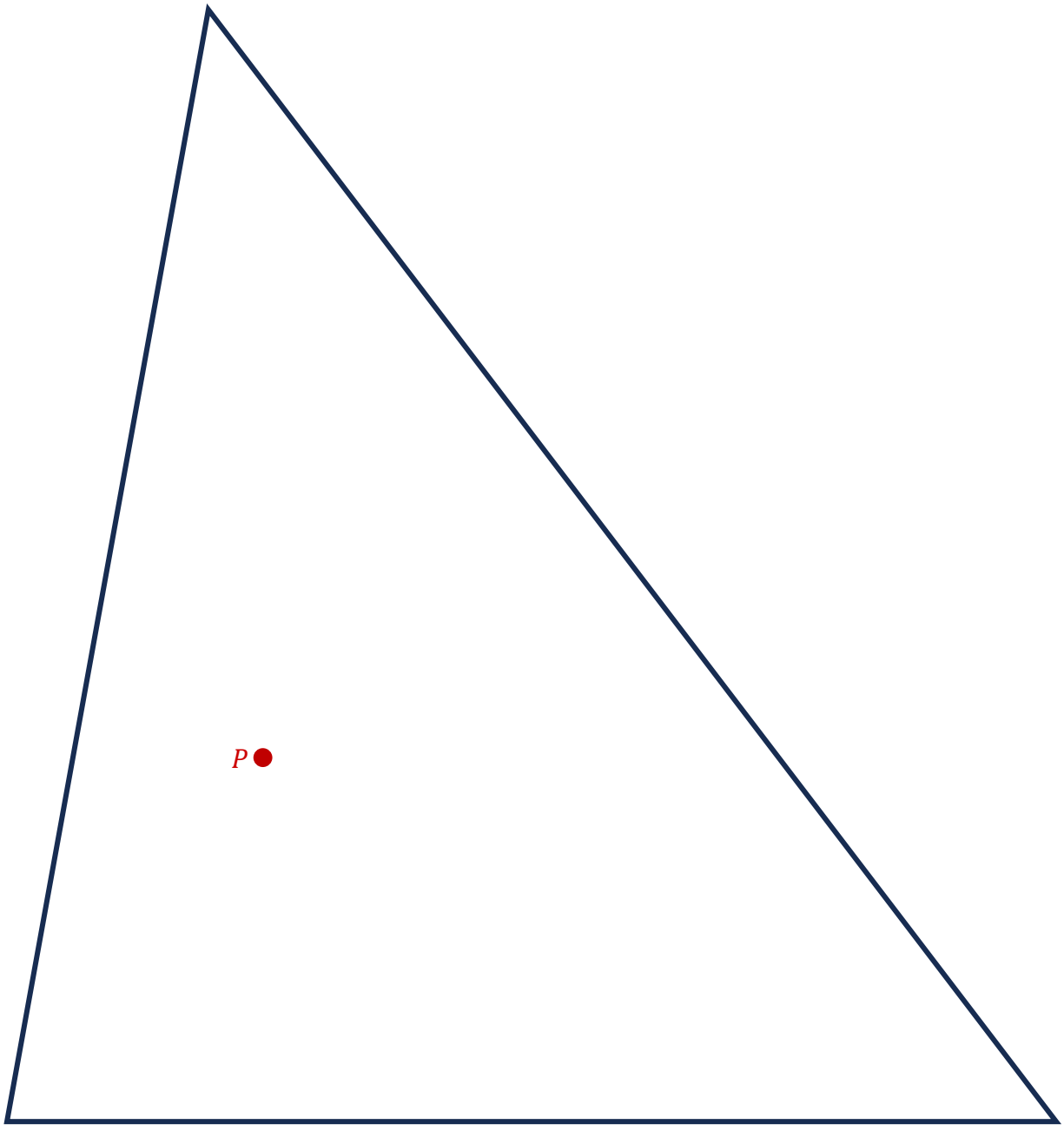


Determine the vertices of the dilated figure.

$L(1,2), M(-3,-2), N(0,-5), O(3,-2)$ Dilate the figure by a scale factor of 6 from the origin.	$L(1,2), M(-3,-2), N(0,-5), O(3,-2)$ Dilate the figure by a scale factor of ½ from the origin.

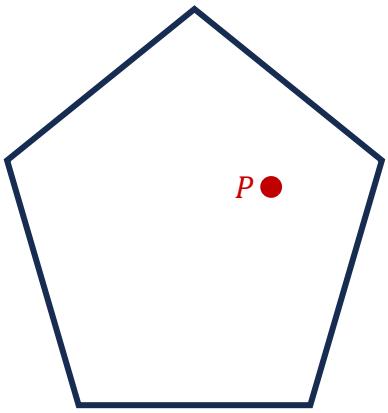
Dilation of Figure

Dilate the image by a scale factor of ½ from the center of dilation, P.



Dilation of Figure

Dilate the image by a scale factor of 3 from the center of dilation, P.



Main Topic **Transformation of Figures Applications**

Banner Resize: A small logo on a business card has a key point at P(3, 4). The designer needs to **enlarge** the logo to fit a large banner using a scale factor of k = 5. What are the new coordinates of P'?

Web to Print: A web icon is defined by a corner at V(2, 6). To prepare it for high-resolution printing, the designer applies a dilation with a scale factor of k = 1.5. What are the coordinates of the enlarged corner V'?

Map Detail: A small square on a map graphic has a side length of 4 units. The designer dilates the map by a scale factor of k = 3. What is the new side length of the square, and how has its area changed?

Proportional Shrink: A vector graphic is defined by a circle with a radius of 15 units. The graphic is dilated using the rule (x, y) → (0.2x, 0.2y). What is the scale factor, and what is the new radius of the circle?

Icon Reduction: A large button graphic defined by a key vertex V(18, -12) needs to be reduced to one-third its original size for a mobile app. What is the scale factor, and what are the new coordinates of V'?

Honors Level

Why is dilation *not* classified as a rigid transformation (isometry), even though it preserves the shape of the figure?

What does the scale factor (k) fundamentally measure in a dilation?
How does the concept of k relate to proportionality?

What is the conceptual significance of the center of dilation?
How does the position of this point affect the final location of the dilated image?

Unlike reflection, rotation preserves the figure's orientation.
What does this mean in terms of the clockwise/counter-clockwise order of the vertices?

If a figure is dilated by a scale factor k, how does the perimeter of the image figure relate to the perimeter of the pre-image figure, and why?

SEL Activity

The Scale of You

Self-Management & Personal Agency

The Concept: A dilation moves points away from or toward a "Center of Dilation" (usually the origin).

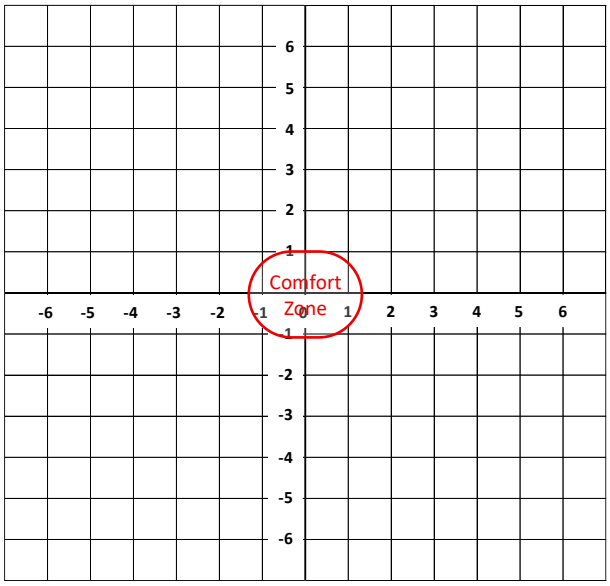
Activity:

- **Plotting Growth:** Plot three points that represent things you are currently comfortable doing (e.g., speaking in class, helping a friend). This is your 'Pre-Image'.

Point A: _____

Point B: _____

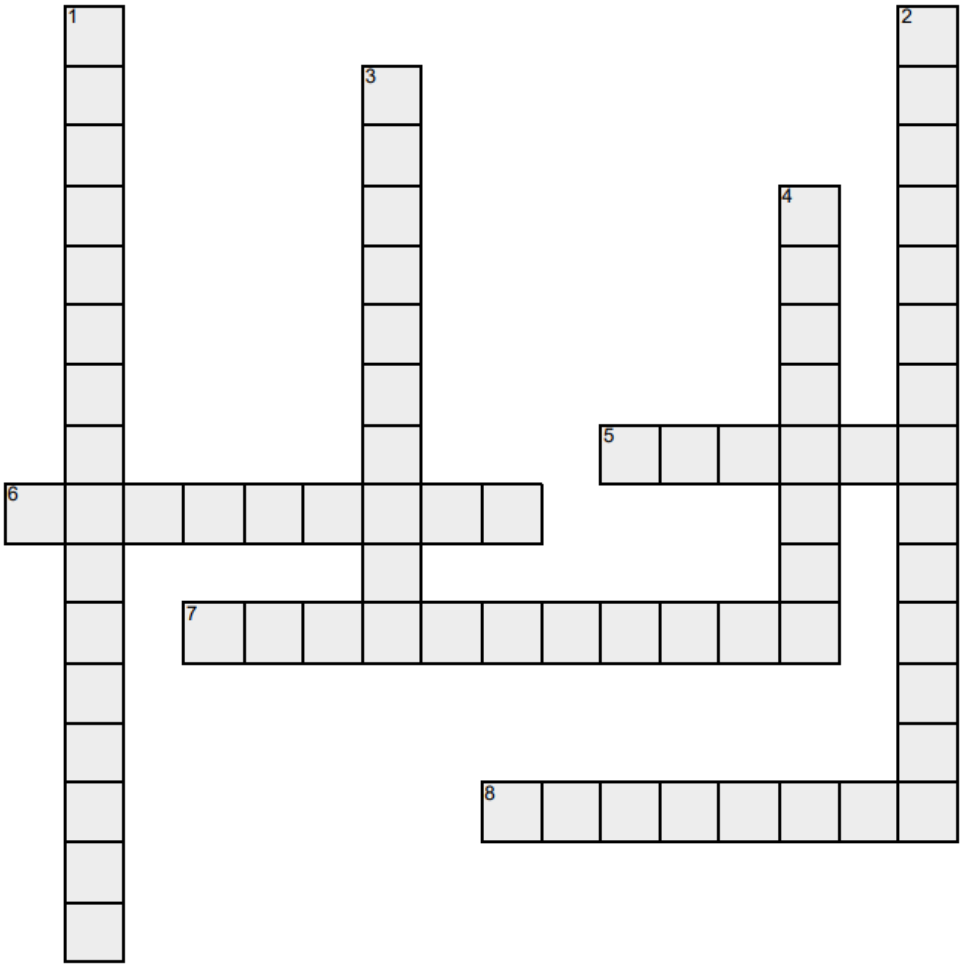
Point C: _____



- **The Expansion:** Now, apply a scale factor of k=3. Where do those points land now? Label these new points with things that are currently 'out of reach' but you want to achieve.

- **Reflection:** Notice that as the figure grows, it stays centered around the origin. How do you stay 'centered' in your values while taking bigger risks?

Transformation of Figures



Across	Down
5. Scale _____ is a number that tells you by how much a figure is enlarged (stretched) or shrunk (compressed) during a dilation. 6. It refers to the direction of rotation that follows the movement of the hands on a traditional clock face. 7. A transformation that moves a figure in a specific direction without changing its size, shape, or orientation. 8. A transformation that turns a figure around a fixed point by a specific angle.	1. It refers to the direction of rotation opposite to the movement of the hands on a traditional clock face. 2. A rule or process that manipulates a geometric figure to create a new figure. 3. A transformation that creates a mirror image of a figure across a line. 4. A transformation that resizes a figure by a specific factor (called the scale factor) around a fixed point.

fun and exhilarating math for all

Unit 2 | Congruence and Similarity

Product Design

8th Grade Mathematics

North Carolina 8th Grade Math Standards

Unit 2

Understand congruence and similarity using physical models, transparencies, or geometry software.	
NC.8.G.4	Use transformations to define similarity. • Verify experimentally the properties of dilations that create similar figures. • Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations. • Given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

2.1 Understanding Congruent Figures

Warm-Up

Write all you know about the term congruent.

Main Topic **Congruent Figures**

Pair the cutouts that have the same size. Use a ruler to measure the length of each side, then label. Use a protractor to measure each interior angle, then label.

Building on the previous activity, suppose the two figures we compared are congruent. How can we define congruent figures?

Congruent Figures

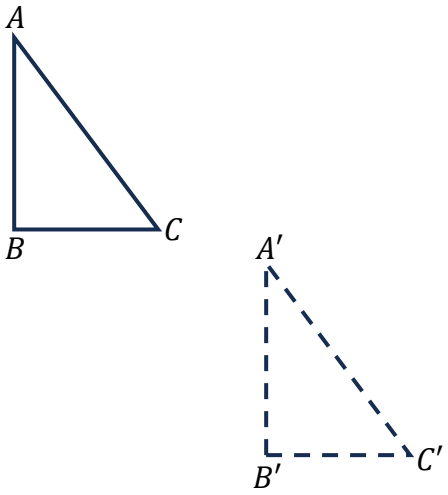
TASK 1

- Describe the transformations of the solid outlined figure to the dashed outlined figure.

  _____

  _____

- List pairs of congruent sides.



- List pairs of congruent angles.

- Solve for x.

- $\overline{AB} = 4\ units, \overline{BC} = 3\ units,$ $\overline{AC} = 5\ units$

- $\overline{A'B'} = x + 1\ and\ \overline{B'C'} = 2x$

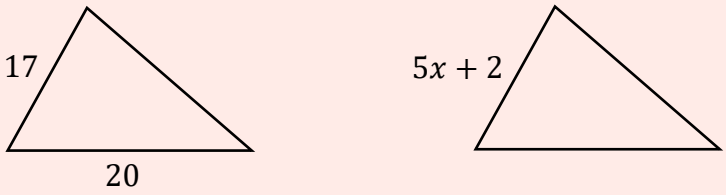
Need Help?

I Do - We Do - You Do

Solve for x.

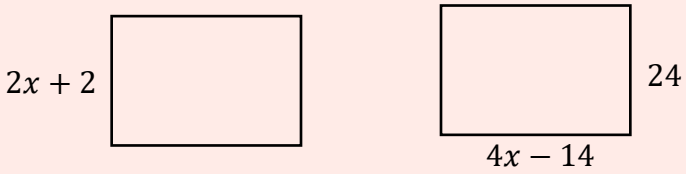
I Do

Teacher models how to solve this problem.



We Do

Work with classmates and minimal teacher guidance.

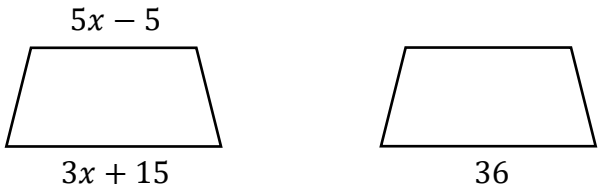


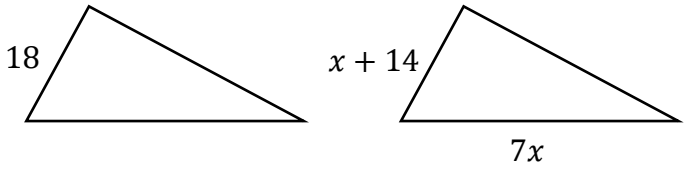
You Do

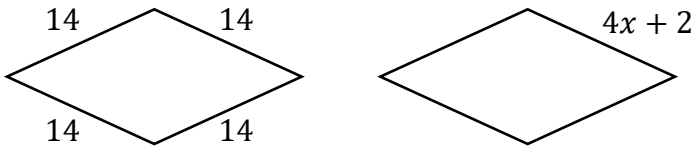
You can do it on your own.

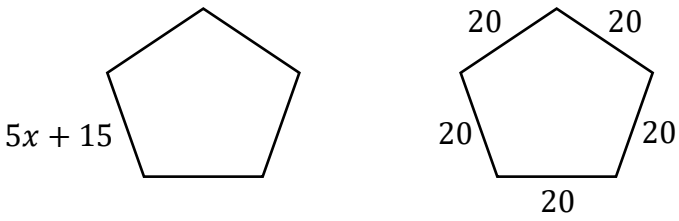
Main Topic **Congruent Figures**

Solve for x.









Need Help?

Designing Congruent Phone Parts

A product design firm, "Tech-Fit Solutions," is designing a new smartphone model. They need to ensure that the small metal bracket that holds the battery in place is **perfectly congruent** to the plastic bracket that secures the charging port. Congruence is essential for the automated assembly machine to correctly place both parts on the circuit board.

The design team models the shapes of the two brackets on a coordinate plane. Both brackets are right triangles.

Bracket 1: The Metal Battery Bracket (Pre-image)

The metal bracket is defined by the following side lengths (in millimeters), which are also hypotenuses of small right triangles on the grid:

- **Side A**: The length of the side along the x-axis is 4x + 10.
- **Side B**: The length of the side along the y-axis is 6x + 2.

Bracket 2: The Plastic Charging Port Bracket (Image)

The plastic bracket, which must be congruent to the first, has the following corresponding side lengths:

- **Side A'**: The length of the side along the x-axis is 7x - 5.
- **Side B'**: The length of the side along the y-axis is 8x - 2.

Honors Level

What is the most precise way to define two figures as congruent?
(Hint: Think about size and shape).

Why is the establishment of corresponding parts (vertices, sides, angles) a mandatory first step when proving that two figures are congruent?

How does the definition of congruence relate directly to the three basic rigid transformations (translations, rotations, reflections)?

If two polygons are congruent, why must every angle in the first polygon be congruent to its corresponding angle in the second?

If two figures are congruent, what must be true about their perimeter and their area?

SEL Activity

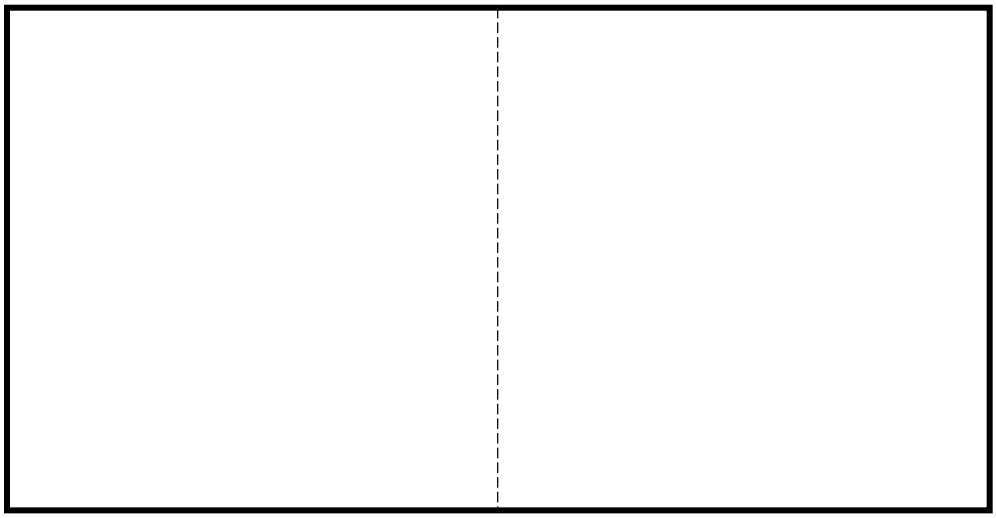
The Search for Congruence

Relationship Skills & Social Awareness

The Concept: CPCTC (Corresponding Parts of Congruent Triangles are Congruent).
If the triangles match, every single part matches.

Activity:

Authenticity Box



1. **The Left Side (The Pre-Image):** Write down three values that are non-negotiable for you (e.g., "Honesty," "Creativity," "Loyalty").

2. **The Right Side (The Image):** Think about how you act when you are under pressure or trying to impress someone.

3. **The Audit:** Are your actions on the right **congruent** with your values on the left? If there is a 'distortion' (not congruent), what is one small 'transformation' you can make to bring your actions back in line with who you really are?

2.2 Understanding Similar Figures

Warm-Up

Write all you know about similar figures.

Main Topic **Similar Figures**

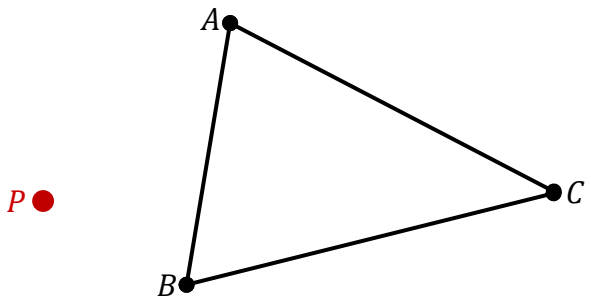
Using a separate sheet of paper, cut a right triangle whose base is 6 inches and height is 4 inches. Using the cutout, figure out a method to dilate the shape half its size.

Use your own words to define similar figures.

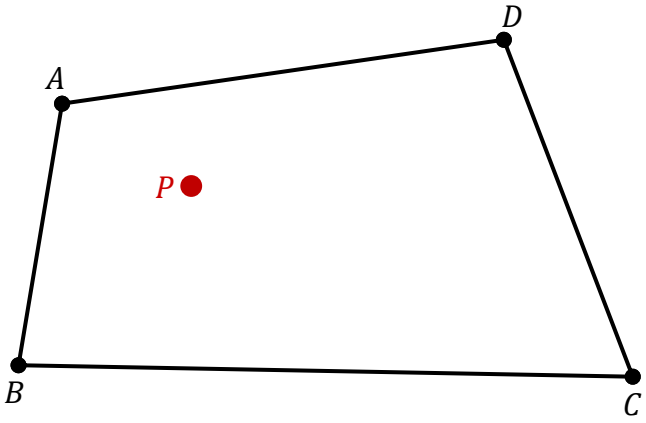
Similar Figures

Dilate the figure from the center of dilation, P.
Compare the lengths of the dilated figure with the original figure.

Scale Factor: 2

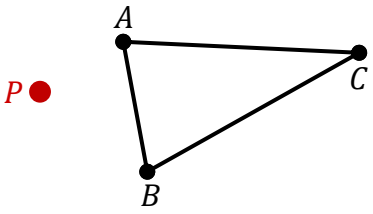


Scale Factor: ½

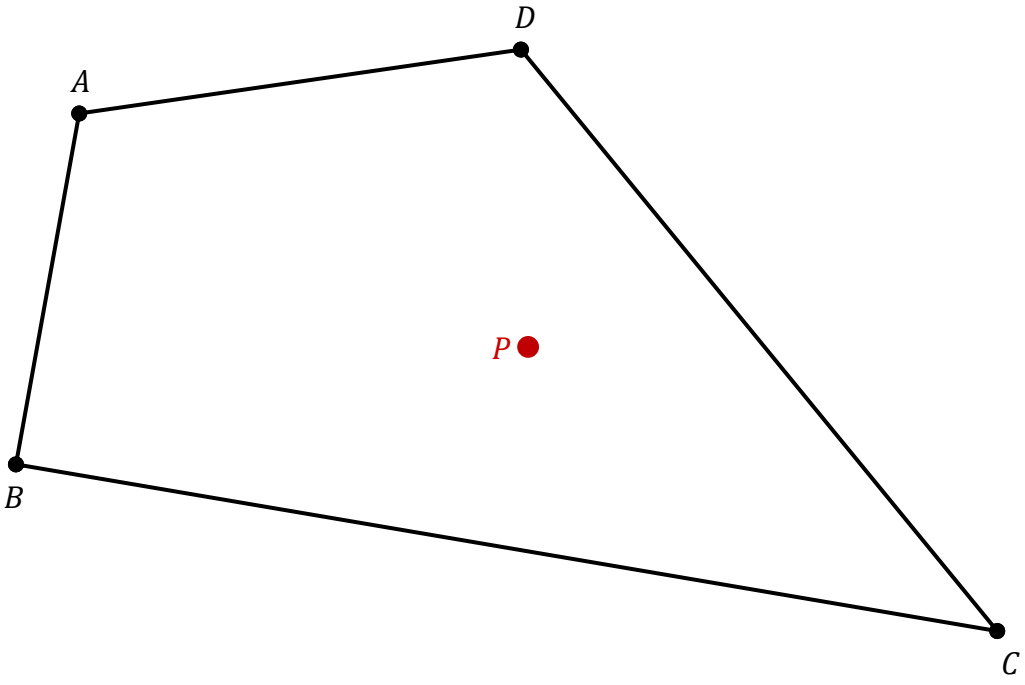


Dilate the figure from the center of dilation, P.

Scale Factor: 3



Scale Factor: 1/3



TASK 1

- Plot and connect points

  $A(-2,6), B(4,6), C(4,-4).$

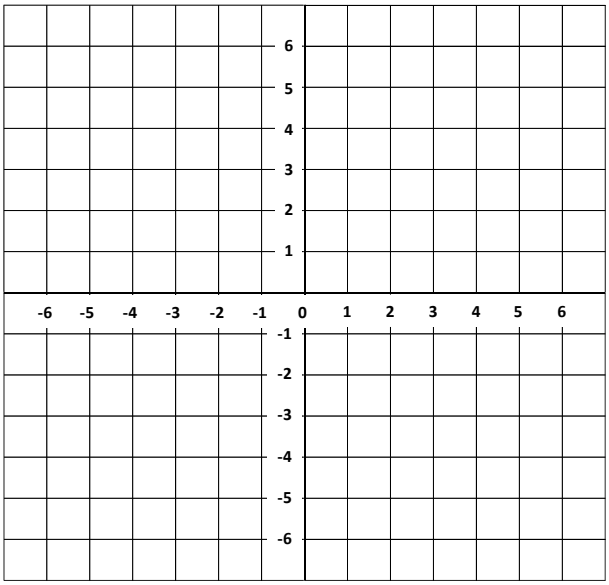
- Dilate the shape by a scale factor of ½ from the origin.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Write your observations about the lengths of the shapes.

  _____

  _____



TASK 2

- Plot and connect points

  $A(-1,1), B(2,2), C(1,-3).$

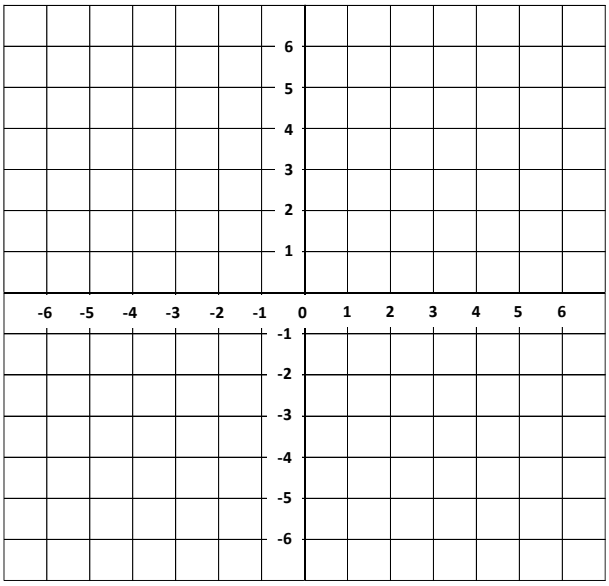
- Dilate the shape by a scale factor of 2 from the origin.

  $A'(\quad,\quad), B'(\quad,\quad), C'(\quad,\quad).$

- Write your observations about the lengths of the shapes.

  _____

  _____



Your original school picture is 2 inches wide by 3 inches tall. The ID card requires a smaller picture that maintains the same aspect ratio (ratio of width to height). The ID card slot is only 1 inch wide.

- What scale factor will you need to use to shrink the picture while keeping the same aspect ratio?
- What will be the height of the picture on your ID card?

You are giving a presentation about a local park and need to enlarge a map for better visibility. The original map has a scale of 1 cm : 20 meters. You want the enlarged map to show a distance of 100 meters with a length of 10 cm on the map.

- What scale factor will you need to use for the enlarged map?
- If a walking trail on the original map measures 2 cm, what will be its length on the enlarged map?

Main Topic	Similar Figures

Photo Enlargement: A small photo measuring 3 inches by 5 inches is being enlarged. The new photo has a width of 15 inches and a length represented by 2x + 1. Write a proportion and solve for the value of x.

Triangle Bases: Two similar triangles have corresponding bases b^1 and b_2. The scale factor from the small triangle to the large triangle is 2/3. If the base of the small triangle is 3x - 2 and the base of the large triangle is 2x + 10, write an equation and solve for x.

Perimeter of Similar Polygons: Two similar pentagons have perimeters in the ratio of 4:9. If the smallest side of the smaller pentagon is 8 cm, what is the length of the corresponding side on the larger pentagon?

Trapezoid Sides: Two similar trapezoids have corresponding sides represented by 4x and x + 15. If the scale factor from the small trapezoid to the large trapezoid is ¼, find the value of x.

Honors Level

What are the two necessary and sufficient conditions that must be met for two polygons to be defined as similar?

Explain the conceptual role of the scale factor (k).
What does k quantify in a dilation, and how does it relate the size of the pre-image to the image?

Explain how congruence can be considered a special case of similarity.
What specific value must the scale factor, k, hold in this case?

Why must corresponding angles of similar figures always be congruent (equal in measure), even when the side lengths are different?

In the similarity statement $\Delta ABC \sim \Delta XYZ$, what does the specific order of the vertices conceptually communicate about the correspondence of sides and angles?

SEL Activity

The Same, Just Scaled

Self-Awareness & Social Awareness

The Concept: In similar figures, the side lengths change, but the **angles** stay exactly the same. The angles are what give the shape its "character."

Activity:

1. Think of your "Angles" as your core character traits (e.g., your kindness, your curiosity, your sense of justice).

2. **Reflective Prompt:** As you grow from a child to an 8th grader, and eventually to an adult, your 'side lengths' (your height, your responsibilities, your skills) will increase. Which 'Angles' of your personality do you hope never change, no matter how big your life gets?

3. **Task:** Draw a small triangle labeled with your three strongest traits. Now, draw a much larger **similar** triangle. Notice how the shape is identical, even though it takes up more space.

2.3 Solving Congruent and Similar Figures - Triangles

Warm-Up

Solve for x.

$$2x + 2 = 24$$

$$\frac{41}{15} = \frac{4x-4}{x+6}$$

Main Topic **Right Triangles Cutouts**

Use a ruler to measure the lengths of a right triangle cutout, then label each side.
Use multiple cutouts to form a bigger version of the right triangle, then label each side.

Great job! You've mastered transformations of figures. Now, let's solidify our understanding by going through some steps together.

- Trace a triangle cutout below.
- Translate the cutout several units to the right, then up.
- Reflect the shape over a horizontal axis.

Are the shapes similar or congruent? Explain.

_____

_____

_____

TASK 1

- Plot and connect points

  $A(2,2), B(2,-3), C(5,-3).$

- Plot and connect points

  $A'(-2,5), B'(-2,0), C'(-5,0).$

- Describe the transformations.

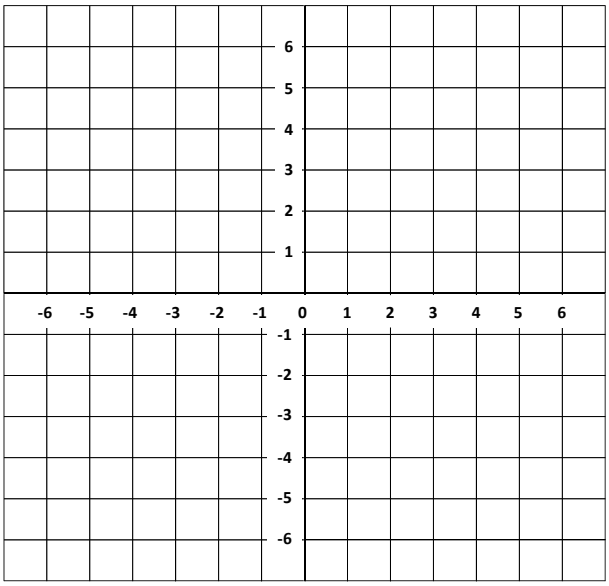
  _____

  _____

- Are the shapes congruent or similar? Explain.

  _____

  _____



TASK 2

- Plot and connect points

  $A(-1,1), B(2,0), C(0,-3).$

- Plot and connect points

  $A'(-2,2), B'(4,0), (0,-6).$

- Describe the transformations.

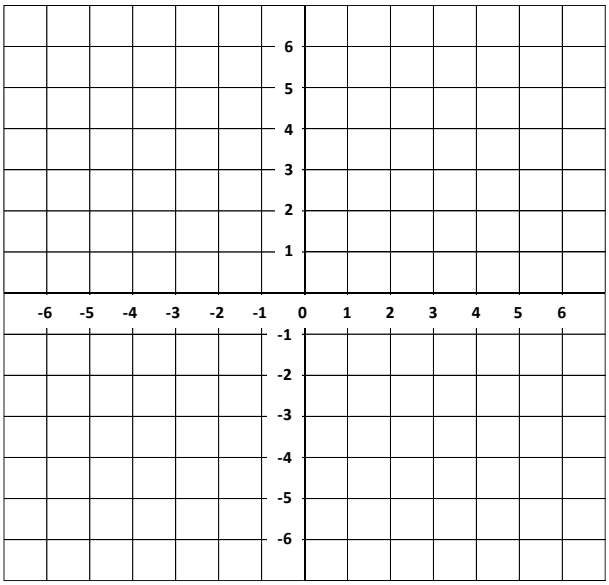
  _____

  _____

- Are the shapes congruent or similar? Explain.

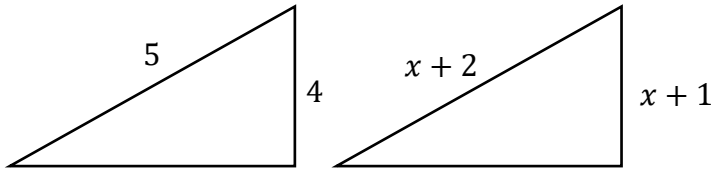
  _____

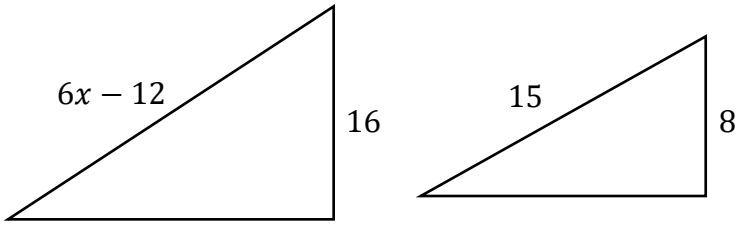
  _____

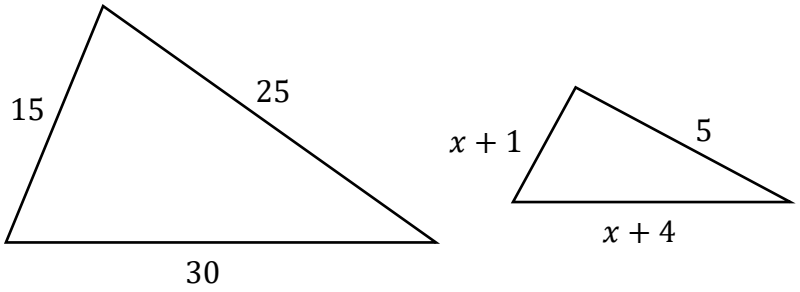


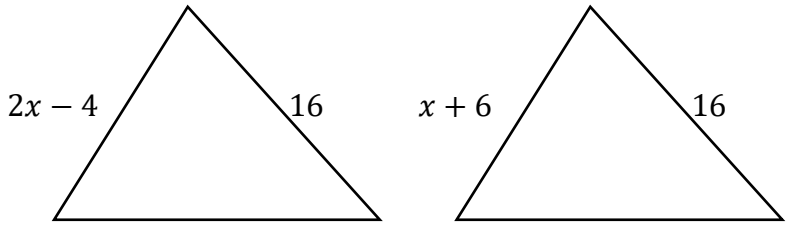
Main Topic **Congruent and Similar Figures**

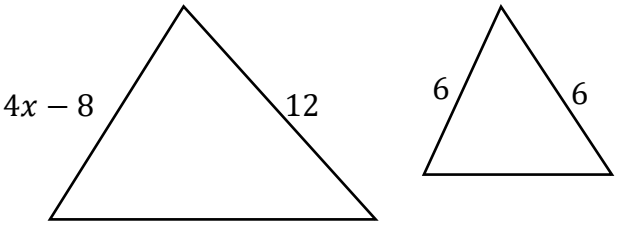
Solve for x.











Need Help?

Scaling a Smartphone Camera Mount

The Dual-Size Mount

A product design firm, "Tech-Scale Industries," is designing a new camera mounting bracket for two different sizes of smartphone—a standard model and a smaller "Mini" model. To keep manufacturing costs down, the two brackets must be **similar in shape**, meaning their corresponding parts form similar triangles.

The cross-section of the mounting bracket uses a right triangle.

Bracket 1 (Standard Model): The hypotenuse of the large bracket is $H_L = 2x + 10$ and the short leg is $L_S = 3x$.

Bracket 2 (Mini Model): The hypotenuse of the small bracket is $H_S = 14$ and the short leg is $L_M = 12$.

SEL Activity

The Proof of Connection

Relationship Skills & Responsible Decision-Making

The Concept: Two triangles might *look* congruent, but without markings or measurements, we can't be sure.

Activity:

1. Think of a "Social Pre-Image" (how someone presents themselves on social media or in the hallway).

2. **Reflective Prompt:** If you only see one 'side' of a person, can you truly know who they are? In math, we need three pieces of information to prove congruence. What are three 'pieces of evidence' you need to truly trust someone as a friend?

3. **Task:** Draw a triangle. Label the three sides with three traits you must see in a friend before you consider them "congruent" with your values (e.g., *Side 1: Consistency*, *Side 2: Honesty*, *Side 3: Shared Interests*).

2.4 Solving Congruent and Similar Figures – Other Polygons

Warm-Up

Solve for x.

$$7(3x - 2) = 5x + 1$$

$$\frac{x+5}{22} = \frac{8}{13}$$

Main Topic **Similar Polygons**

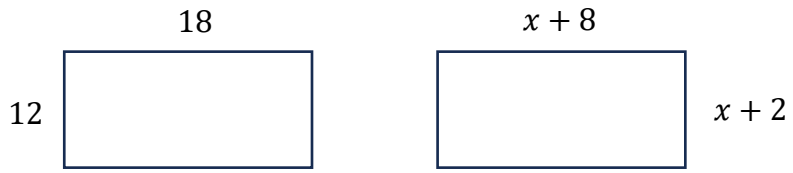
A person who is 6 feet tall casts a 4-foot shadow. At the same time, a nearby tree casts a 20-foot shadow. How tall is the tree?

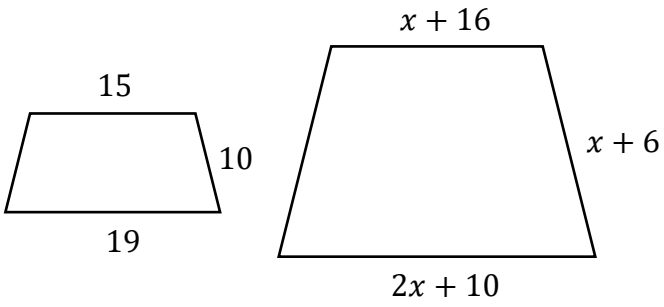
A wheelchair ramp has a slope of 1:12 (for every 1 foot of vertical rise, there are 12 feet of horizontal run). If the ramp needs to reach a porch that is 3 feet high, how long will the ramp need to be?

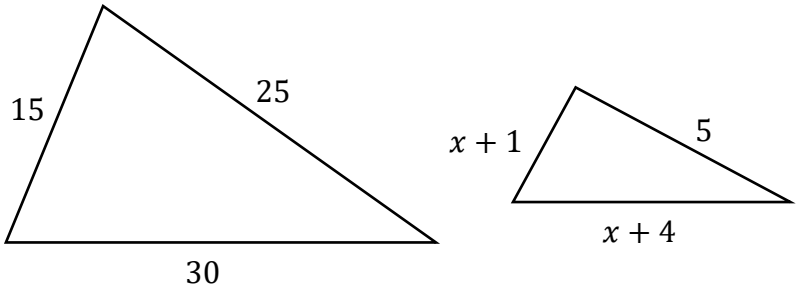
Need Help?

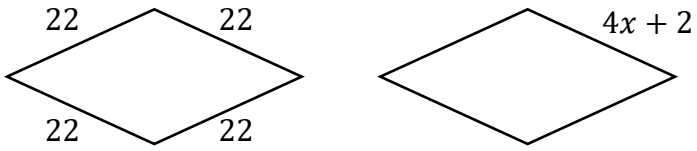
Main Topic **Congruent and Similar Polygons**

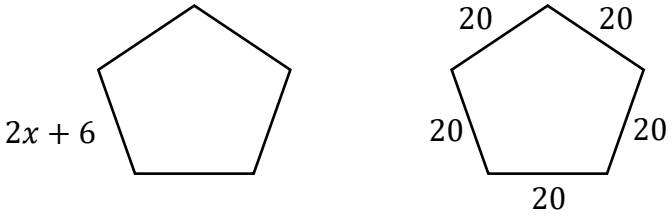
Solve for x.











A city park has a rectangular playground with a length of 40 meters and a width of 25 meters. The plans call for building a smaller, similar playground for a new community center. The scale factor between the new playground and the existing one will be 2/5.

- What will be the dimensions (length and width) of the new playground?

- If the existing playground has a perimeter of 130 meters, what will be the perimeter of the new playground?

An architect is designing a new building with a flat roof. To ensure proper water drainage, the roof will be tilted slightly in the shape of a trapezoid. A model of the roof is built at a 1:10 scale, with a base length of 12 cm and a height of 5 cm.

- What will be the actual base length and height of the full-sized roof on the building?

- If the model has a drainage pipe at the midpoint of the shorter base, at what distance from the edge of the actual roof should the drainage pipe be placed?

A graphic designer has created a pentagon-shaped logo for a soccer team. The original logo has a side length of 3 cm. They need to create a larger version for a banner that will maintain the same pentagon shape. The banner version needs to have a side length that is 2 times longer than the original logo.

- What will be the side length of the pentagon logo on the banner?

- Since the perimeter is the total length of all sides added together, how will the perimeter of the logo on the banner compare to the original logo's perimeter?

A stop sign is an octagonal shape with equal sides. A traffic engineer is designing a miniature replica of the stop sign for educational purposes. The actual stop sign has a side length of 1 meter.

- The replica will be made from a reflective material that comes in sheets 20 cm wide. The engineer wants the replica to be as large as possible while still fitting on a single sheet. What scale factor should be used to create the replica, and what will be the side length of the replica stop sign?

- The actual stop sign has a reflective border along each side that is 5 cm wide. The engineer wants to include a proportionally sized reflective border on the replica. What width should the reflective border have on the replica stop sign?

SEL Activity

The Blueprint of You

Self-Awareness & Social Awareness

The Concept: A polygon is defined by its vertices and sides. Congruent polygons are carbon copies; similar polygons are proportional versions.

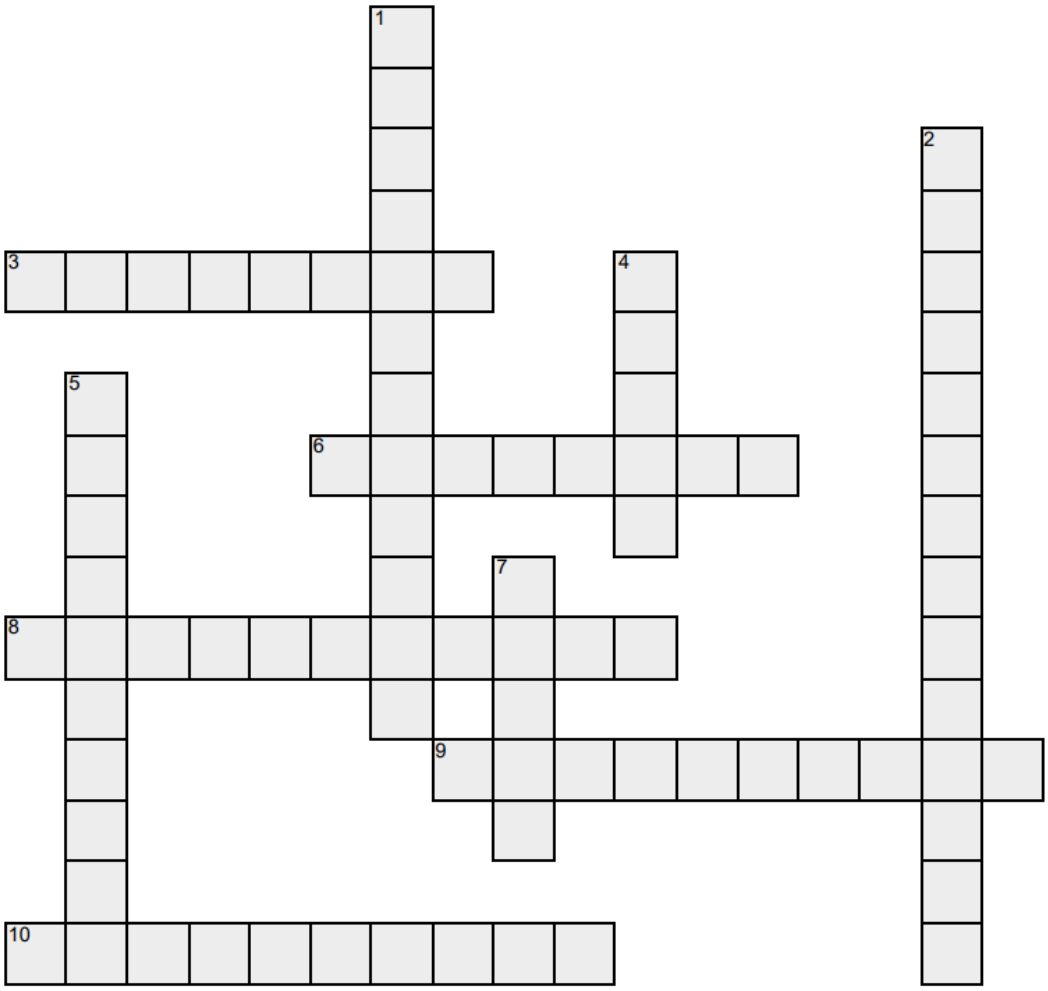
Activity:

1. **Define Your Shape:** If your personality was a polygon, how many "sides" would it have? (e.g., Student, Athlete, Artist, Friend, Sibling).

2. **The Congruence Challenge:** Think of a time you felt pressured to be **congruent** to a peer group—acting exactly like them to fit a "perfect match."

3. **Reflection:** "In geometry, congruence is rigid. In life, trying to be a perfect copy of someone else can feel 'stiff.' Does being congruent to a group make you feel safe, or does it feel like you're losing your own 'coordinates'?"

Congruence and Similarity



Across	Down
3. A transformation that turns a figure around a fixed point by a specific angle. 6. A transformation that resizes a figure by a specific factor (called the scale factor) around a fixed point. 8. A transformation that moves a figure in a specific direction without changing its size, shape, or orientation. 9. It refers to two shapes whose corresponding sides and angles are proportional to each other. 10. A transformation that creates a mirror image of a figure across a line.	1. The corresponding sides and angles of similar figures are _____. 2. A rule or process that manipulates a geometric figure to create a new figure. 4. A rule or process that manipulates a geometric figure to create a new figure. 5. It refers to two shapes being identical in both size and shape. 7. _____ motion is transformation that does not distort the size or shape of a figure (same as isometry).

Unit 3 | Functions

Architecture

8th Grade Mathematics

North Carolina 8th Grade Math Standards

Unit 3

Define, evaluate, and compare functions.	
NC.8.F.1	Understand that a function is a rule that assigns to each input exactly one output. • Recognize functions when graphed as the set of ordered pairs consisting of an input and exactly one corresponding output. • Recognize functions given a table of values or a set of ordered pairs.
NC.8.F.2	Compare properties of two linear functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
NC.8.F.3	Identify linear functions from tables, equations, and graphs.

Use functions to model relationships between quantities.	
NC.8.F.5	Qualitatively analyze the functional relationship between two quantities. • Analyze a graph determining where the function is increasing or decreasing; linear or non-linear. • Sketch a graph that exhibits the qualitative features of a real-world function.

3.1 The Coordinate System

Warm-Up

Write all you know about the Coordinate System.

Main Topic **The Cartesian Plane**

TASK 1

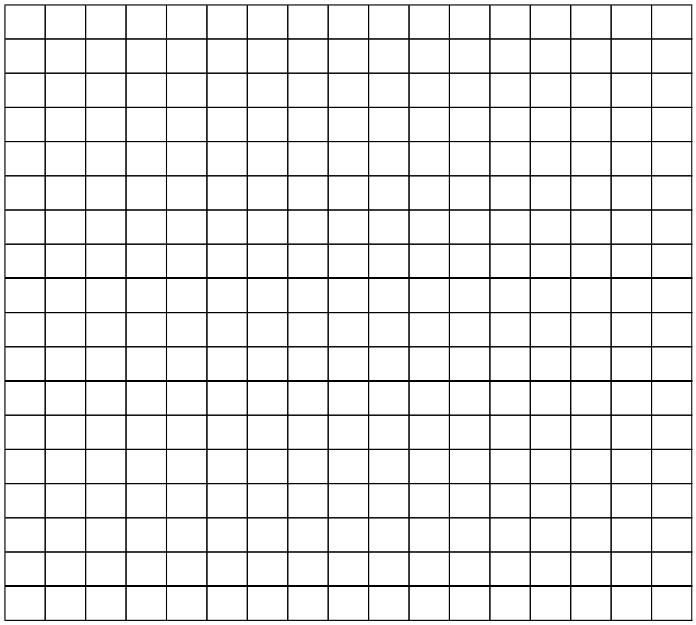
- Draw an x-axis then label.
- Draw a y-axis then label.
- What do you call the intersection between the axes?
- Label the quadrants (I, II, II, IV).
- Plot and connect the points consecutively.

$A(5,0), B(2,-2)$

$C(0,-5), D(-2,-2)$

$E(-5,0), F(-2,2)$

$G(0,5), H(2,2)$



Identify the quadrant location of the points.

$(3,-1)$	$(-5,-2)$	$(1,6)$
$(-32,100)$	$(-0.71,-58.01)$	$\left(5\frac{1}{2},\frac{1}{4}\right)$

Need Help?

Identify the coordinates of the plotted points.

A

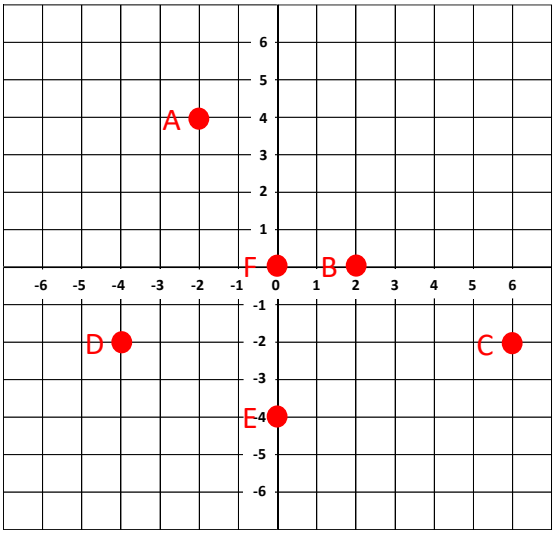
B

C

D

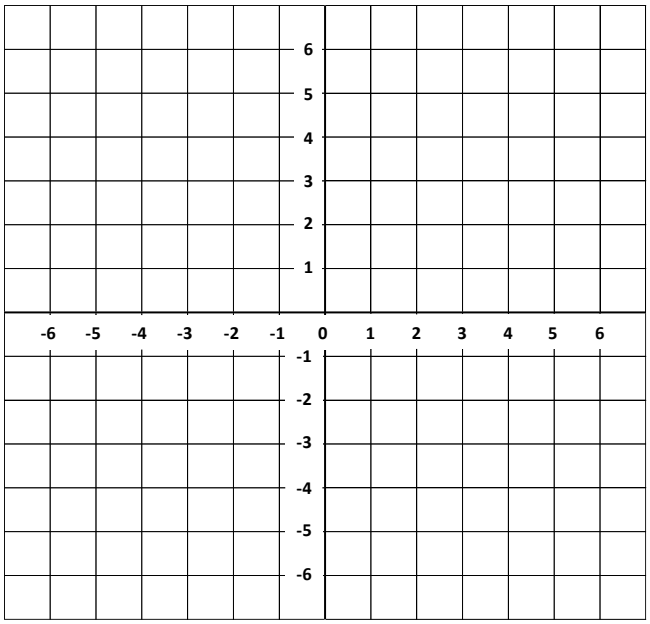
E

F



TASK 2

- Draw a line that passes through $(-5, 1)\ and\ (0, 4)$.
- Describe the line.



- Draw a line that passes through $(4, -3)\ and\ (-2, 5)$.
- Describe the line.

- How do you determine when the graph is increasing?

_____

- How do you determine when the graph is decreasing?

_____

Need Help?

My Dream House Design
(Front View)

Activity Goal

To design the front elevation of a house using line segments and accurately identify the (x, y) coordinates of the endpoints of these segments.

Part 1: Setting Up the Design Grid

1. **Materials:** Graph paper (or digital grid tool), ruler, pencil/pen, colored pencils (optional).
2. **Establish the Axes:**
    - Draw and label the **x-axis** (horizontal) and the **y-axis** (vertical) on the graph paper. The intersection is the origin (0, 0).
    - **Scale:** Define a scale. For this activity, let **1 unit on the grid equal 1 foot (ft)** in the house design.
    - **Foundation:** The ground level of the house should rest on the **x-axis** (y=0).

Part 2: Drawing the Dream House (Front View)

Draw the front view of your dream house, ensuring all lines are straight segments. Be creative!

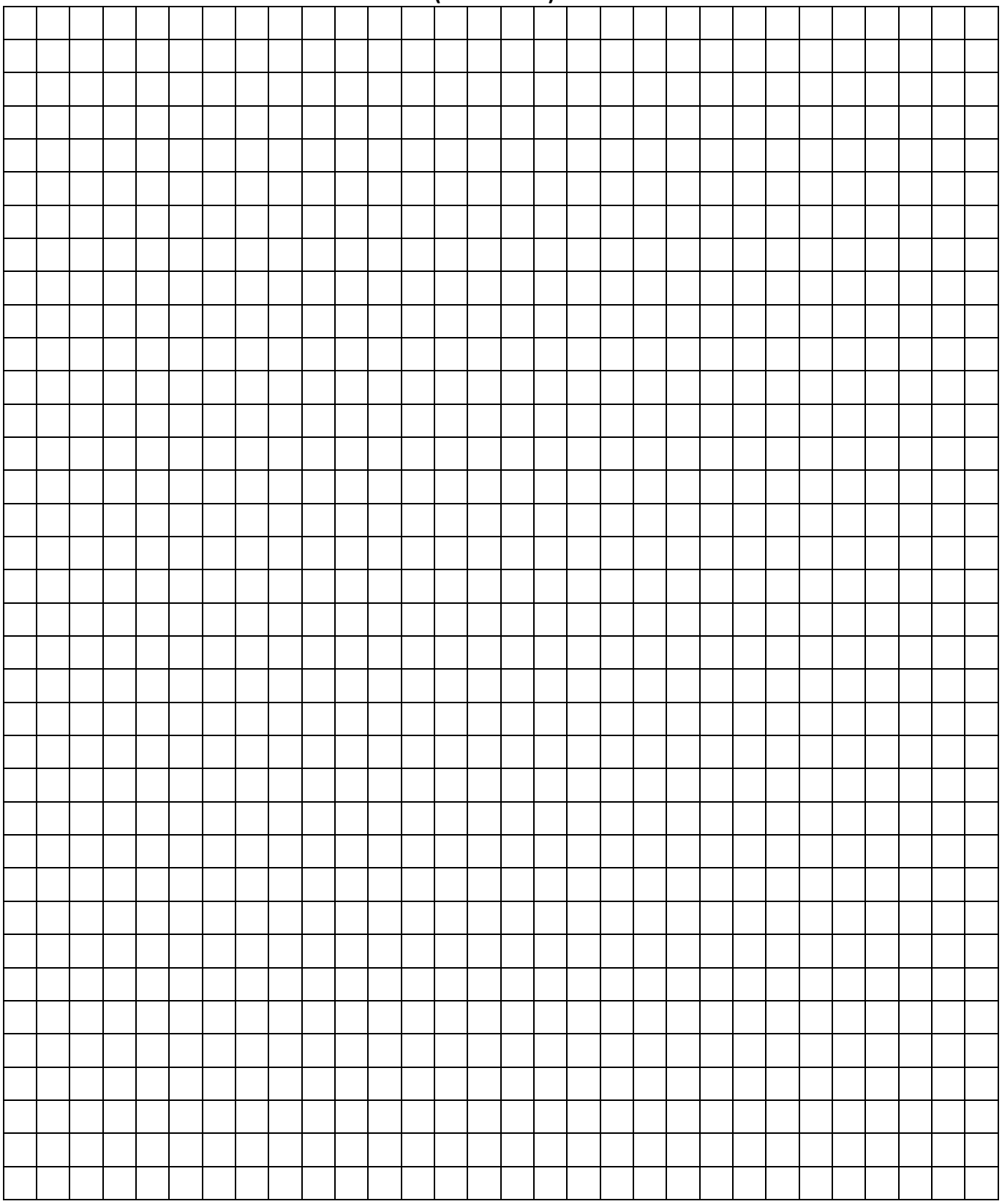
Required Elements to Include:

1. **Main Structure:** A basic rectangular or square outline for the house body.
2. **Roof:** A triangular, trapezoidal, or gabled roof structure.
3. **Door:** A single front door segment.
4. **Windows:** At least two distinct window outlines (can be rectangular or square).
5. **Optional:** Chimney, porch railing, or other architectural details.

Part 3: Coordinate Identification and Documentation

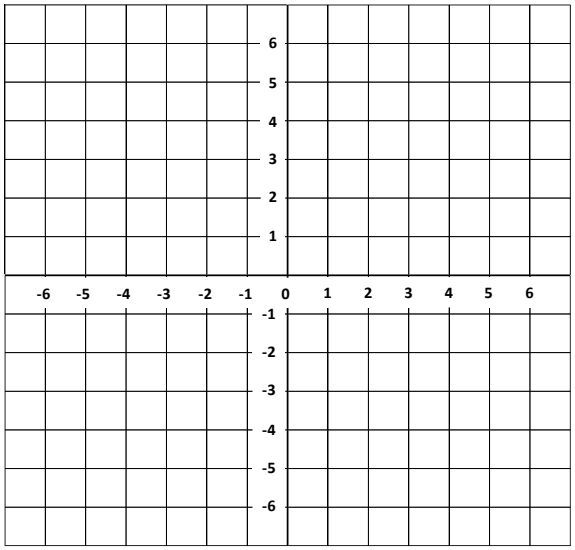
After completing the drawing, systematically identify and record the coordinates for the endpoints of every line segment used in the drawing. Ex. Roof endpoints (-8, 15) and (-1, 21).

My Dream House Design
(Front View)



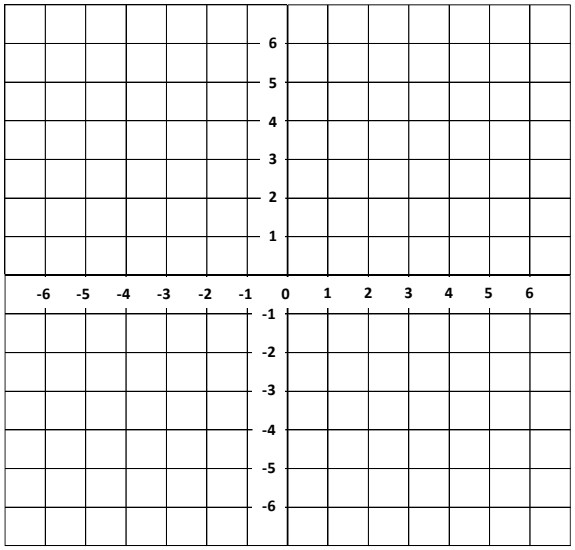
TASK 3

- Draw a curved graph with a maximum at $(2, 5)$, but no minimum point.
- What is the math term for values that goes down continuously?



TASK 4

- Draw a curved graph with a minimum at $(-2, -3)$, but no maximum point.
- What is the math term for values that goes up continuously?



Describe a straight graph.

_____

_____

Describe a curved graph.

_____

_____

The Coordinate System Gallery

Write your name on each sticky note. Define the term.
Then, post your sticky note next to the poster across the classroom.
Once everyone has finished, take a look at your classmates' work and see if you can learn from their approach!

Ordered Pair

Quadrant

Axes

Origin

Vertical

Horizontal

Honors Level

Explain the difference between the Cartesian coordinate system and the number line.

Why is the order of the coordinates in an ordered pair (x, y) crucial?
What geometric concept does this emphasis on order represent?

Describe the geometric transformation (reflection) that occurs when you negate only the x-coordinate, only the y-coordinate, and both coordinates.

How is a translation (shifting a shape) represented algebraically using coordinates, and what property of the shape remains invariant under translation?

What fundamental geometric concept (e.g., perpendicular lines, unit distance) is the entire Cartesian plane structure built upon, and why must the axes be perpendicular?

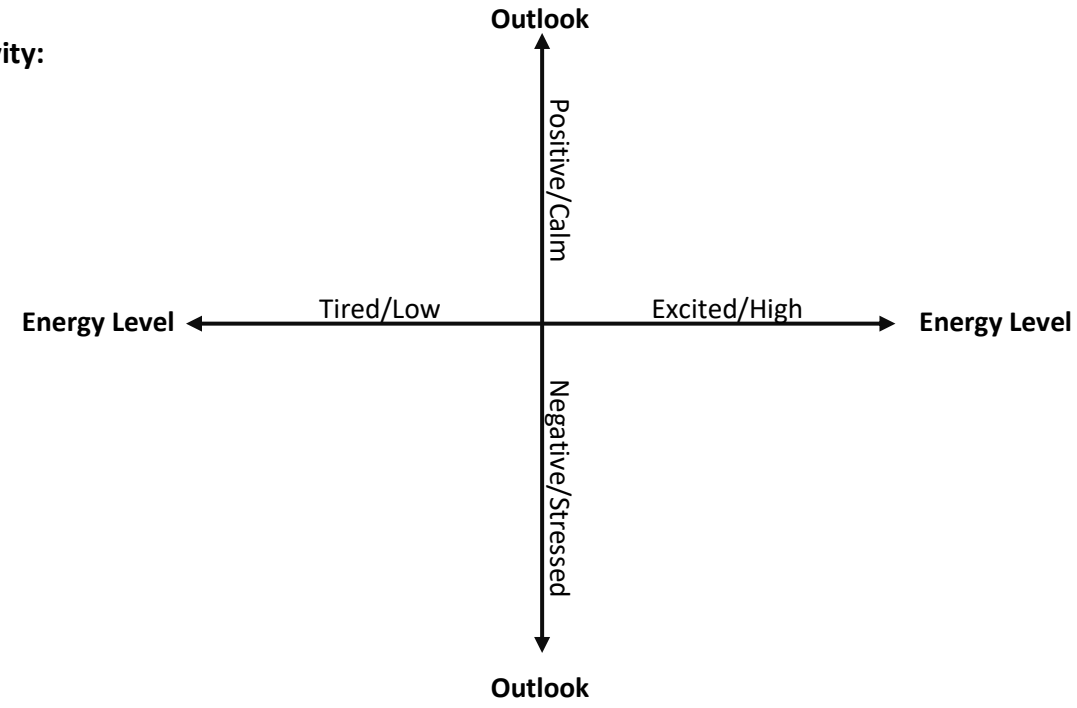
SEL Activity

Mapping Your Mindset

Self-Awareness & Management

The Concept: The two axes divide the world into four distinct areas. In this activity, we rename the axes to map our "Internal Weather."

Activity:



Plotting Points: Plot your 'Today Point.' Where are you right now? Label it point T.

T**he SEL Bridge:** No quadrant is 'bad.' We all spend time in Quadrant III (Tired/Stressed). The goal of math is to know your coordinates; the goal of SEL is to know how to move to a new point if you want to.

Task: Plot Point G (Goal). Where do you want to be by the end of the day? Write the ordered pair and one 'translation' step to get there (e.g., 'Take a 5-minute break').

3.2 Understanding Relations and Functions

Warm-Up

Write all you know about relations and functions.

Main Topic **Defining the Relation**

Designing a Window for Sun Exposure

An architect is designing a small, rectangular window for a sunroom. The total area of the glass must be 12 square feet (12 ft^2). The architect needs to determine the possible combinations of width (w) and height (h) for the window.

Part 1: Defining the Relation

The relationship between the width (w) and height (h) is determined by the fixed area formula:

$$Area = w \cdot h$$

- **Relation Definition:** This equation establishes a **relation** between the width (w) and the height (h). For every possible width, there is a corresponding height that satisfies the area requirement.
- **Creating a Data Table (Possible Window Dimensions):**

Width (w) (feet)	Calculation (12/w)	Height (h) (feet)	Ordered Pair (w, h)
1	12 / 1	12	(1, 12)
2	12 / 2	6	(2, 6)
3			
4			
6			
12			

Main Topic **Defining the Functions**

Part 2: Defining the Function

To determine if this relation is also a function, we need to isolate one variable. In architectural design, the height of a window is often chosen first, as it affects the ceiling and sightlines. Let's make Height (h) the input (independent variable) and Width (w) the output (dependent variable).

- **Function Rule**: Rewrite the relation to express w as a function of h:

$$w(h) = \frac{12}{h}$$

- **Function Check:** For every specific height (h) the architect chooses, is there exactly one unique width (w) that results in a 12 ft^2 area?

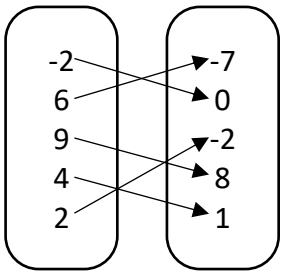
  Answer:

  Conclusion: Because every input (h) has exactly _____ output (w), the relation $w = \frac{12}{h}$ is a _____.

Relation	A relation is like a rule or connection between two sets of things.

Note: If you can create a set of ordered pairs, then it is a relation. Meaning, there is a relationship between the sets of things.

Create sets of ordered pairs.

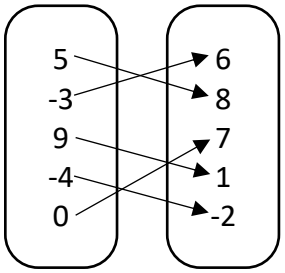
	$y = 3x - 1$

Function	A set of ordered pairs whose x-values are not the same.

Note: If x-values are repeated, then it is not a function. It's a relation, but not a function.

TASK 1

- Create a set of ordered pairs from the diagram.



- Is it a relation? Explain.

_____

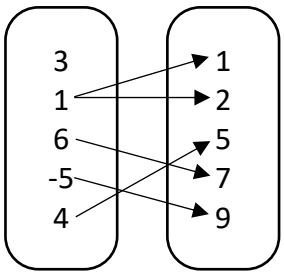
_____

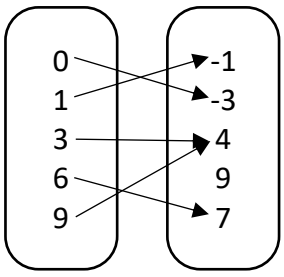
- Is it a function? Explain.

_____

_____

Determine if the relations are functions or not. Prove.





Need Help?

TASK 2

- Create a set of ordered pairs from the table.

x	4	7	8	7
y	-2	0	6	10

- Is it a relation? Explain.

_____

_____

- Is it a function? Explain.

_____

_____

Determine if the relations are functions or not. Prove.

x	-9	3	5	0
y	1	4	7	9

x	18	4	25	25
y	0	-1	7	2

x	11	3	6	2
y	3	-6	1	8

TASK 3

Determine if the relation $y = 3x - 6$ is a function.

- Create a set of ordered pairs.
  - Pick a number.
  - Plug it into the x-value.
  - Solve for y.
  - Write the ordered pair.
- Repeat the process at least 3 times.
- Is it a relation? Explain.

_____

_____

- Is it a function? Explain.

_____

_____

Determine if the relations are functions or not. Prove.

$y = x - 1$	$y = -x + 4$
$y = 5 - 2x$	$y = x^2 + 3$
$y = 3 - x^2$	$y = \frac{1}{2}x$

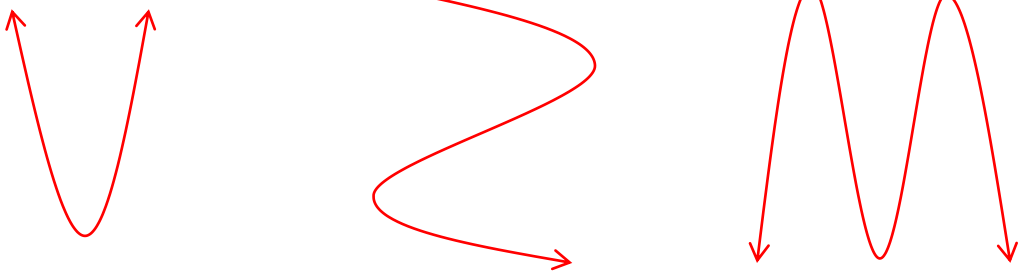
Need Help?

Vertical Line Test

A relation is **NOT** a function when a vertical line crosses the graph at **more than** 1 point.

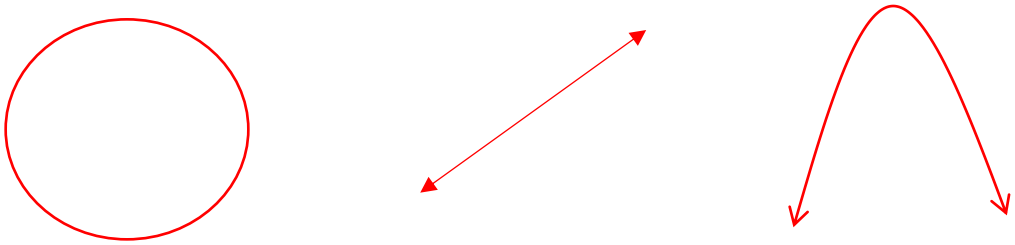
TASK 4

- Draw a vertical line on each graph.
- Identify the intersection(s) between the vertical line and the graph.
- Determine if a graph is a function or not.



Quick Math

Cross out the graph that is NOT a function.



Honors Level

What is the single, crucial distinction that elevates a special type of relation to the status of a function?

Conceptually, what does it mean to say a function is a "mapping" or a "rule," and why is the constraint on the input critical to this definition?

Explain why the Vertical Line Test works to identify a function and what the vertical line passing through two points graphically signifies about the input-output pairing.

In a table of ordered pairs, how would you visually identify a relation that is *not* a function?

How does the way you define the input and output variables (independent vs. dependent) determine whether a real-world scenario is best modeled as a function or just a general relation?

SEL Activity

The Function of Trust

Relationship Skills & Responsible Decision-Making

The Concept: A relation is any set of ordered pairs. A function is a special relation where each input x is paired with exactly one output y.

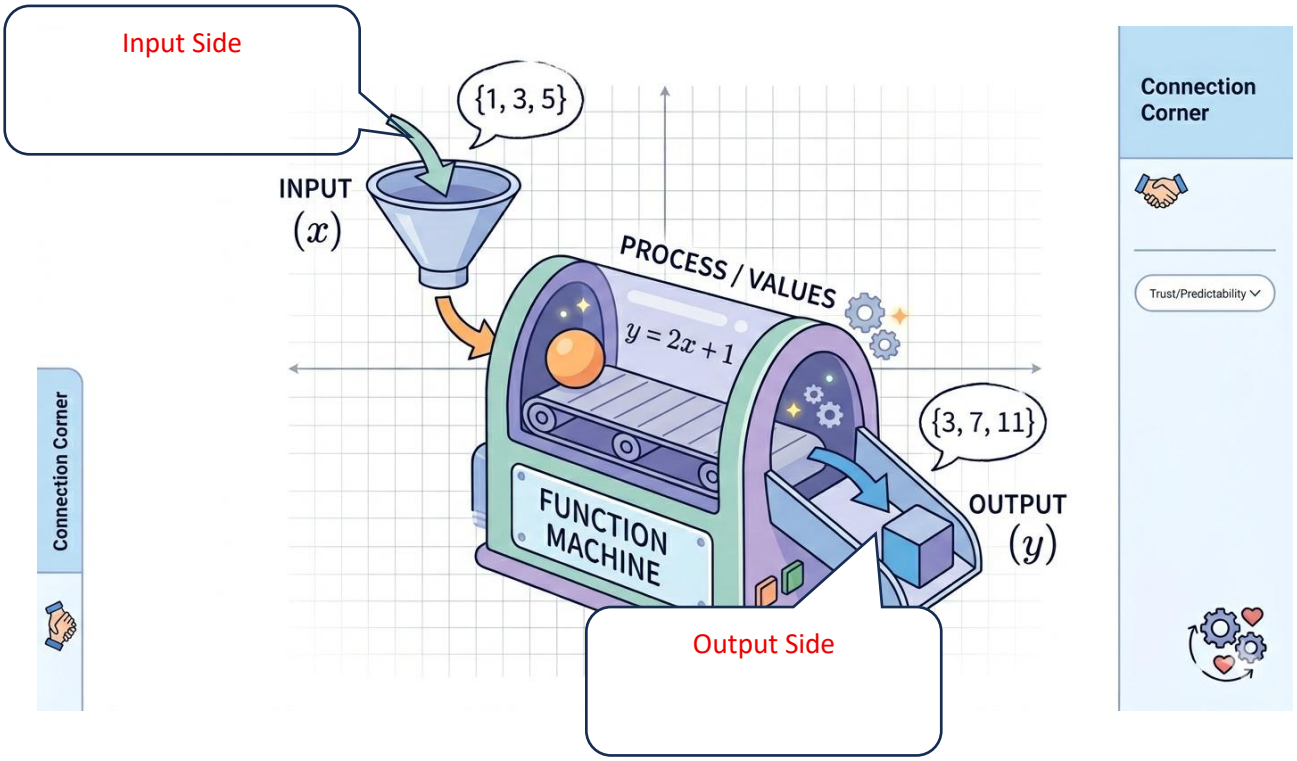
Activity:

Think of a "Social Input" (e.g., *Telling a secret* or *Asking for help*).

The Function Check: In a healthy friendship, your 'Input' should have a predictable 'Output.' If you ask for help (Input), and sometimes you get support (Output A) but other times you get ignored (Output B), that relationship is a **Relation**, but it isn't functioning reliably.

Task: Create a mapping diagram for a "Healthy Friendship Function."

- **Input Side:** List three actions you take (e.g., Being honest, showing up on time).
- **Output Side:** List the one reliable response you expect from a true friend.



3.3 Representing Functions

Warm-Up

Evaluate: $x = 8$ $y = -1$

$h = 2x - 6$ $m = \frac{1}{2}y + 1$ $s = 8x - 2y$

Main Topic **Equations of Functions**

The day at the amusement park is finally here! After all the anticipation, my family and I are getting ready to head out from our hotel. We'll be catching a taxi to the park, which charges a flat fee of $12 plus $5 per mile.

No. of Miles	Total Cost	Expression
0		
1		
2		
3		
4		
5		
n		

How much is the total cost of the ride if their hotel is 7 miles away from the park?

Need Help?

Main Topic **Tables of Functions**

Function Notation

A function can be denoted by $f(n)$, where "f" represents the function name and "n" represents the input variable.

Designing a Roller Coaster Ramp

An amusement park architect is designing the start of a roller coaster track. The initial climb is a straight, steady ramp that must rise a certain amount for every horizontal distance it covers. The relationship between the horizontal distance (x) and the height (f(x) or y) is modeled by a linear function.

The architect knows the following two facts about the ramp:

1. The ramp starts at a height of 5 meters above the ground (the starting platform).
2. For every 10 meters the ramp travels horizontally, it rises 6 meters.

Part 1: Defining the Linear Function

The general form of a linear function is f(x) = mx + b, where:

- x = **Horizontal Distance** from the start (in meters - the independent variable).
- f(x) (or y) = **Height** of the track above the ground (in meters - the dependent variable).
- m = **Slope** (the rate of change, or "rise over run").
- b = **Y-intercept** (the starting height when x=0).

Write the equation of the function.

Part 2: Completing the Table of Values

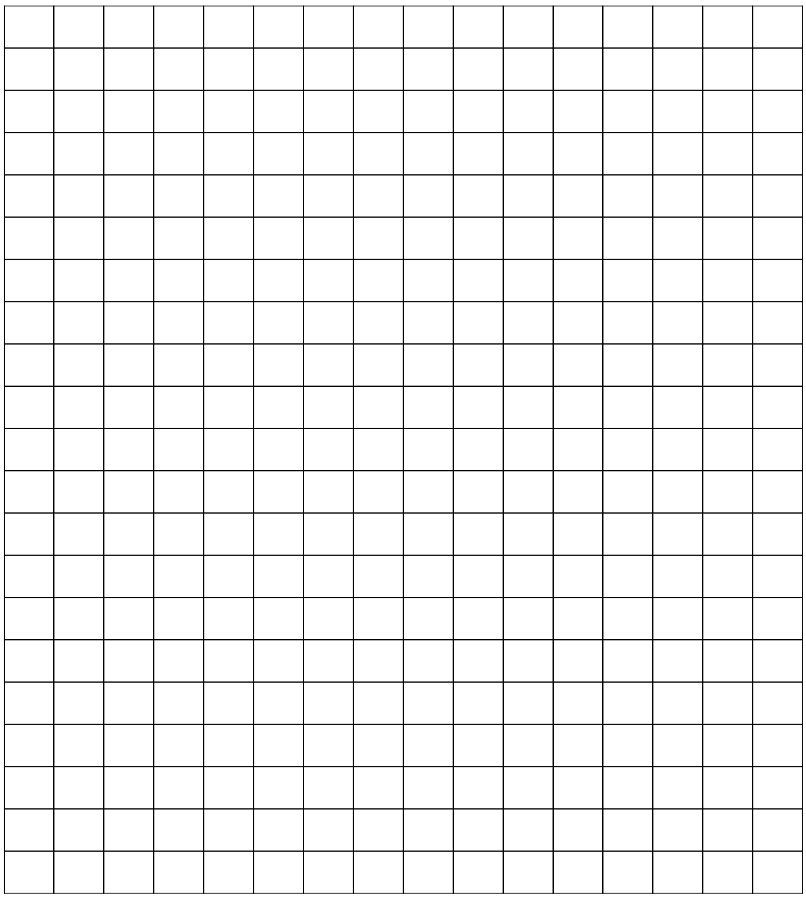
Use the function, f(x), to calculate the height of the roller coaster track at various horizontal distances.

Horizontal Distance (x) (meters)	Calculation	Height (f(x)) (meters)
0		
5		
10		
25		
50		

Main Topic **Graphs of Functions**

Equation	Table
$y = 3x + 2$	

x	y
0	
1	
2	
3	



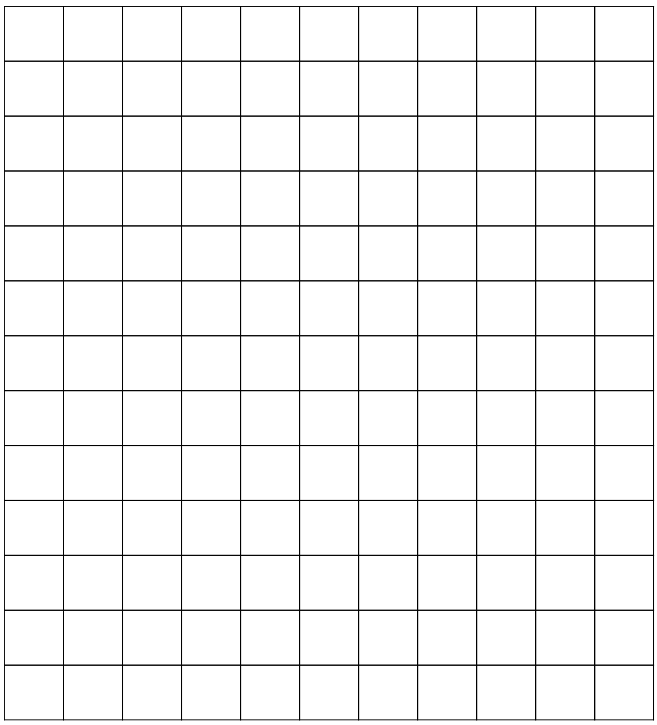
Write your observations about the graph.

_____

_____

Graph: $f(x) = x^2$

x	y
-3	
-2	
-1	
0	
1	
2	
3	



Write your observations about the graph.

_____

_____

Quick Math

Circle the functions that represent a nonlinear graph.

$f(x) = 3x + 2$ $h(n) = n^2 - 5$ $t(s) = 7 - 2s$

$a(b) = 7b + 1$ $f(n) = 10n + 4$ $f(x) = 5 - 6x^2$

Grouping Functions

Put the equation, table, and graph together.

Linear Function

Nonlinear Function

Grouping Functions

Put the equation, table, and graph together.

Linear Function

Nonlinear Function

Honors Level

What is the fundamental definition of a function, and how does it relate to the concept of a unique output for every input?

If you are given a function as a graph, how do you generate three distinct (x, y) pairs for a corresponding table?

Given an equation, y = f(x), explain the steps to construct a table of values that accurately represents the function.

When would a table be a more effective representation of a function than an equation, and vice versa?

In what situations is the graphical representation of a function most useful for understanding its behavior (e.g., intercepts, minimums, maximums)?

SEL Activity

The Four Faces of You

Self-Awareness & Relationship Skills

The Concept: A function often starts as a "Rule" described in words.

Activity:

1. **Define Your Rule:** Think of a "Personal Function" for your week.
   Example: "For every hour I spend practicing my sport/hobby (x), I feel two units of confidence (y).

2. **The Table:** Create a 4-row table for your rule.
   - Input (x): Hours of practice.
   - Output (y): Units of confidence.

3. **Reflection:** If you look at your table, does your 'Output' match your effort? Does your 'Rule' help you grow, or is it a rule that makes things harder for you?

4. **The Social Connection:** In a function, an input cannot have two different outputs. If your friend is kind one day (Input) but mean the next (different Outputs for the same Input), that relationship is not functioning. It's just a relation.

5. **Closing Questions:**
   - If you only saw a 'Table' of someone's actions without knowing their 'Word' (their story), would you have the full picture?

   - Why is it important to look at all 'Representations' of a person before judging them?

3.4 Identifying Linear and Nonlinear Functions

Warm-Up

Draw at least two nonlinear graphs.

Main Topic **Linear Functions**

Cost of Blueprint Printing

An architectural firm needs to print a set of large-format blueprints for a new skyscraper project. The local printing shop charges based on the number of pages, plus a fixed setup fee.

- **The Fixed Cost (b):** The shop charges a **$50 setup fee** for preparing the digital files and calibrating the large-scale printer, regardless of the number of blueprints printed.
- **The Variable Cost (m):** The shop charges **$2.50 per blueprint page** printed.
- **The Variables:**
  - x = Number of blueprint pages printed.
  - f(x) = Total cost of printing (in dollars).

Create an equation.	Graph
Create a table.	

What is the initial value of the function?

What is the constant rate of change of the function?

Need Help?

Main Topic **Linear Function vs. Nonlinear Function**

TASK 1

- What do you notice about the y-values in the table?

_____

_____

- Create an equation.

- Is it a linear function or not? Explain.

_____

_____

_____

x Input Independent	y Output Dependent
1	4
2	6
3	8
4	10
5	12

TASK 2

- What do you notice about the y-values in the table?

_____

_____

- Create an equation.

- Is it a linear function or not? Explain.

_____

_____

_____

x Input Independent	y Output Dependent
1	1
2	3
3	9
4	27
5	81

Main Topic **Linear Function vs. Nonlinear Function**

TASK 3

- What do you notice about the y-values in the table?

  _____

  _____

- Create an equation.

- Is it a linear function or not? Explain.

  _____

  _____

  _____

x Input Independent	y Output Dependent
1	1
2	4
3	9
4	16
5	25

Create a linear function and a nonlinear function.

Linear Function		**Nonlinear Function**	
Equation	Table	Equation	Table

Main Topic **Rate of Change**

Define “Rate of Change” in your own words.

Rate of Change

Which function has the greater rate of change?

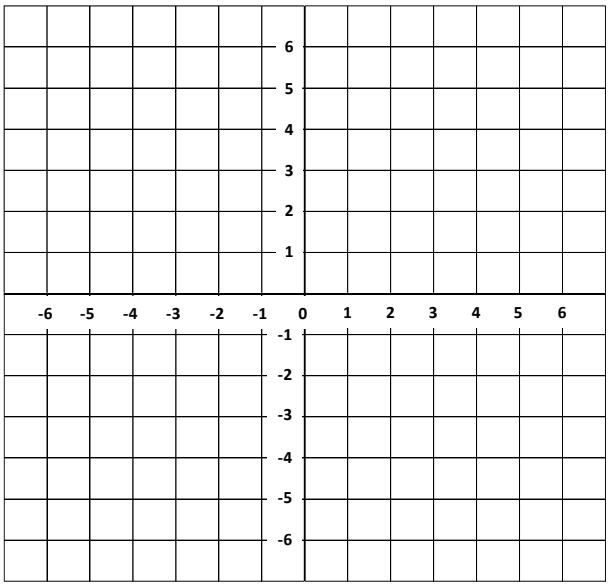
Functions A

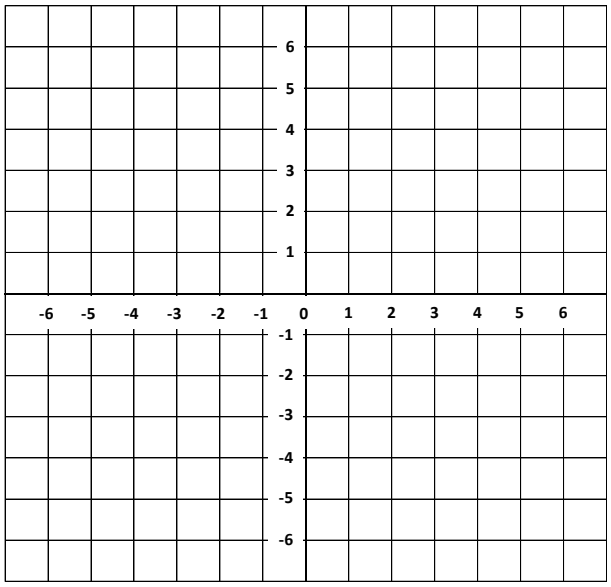
x Input Independent	y Output Dependent
1	1
2	6
3	11
4	16
5	21

Functions B

x Input Independent	y Output Dependent
1	2
2	4
3	6
4	8
5	10

Graph examples of nonlinear functions below.





Main Topic **Applications of Functions in Architecture**

Cost of Tiling

An architect needs to calculate the cost of tiling a long hallway. The tiler charges a fixed rate of $500 for equipment rental plus $15 per square meter of tile installed. Is the total cost a linear or non-linear function of the area of the hallway?

Bricklaying Time

A bricklayer can lay 70 bricks per hour after a 30-minute setup time. Is the total number of bricks laid a linear or non-linear function of the total time spent working?

Window Area

The budget requires that all square windows installed in a building have an area of Area = s^2, where s is the side length. Is the window's area a linear or non-linear function of its side length?

Suspension Bridge Cable

The shape of the main cable of a suspension bridge, hanging between two towers, is defined by a parabolic curve. Is the height of the cable a linear or non-linear function of the horizontal distance from the tower?

Honors Level

What is the single most defining characteristic of a linear function that is always absent in a non-linear function? (Hint: Think about the rate of change).

Explain the concept of constant rate of change and how it geometrically manifests in a linear function's graph.

When analyzing a table of values, what specific relationship between successive y-values must hold true for the function to be linear?

A function's table shows the output doubling every time the input increases by 1. Is this function linear or non-linear? What type of function is it?

What is the fundamental visual test you would apply to a function's graph to immediately confirm that it is non-linear?

SEL Activity

The Shape of Progress

Self-Management & Persistence

The Concept: A linear function moves at a constant rate (y = mx + b). For every step forward, you go a predictable amount up.

Activity:

1. **The Expectation:** We often think learning a new skill (like a language or an instrument) should be linear. "If I practice 1 hour, I should get 1 unit better every single day."

2. **The Table:** Look at this "Expectation Table."
   - *Day 1:* 10% Skill
   - *Day 2:* 20% Skill
   - *Day 3:* 30% Skill

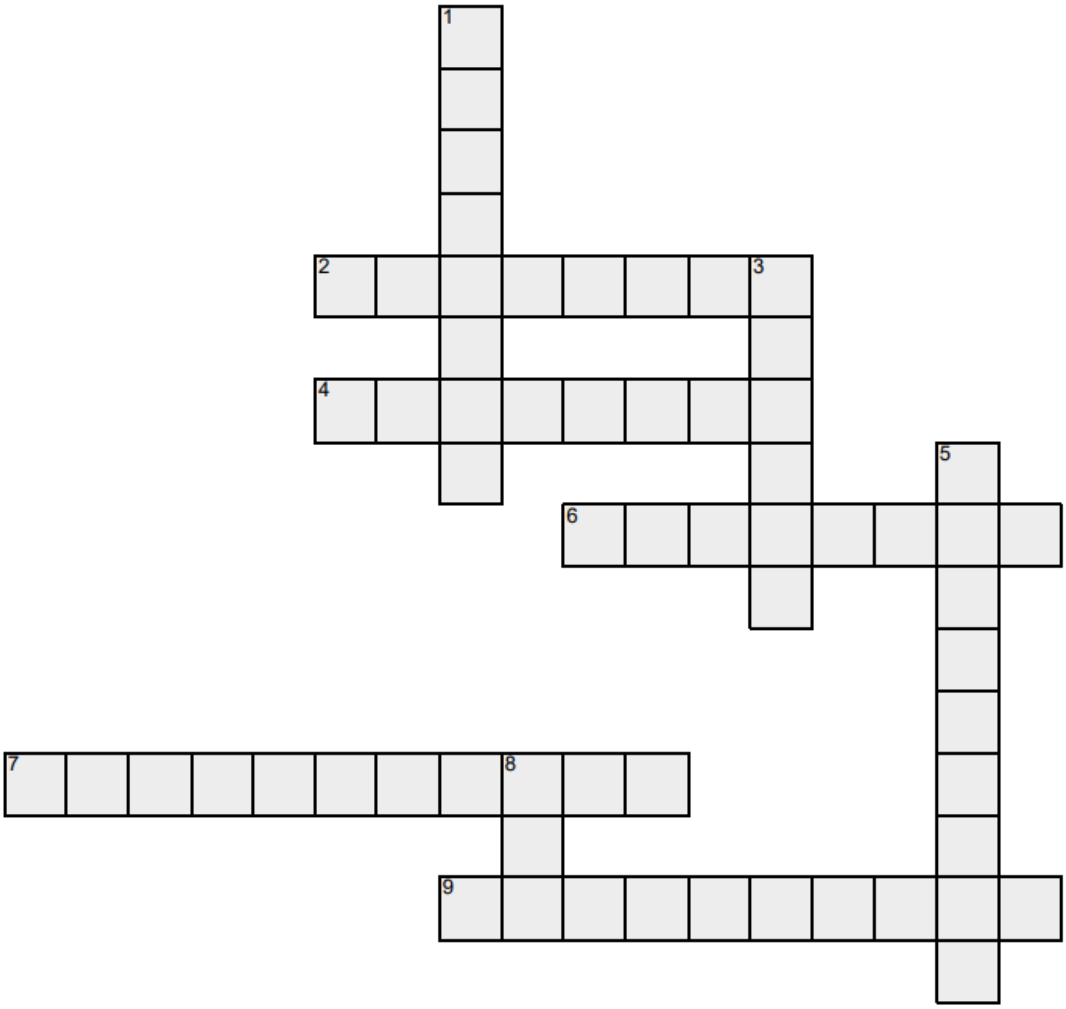
3. **Reflective Prompt:**
   - Why does the 'Linear Expectation' sometimes make us want to quit?
   - If we have one bad day where we don't 'move up the line,' why do we feel like we've failed?

4. **The SEL Bridge:** Progress is nonlinear. You might practice for weeks with no visible change (the flat part of the curve), and then suddenly, everything clicks (the steep part of the curve).

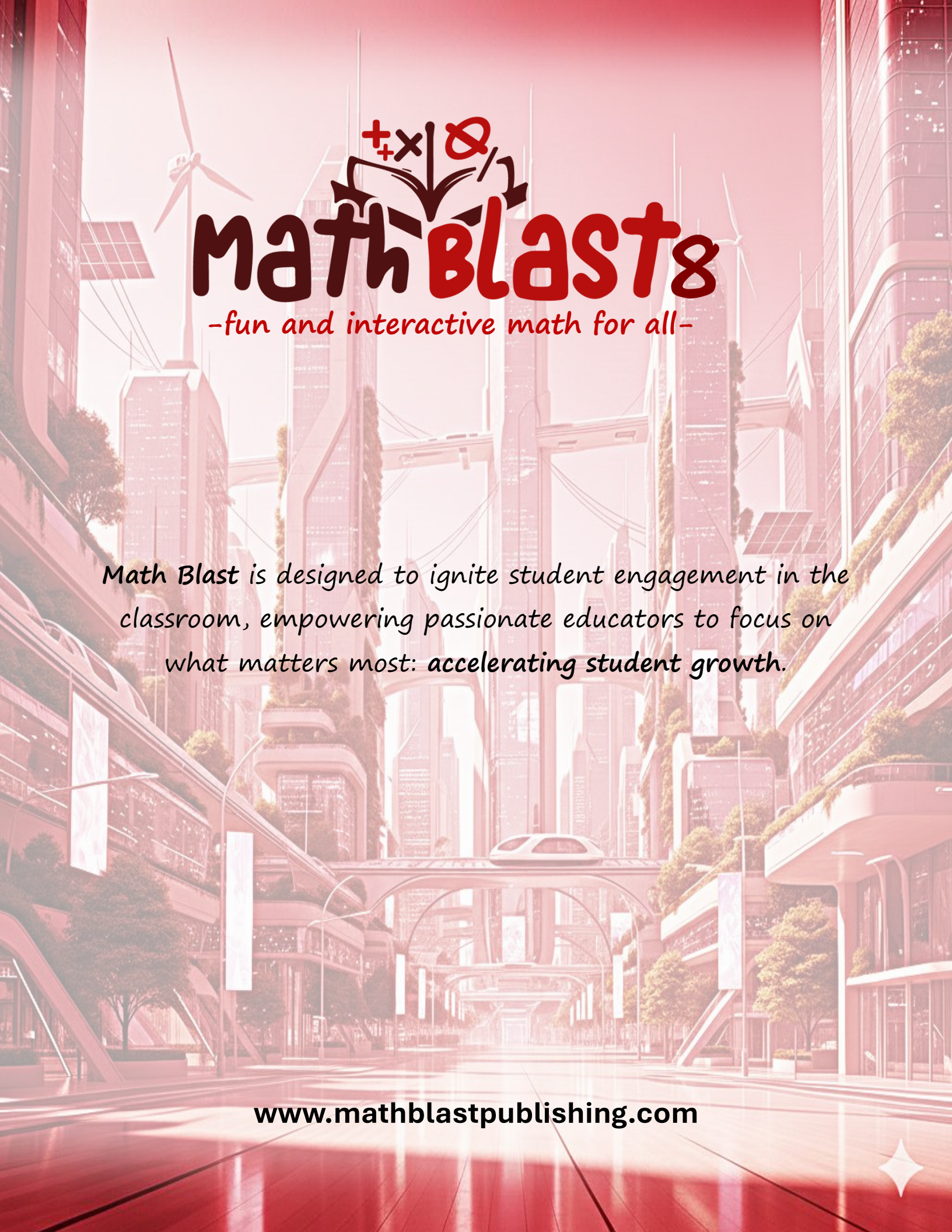
5. **Task:** Think of a skill you've learned. Draw a nonlinear line that represents your journey. Did you have a 'dip' where things got harder before they got easier?

6. **Closing Question:** If you are in a 'flat' part of your growth curve right now, what mathematical proof can you use to remind yourself that the rate of change is likely to increase again soon?

Functions



Across	Down
2. _____ line is a line parallel with the y-axis. 4. A special type of relation between two sets, and it describes a rule or process that assigns a single output value (y) to each input value (x) within the domain. 6. A collection of ordered pairs that link elements from two sets. 7. The pair of x-value and y-value, also known as ordered pair. 9. _____ line is a line parallel with the x-axis.	1. A region created by the intersection of the horizontal x-axis and the vertical y-axis. 3. A function whose graph has a constant rate of change. 5. A function whose graph does not have a constant rate of change. 8. A graph of relation is considered function when a vertical line does not intersect the graph at least_____ points.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