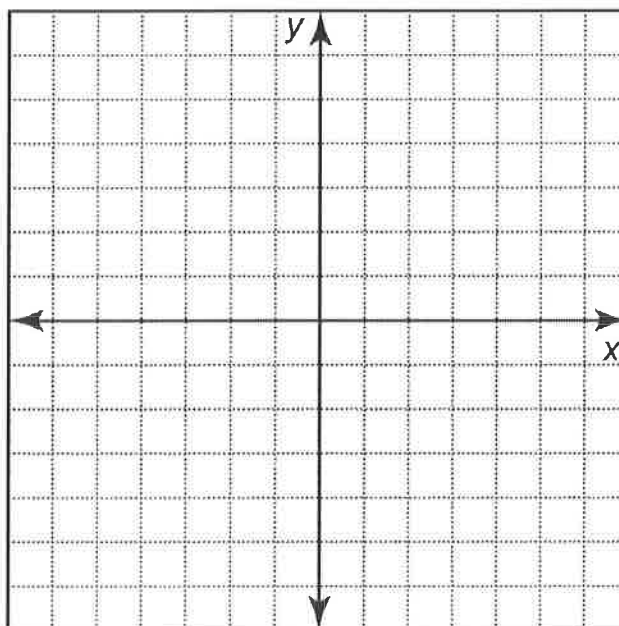


Day 1: Geometric Properties

Properties of Triangles

Part 1: Do It Now

- a) Draw the triangle with vertices $D(-2, -5)$, $E(2, 3)$, and $F(4, -3)$.



- b) Find the lengths of the sides of $\triangle DEF$.

Length of DE

$$(DE)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

Length of EF

$$(EF)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

Name: _____

Length of DF

$$(DF)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

c) Find the slopes of the sides of $\triangle DEF$.

Slope of DE

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope of EF

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope of DF

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

d) Classify $\triangle DEF$. Explain your reasoning.

Part 2: As a class we will use GSP to discover two geometric properties of medians

Properties Learned from GSP:

1. The medians of a triangle meet at a single point called the _____
2. Each median _____ the area of a triangle

Part 3: As a class we will attempt to prove geometric properties of medians.

- a) Find the centroid of triangle $O(0,0)$ $P(8,-4)$ $Q(4,4)$

Step 1: Find the Median of each side of the triangle

- Find the midpoint of the side
- Find the equation for the line that connects the midpoint to the opposite vertex

Find the Median of OP (Equation of line from midpoint of OP to vertex Q)

Chapter 3: Geometric Properties
Mr. Jensen

Name: _____

Find the Median of PQ

Find the Median of OQ

Step 2: Find the point of intersection of two pairs of lines

- Use either substitution or elimination

POI of OP and PQ

POI of PQ and OQ

Name: _____

Do the medians intersect at a single point? What is this point called? What are the coordinates of this point?

Day 1 Homework:

A landscape architect is drawing plans for a rigid triangular canopy to provide shade in a courtyard. On the drawing, the vertices of the canopy are $O(0,0)$, $P(10,0)$ and $Q(2,12)$. A single pole will support the canopy.

- a) The architect knows that the best place to support the canopy is at the centroid of the triangle. What are the coordinates of the centroid?

Step 1: Find the Medians of each side

- Find the midpoint of the side
- Find the equation for the line that connects the midpoint to the opposite vertex

Find the Median of OP (Equation of line from midpoint of OP to vertex Q)

Name: _____

Find the Median of PQ

Find the Median of OQ

Name: _____

Step 2: Find the point of intersection of two pairs of lines

- Use either substitution or elimination

POI of OP and PQ

POI of PQ and OQ (use this POI to verify that medians intersect at a single point)

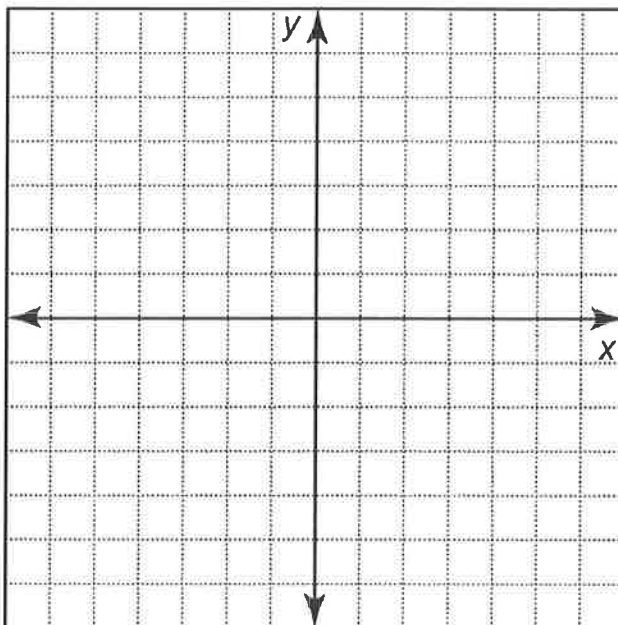
What are the coordinates of where the architect should support the canopy?

Geometric Properties Day 2

Properties of Triangles

Part 1: Do It Now

- a) Draw the triangle with vertices $D(-2, -5)$, $E(2, 3)$, and $F(4, -3)$.



- b) Find the lengths of the sides of $\triangle DEF$.

Length of DE

$$(DE)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

Name: _____

Length of EF

$$(EF)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

Length of DF

$$(DF)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

c) Find the slopes of the sides of ΔDEF .

Slope of DE

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope of EF

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope of DF

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

d) Classify $\triangle DEF$. Explain your reasoning.

Part 2: As a class we will use GSP to discover two geometric properties of the midpoints of a triangle

Properties Learned from GSP:

1. The line segment joining the midpoints of opposite sides of a triangle have _____ slope.
2. The line segment joining the midpoints of opposite sides of a triangle is _____ the length of the third side.

Part 3: As a class we will attempt to prove geometric properties of midpoints of a triangle.

Problem: For $\triangle ABC$, with coordinates $A(1,3)$, $B(7,5)$, and $C(5,1)$, show that the line connecting the midpoints of AB and BC is parallel to AC and half the length of AC .

Step 1: Find the midpoints of AB and BC

Midpoint of AB (point D)

$$(x, y) = \left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2} \right)$$

Midpoint of BC (point E)

$$(x, y) = \left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2} \right)$$

Name: _____

Step 2: Find the slope of DE and AC

Slope of DE

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope of AC

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Compare the slopes, are they equal?

Name: _____

Step 3: Find the Length of DE and AC

Length of DE

$$(DE)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

Length of AC

$$(AC)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

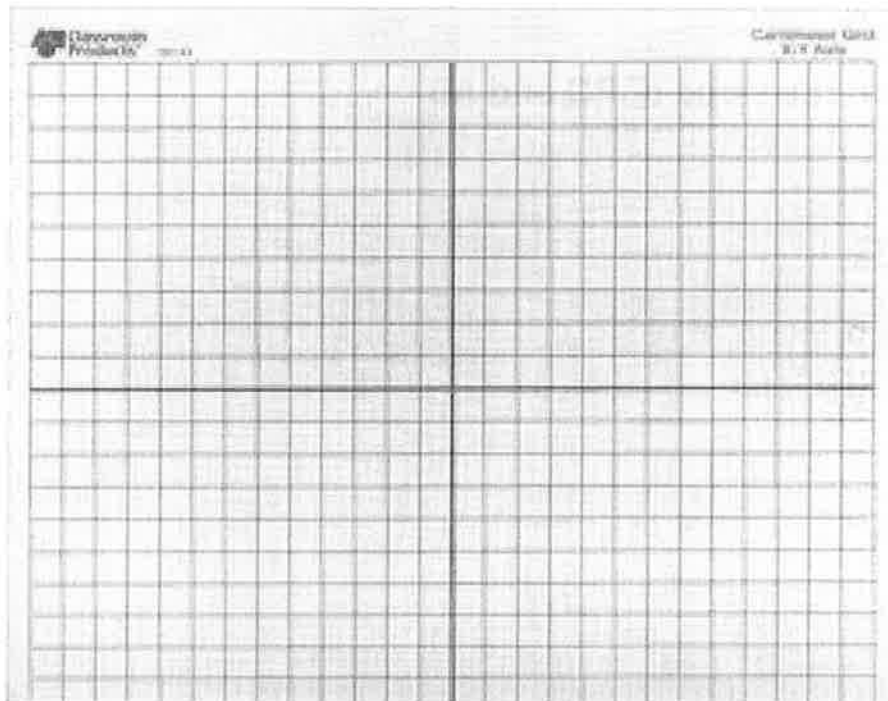
Compare the slopes, are they equal?

Make a conclusion about the line segment joining the midpoints of two sides of a triangle:

Day 2 Homework: Verify Properties of Midpoints of a Triangle

Problem: For $\triangle PQR$, with coordinates $P(2,4)$, $Q(-4,-6)$ and $R(12,0)$, show that the line connecting the midpoints of PR and QR is parallel to PQ and half the length of PQ

Step 1: Graph the triangle



Step 2: Find the midpoints of PR and QR

Midpoint of PR (point A)

$$(x, y) = \left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2} \right)$$

Name: _____

Midpoint of QR (point B)

$$(x, y) = \left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2} \right)$$

Step 3: Find the slope of PQ and AB

Slope of PQ

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope of AB

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Name: _____

Compare the slopes, are they equal?

Step 4: Find the Length of PR and AB

Length of PR

$$(PR)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

Length of AB

$$(AB)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$$

Compare the slopes, are they equal?

Day 3: Properties of Quadrilaterals

Part 1: Do It Now

Match the definition with the type of quadrilateral:

1. A quadrilateral with two pairs of opposite sides that are parallel
2. A quadrilateral in which the lengths of all four sides are equal
3. A quadrilateral with two pairs of equal opposite sides and four right angles
4. A quadrilateral with four opposite sides and four right angles
5. A quadrilateral with one pair of opposite sides that are parallel

_____. Square

_____. Rhombus

_____. Parallelogram

_____. Rectangle

_____. Trapezoid

Part 2: Geometer's Sketchpad Diagonals of a Parallelogram Investigation (Class Example)

Goal: to verify that joining the midpoints of adjacent sides of any quadrilateral forms a parallelogram.

Parallelogram: A quadrilateral with two pairs of opposite sides that are parallel

Step 1: Setting up GSP

- Open Geometer's Sketchpad, make a text box with your name in the top right
- GRAPH → SHOW GRID
- GRAPH → SNAP POINTS

Step 2: Making the Parallelogram

- Plot points A(-2,1), B(-1,-3), C(4,-1), and D(3,3)
- Label the points
 - Click on point using arrow function, DISPLAY → LABEL POINT
- Construct a parallelogram by joining the points
 - Using the arrow function, click on points A and B then CONSTRUCT → SEGMENT
 - Follow the same steps to make lines BC, CD, and DA

Step 3: Drawing the diagonals

- Make a diagonal from A to C
 - Using the arrow function, click on A, then click on C, then CONSTRUCT → SEGMENT
- Make a diagonal from B to D

Step 4: Find Intersection point

- Using the arrow function, click on line AC then BD
- Then CONSTRUCT → INTERSECTION

Name: _____

- Label the POI point E.

Step 5: Check if point E bisects each diagonal

- Measure the length of AE
 - Click on A, then E, then MEASURE → DISTANCE
- Measure the length of CE and check if it is equal to the length of AE

- Now check if the lengths of BE and DE are equal.

Step 5: Making a conclusion

- Organize your results in the top left of the page.
- Make a text box and write a conclusion about the findings.
- Save the file as “your name - diagonals of a parallelogram

Part 3: Geometer's Sketchpad Midpoints of a Parallelogram Investigation (Try on your own)

Goal: Verify that a parallelogram is formed by joining the midpoints of adjacent sides of a quadrilateral

Quadrilateral: Any polygon that has four sides

Step 1: Setting up GSP

- Open Geometer's Sketchpad, **make a text box with your name in the top right**
- GRAPH → SHOW GRID
- GRAPH → SNAP POINTS

Step 2: Making the Quadrilateral

- Plot points $A(-4,2)$, $B(2,-5)$, $C(7,-3)$, and $D(1,5)$
- Label the points
 - Click on point using arrow function, DISPLAY → LABEL POINT
- Construct a quadrilateral by joining the points
 - Using the arrow function, click on points A and B then CONSTRUCT → SEGMENT
 - Follow the same steps to make lines BC, CD, and DA

Step 3: Find the Midpoints of Each Side

- Make the midpoint of AB
 - Click on line AB, then CONSTRUCT → MIDPOINT
 - Label this point E by clicking on the point, then DISPLAY → LABEL SEGMENT
- Make midpoints for BC, CD, and DA
 - Label them points F, G, and H accordingly

Step 4: Connect the Midpoints of Adjacent Sides

- Make line segment EF by clicking on E, then on F, then CONSTRUCT→SEGMENT
- Make line segments FG, GH, and HE using the same method

Step 5: Calculate the Slopes of the Lines Joining the Midpoints

- Calculate the slope of EF by clicking on line EF, then MEASURE→SLOPE
- Calculate the slope of FG, GH, and HE using the same method
- Organize the results at the top left of your page.
- Compare the slopes of opposite sides and make a conclusion about the resulting shape when you join the midpoints of adjacent sides of a quadrilateral
- Save the file as “your name – midpoints of a quadrilateral”

Print both files when you are finished. Make sure your name is on them before you print.

Homework:

Problem - For trapezoid ABCD, with coordinates A(2,8), B(4,2), C(13,5), and D(14,12):

- a) Draw the trapezoid on a sheet of graph paper
- b) Find the midpoints of the non-parallel sides
- c) Find the slope of the line connecting the midpoints of the non-parallel sides
- d) Find the slope of the parallel sides
- e) Write a conclusion about the relationship between the slopes

Note: A trapezoid is a quadrilateral with one pair of parallel sides.

Chapter 3 Culminating Task
Geometric Properties

Name : _____

Instructions:

- Complete all 4 of the questions provided.
- Show all your work!
- Make sure your solutions are organized!
- Complete answers on separate sheets of paper. Attach all of your work, in order, when you are finished.

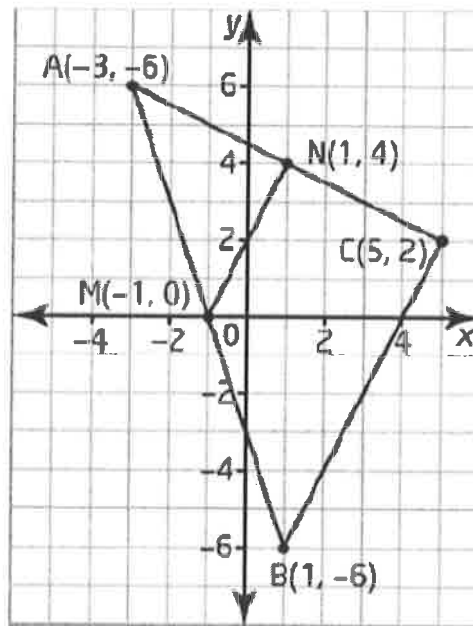
The three questions I have chosen to complete are:

Geometric Properties of Triangles

1. Midpoints of a Triangle

- Verify that M is the midpoint of AB and N is the midpoint of AC
- Verify using analytic geometry that MN is parallel to BC.
- Verify using analytic geometry that MN is half the length of BC.

Note: Point A is supposed to be (-3,6)



2. For the triangle with points D (-18,12) E(-6,-12) and F(12,6):

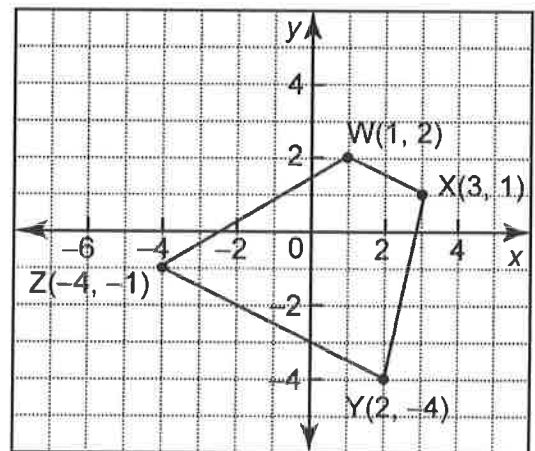
- Graph the triangle on a piece of graph paper
- Calculate the equation of the right bisector for each of the 3 sides
- Show that the right bisectors intersect at (-4,4)

Geometric Properties of Quadrilaterals

3. Verify that the line joining the midpoints of the non-parallel sides of a trapezoid is parallel to the other two sides.

Remember: A trapezoid is a quadrilateral with one pair of parallel sides

- Find the midpoint A of side WZ, the midpoint B of side XY
- Find the slope of line AB, ZY, and WX
- Compare the slopes and write a conclusion about the relationship between the lines AB, ZY, and WX



4. Verify properties of a rectangle

Remember: A rectangle is a quadrilateral with two pairs of equal opposite sides and four right angles.

- Draw the quadrilateral with vertices $A(-2, 3)$, $B(-5, 1)$, $C(-1, -5)$, and $D(2, -3)$ on a piece of graph paper.
- Find the lengths of sides AB, BC, CD, and AD
- Find the slopes of each side as well
- Is quadrilateral ABCD a rectangle? Explain using your results from b) and c)