Title: **Geometer Jones – The Search for Pythagoras' Treasure**

Brief Overview:

This Concept Development Unit is designed to incorporate new instruction as well as review of the concepts of concurrent lines and the four points of concurrency of triangles (circumcenter, incenter, centroid, and orthocenter) using the following activities/tools: constructions, matching, round table, word webs, graphic organizers. Students will identify relevant vocabulary and determine a consistent approach to constructions. Ultimately, each student will construct each point of concurrency in order to locate a hidden treasure. This activity (or any part of it) is meant to introduce the constructions and the points of concurrency before the summative assessment.

NCTM Content Standard/National Science Education Standard:

- Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
- Analyze properties and determine attributes of two- and three-dimensional objects;
- Use visualization, spatial reasoning, and geometric modeling to solve problems
- Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools;
- Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture

Grade/Level:

Grades 9 – 12, Geometry

Duration/Length:

Four – Five 45-minute lessons

Student Outcomes:

Students will be able to:

- Define and sketch concurrent lines (perpendicular bisectors, angle bisectors, medians, and altitudes).
- Identify and classify points of concurrency (circumcenter, incenter, centroid, and orthocenter).
- Construct concurrent lines (perpendicular bisectors, angle bisectors, medians, and altitudes).
- Apply constructions of concurrent lines to find points of concurrency in a real-life situation.

Materials and Resources:

- Compass
- Poster (Chart) paper
- Scissors
- Glue
- Ruler
- Worksheets:
  - Lesson 1 Pre-Assessment
  - Concurring with Concurrence
  - Lesson 2 Pre-Assessment
  - Sample Obtuse Triangle
  - Math-A-Round
  - Contemplating Constructions
  - Construction Instructions
  - Triangle Island Map Clues
  - Summative Assessment
  - Special Points in a Triangle
  - Word Webs
  - Sample Acute Triangle
  - Compass Construction – Teacher Resource
  - CICO PAMA
  - The SETUP
  - Triangles for Constructions
  - Triangle Island Map

Development/Procedures:

Lesson 1

Pre-Assessment – Have students draw the three perpendicular bisectors and angle bisectors in two different triangles using the "Lesson 1 Pre-Assessment WS".

Launch – Review the pre-assessment with the students. Introduce the definitions of median and altitude.

Teacher Facilitation – Have students now sketch three medians and altitudes in two new triangles. Be sure to demonstrate the altitude of an obtuse triangle as well, which lies outside of the triangle. Use the "Special Points of a Triangle – Teacher Resource WS" or have students complete the lesson notes in their notebook.

Ask students what they notice about the three segments. (They should see that they all intersect at one point). Identify the "points of concurrency" and define them with the class.

Student Application – Matching Activity: Students are given the worksheet titled "Concurring with Concurrence Matching Worksheet". In this activity, students review perpendicular

bisectors, angle bisectors, medians, and altitudes by matching the word with its corresponding picture.

Embedded Assessment – Teacher circulates or collects the applications to assess student's understanding.

Re-teaching – Struggling students will have another opportunity to learn material by completing the "Word Webs WS". As students work on Word Webs, circulate throughout the room to identify struggling students and reviews/answers concepts/questions on an individual basis.

Extension – Have students write the steps that are necessary to construct concurrent lines using:

- paper folding methods
- compass/straight-edge methods
- Mira

Lesson 2

Pre-Assessment – Students construct a perpendicular bisector and angle bisector using paper folding or compass and straightedge using "Lesson 2 Pre-Assessment WS".

Launch – Teacher uses direct instruction to model constructing the four points of concurrency in triangles. Teacher should identify the steps to those constructions as well, preferably on chart paper so that they can be displayed in the classroom using "Acute Triangle and Sample Obtuse Triangle WS and Compass Construction WS".

Teacher Facilitation – Discuss with the students any disagreements that they may have on any of the steps for the constructions.

Student Application – Explanation of "Math-A-Round WS": Explain to students that they will be in groups of four and that each student will have a different worksheet. Students will be completing Person 1 Task on their worksheet, then rotate their worksheet to the next person in their group by passing their sheet to the right. Then, each student will

check Person 1 Task and complete the Person 2 Task on the sheet in front of them. Students will keep rotating their worksheets until all steps are completed and checked.

After the Math-A-Round, discuss the results as a class to ensure that all students agree on the characteristics of concurrent lines.

Embedded Assessment –

1. The teacher will circulate to ensure that every student understands how to construct medians, altitudes and angle bisectors.
2. As students are completing their constructions on the Math-A-Round, they will also be assessing each other to ensure that their group successfully completes all three constructions.
3. For homework, each student will then be responsible for completing the two other constructions that were not done in class. For example, Student A constructed all medians and the centroid during class. For homework, this student will construct all altitudes/orthocenter and all angle bisectors/incenter.

Re-teaching – Introduce the students to the mnemonic CICO PAMA, and distribute the "CICO PAMA Graphic Organizer". This mnemonic device will help students remember the correspondence between concurrent lines and their respective points of concurrency. Read off the first two columns and let the students compete the sketches on the right. This will allow students that are struggling with these concepts another way to memorize them.

Have students who finish early help others, along with teacher assistance.

Have students explore demonstrations of constructions at http://www.mathopenref.com/tocs/constructionstoc.html

Extension – Have students perform the constructions using alternate methods (paper folding, Mira, Cabri, Jr.).

Lesson 3

Pre-Assessment – Students should be familiar with the points of concurrency from the previous lesson. In order to recall knowledge, have the students use their constructions from the Math-A-Round from the previous day to complete "Contemplating Constructions" WS.

Launch – Teacher motivates the students by telling them a story (or hand out the "SETUP" handout). Explain how students will be reviewing and applying the constructions they have just learned in order to find a treasure.

Teacher Facilitation – Bring the students back to their groups from the previous lesson. Direct the students to read the directions on the "Construction Instructions" worksheet. Stress that the goal of the lesson is to use constructions to determine the location of the treasure. Make sure that students are clear in their knowledge and understanding of the characteristics of the points of concurrency.

Student Application –Have students complete the "Construction Instructions" worksheet using the triangles with the symbols inside of them. Then complete the "Triangle Island Map Clues" worksheet.

Independently: Students individually perform one of the constructions. (using triangles with symbols inside)

Collectively: Each group member assesses the constructions for accuracy. Then, they work together to cut and paste the symbols to the map, and perform the new construction to find the treasure. (using the "Treasure Island Map")

Embedded Assessment – The student responses to the questions in the Pre-Assessment and their success in finding the treasure on the map will determine success.

Re-teaching/Extension –

- Have students find other points of concurrency on their map. Question the students on what types of points of concurrency can fall inside or outside of a given triangle and why.
- Using the background grid as a coordinate plane, have the students find the circumcenter (and other points of concurrency) using slope and the distance formula.

Summative Assessment:

Making the map in Lesson 3 assesses the students understanding of constructions. The student will also be given the "Summative Assessment".

Authors:

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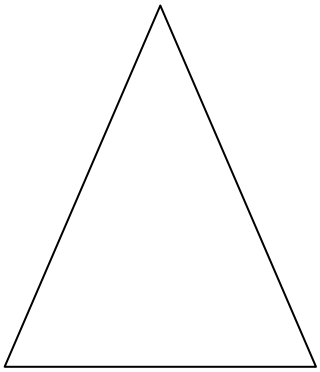
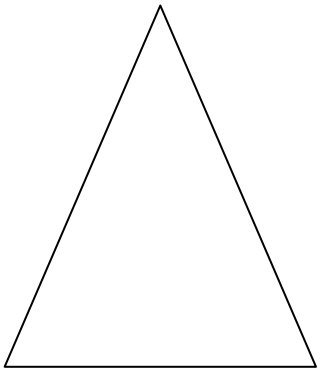
Lesson 1 Pre-Assessment

Name: _____
Date: _____

1. Sketch the angle bisector of each angle of the triangle below:



2. Sketch the perpendicular bisector of each side of the triangle below:

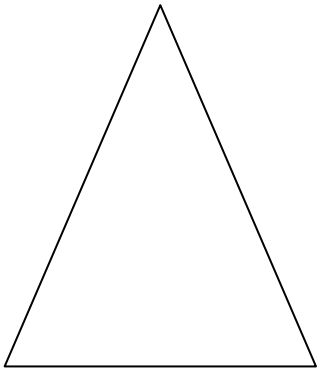


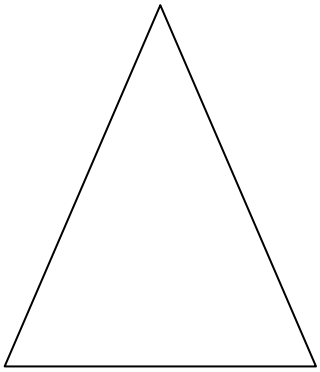
Lesson 1 Pre-Assessment

Name: _____
Date: _____

1. Sketch the angle bisector of each angle of the triangle below:

2. Sketch the perpendicular bisector of each side of the triangle below:

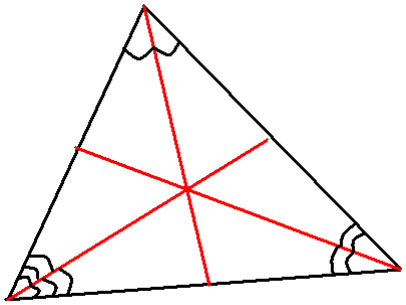




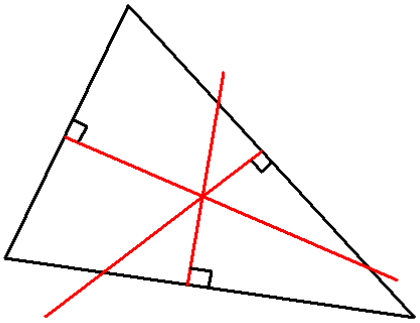
Lesson 1 Pre-Assessment

Name: ____**ANSWER KEY**_____
Date: _____

1. Sketch the angle bisector of each angle of the triangle below:



2. Sketch the perpendicular bisector of each side of the triangle below:

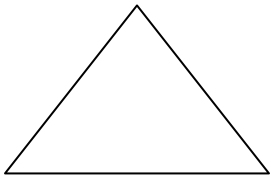


Special Segments of a Triangle

Name: _____
Date: _____

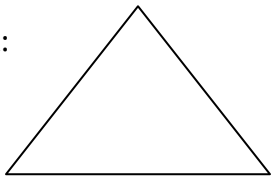
- Concurrent Lines:
- Five Special Segments of a Triangle
  - ❖ Perpendicular Bisector:

EX:



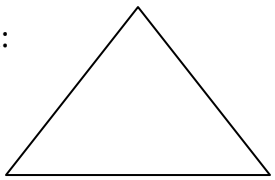
  - ❖ Angle Bisector:

EX:



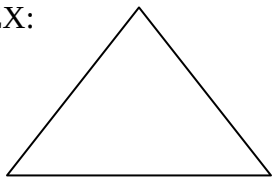
  - ❖ Median:

EX:



  - ❖ Altitude:

EX:



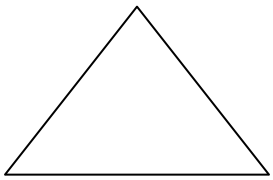
Special Points of a Triangle

Name: _____
Date: _____

- Concurrent Lines:
- Points of Concurrency

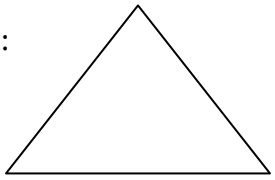
  ❖ Circumcenter:

EX:



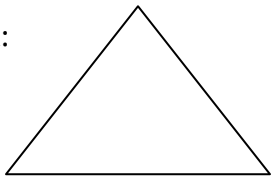
  ❖ Incenter:

EX:



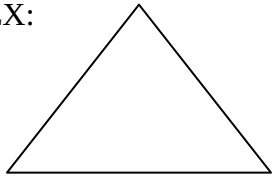
  ❖ Centroid:

EX:



  ❖ Orthocenter:

EX:

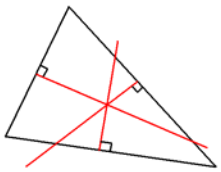


Special Segments of a Triangle Name: ____ **ANSWER KEY** ____
Date: _____

- Concurrent Lines: *Three or more lines intersecting at one point*
- Five Special Segments of a Triangle

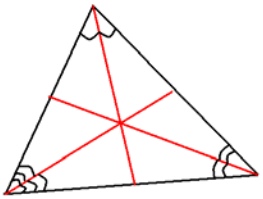
  ❖ Perpendicular Bisector: *A line that is intersects a segment at a right angle and cuts it in half*

  EX:



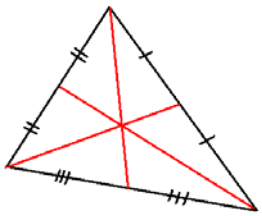
  ❖ Angle Bisector: *A ray that cuts an angle in half*

  EX:



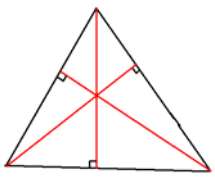
  ❖ Median: *A segment connecting the vertex of a triangle to the midpoint of the opposite side.*

  EX:



  ❖ Altitude: *A segment going through the vertex of a triangle, perpendicular to the opposite side (you may have to extend the sides).*

  EX:

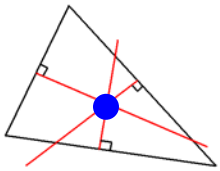


Special Points of a Triangle Name: _____ **ANSWER KEY** ___
Date: _____

- Points of Concurrency

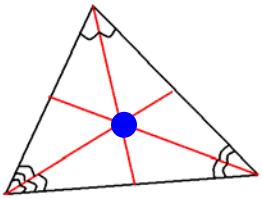
  - ❖ Circumcenter: *The intersection of the perpendicular bisectors. This point is equidistant from the three vertices*

    EX:



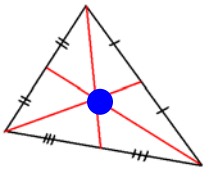
  - ❖ Incenter: *The intersection of the angle bisectors. This point is equidistant from the three sides and always in the interior of the triangle*

    EX:



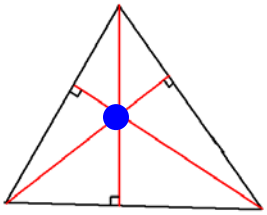
  - ❖ Centroid: *The intersection of the three medians. This point is 2/3 of the way between the vertex and midpoint of the opposite side, is always in the interior of the triangle, and is the center of balance of the triange.*

    EX:



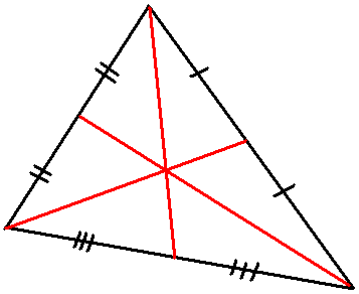
  - ❖ Orthocenter: *The intersection of the three altitudes.*

    EX:



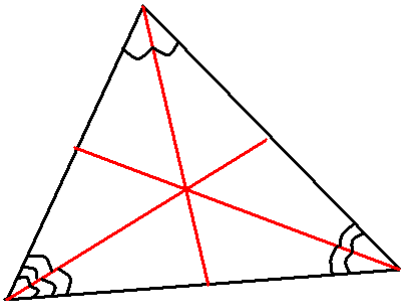
Concurring with Concurrence Name: _____
Matching Worksheet Date: _____

Directions: Fill in the blanks using the words from the Word Bank.



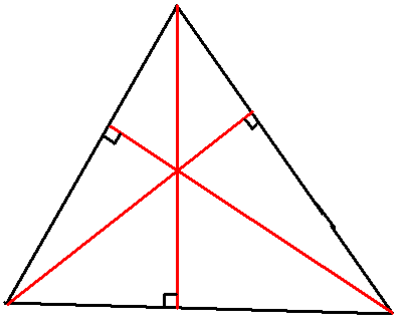
The segments constructed are all _____.

The point of concurrency where they intersect is called the _____.



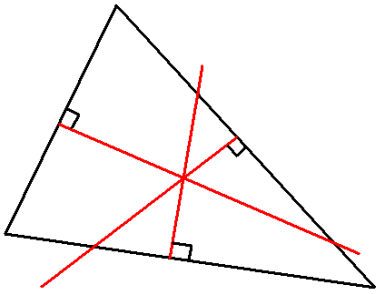
The segments constructed are all _____.

The point of concurrency where they intersect is called the _____.



The segments constructed are all _____.

The point of concurrency where they intersect is called the _____.



The segments constructed are all _____.

The point of concurrency where they intersect is called the _____.

WORD BANK

ORTHOCENTER

CENTROID

INCENTER

CIRCUMCENTER

ANGLE BISECTORS

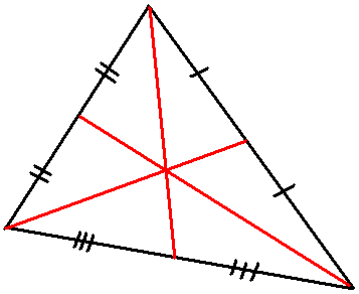
MEDIANS

PERPENDICULAR BISECTORS

ALTITUDES

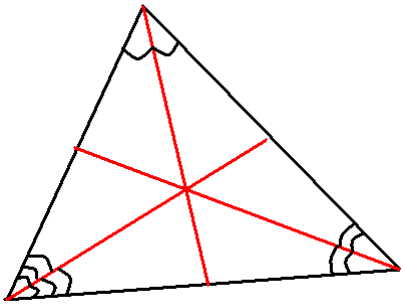
Concurring with Concurrence Name: __**ANSWER KEY**__
Matching Worksheet Date: _____

Directions: Fill in the blanks using the words from the Word Bank.



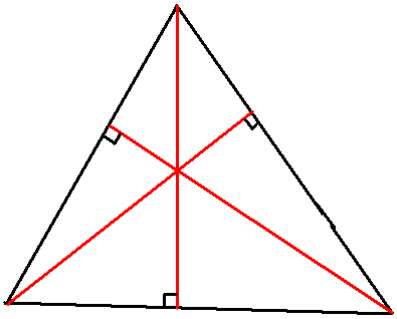
The segments constructed are all
__**Medians**_____.

The point of concurrency where they intersect is called the
__**Centroid**_____.



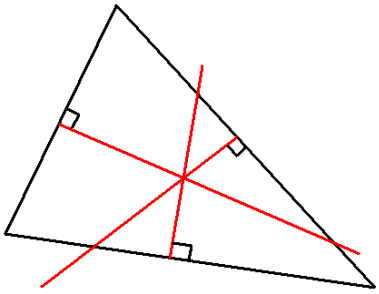
The segments constructed are all
__**Angle Bisectors**_____.

The point of concurrency where they intersect is called the
__**Incenter**_____.



The segments constructed are all
___**Altitudes**_____.

The point of concurrency where they intersect is called the
___**Orthocenter**_____.



The segments constructed are all
__**Perpendicular Bisectors**____.

The point of concurrency where they intersect is called the
__**Circumcenter**_____.

WORD BANK

ORTHOCENTER

CENTROID

INCENTER

CIRCUMCENTER

ANGLE BISECTORS

MEDIANS

PERPENDICULAR BISECTORS

ALTITUDES

Word Web Name: _____
Date: _____

Definition (in your own words)	Visual Representation- Acute Triangle
CIRCUMCENTER	
Visual Representation- Obtuse Triangle	How will I remember it?

Definition (in your own words)	Visual Representation- Acute Triangle
INCENTER	
Visual Representation- Obtuse Triangle	How will I remember it?

Word Web Name: _____
Date: _____

Definition (in your own words)	Visual Representation- Acute Triangle
CENTROID	
Visual Representation- Obtuse Triangle	How will I remember it?

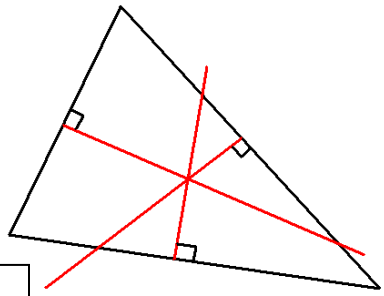
Definition (in your own words)	Visual Representation- Acute Triangle
ORTHOCENTER	
Visual Representation- Obtuse Triangle	How will I remember it?

Word Web Name: __ANSWER KEY___
Date: _____

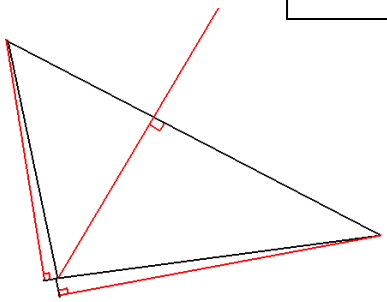
Definition (in your own words)

The circumcenter is the point where the three perpendicular bisectors in a triangle intersect.

Visual Representation



CIRCUMCENTER



Visual Representation- Obtuse Triangle

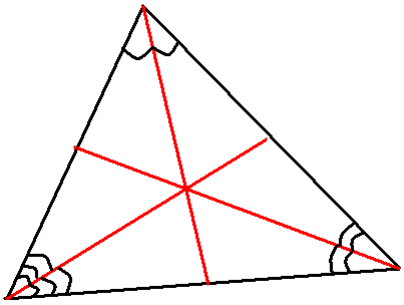
Answers may vary

How will I remember it?

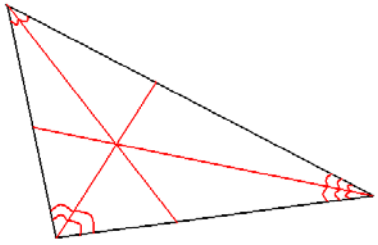
Definition (in your own words)

The incenter is the point where the three angle bisectors in a triangle intersect.

Visual Representation



INCENTER

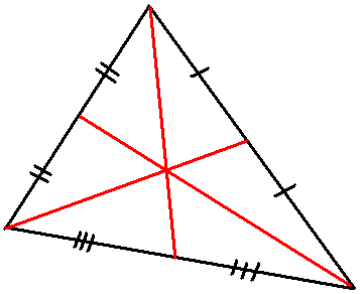
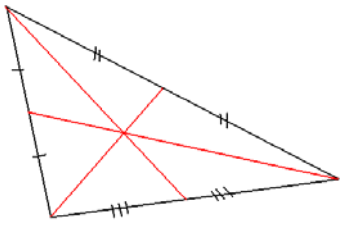


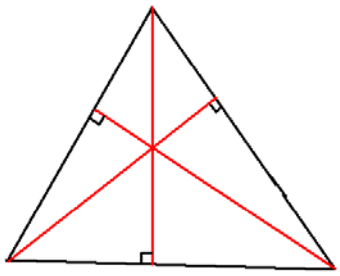
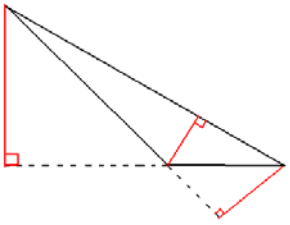
Visual Representation- Obtuse Triangle

Answers may vary

How will I remember it?

Word Web Name: __ANSWER KEY___
Date: _____

Definition (in your own words)	Visual Representation
The centroid is the point where the three medians in a triangle intersect.	
CENTROID	
	Answers may vary
Visual Representation- Obtuse Triangle	How will I remember it?

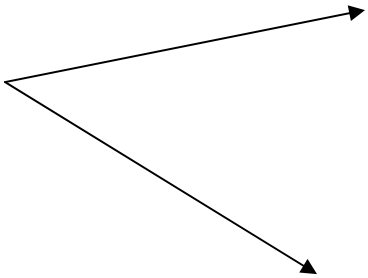
Definition (in your own words)	Visual Representation
The orthocenter is the point where the three altitudes in a triangle intersect.	
ORTHOCENTER	
	Answers may vary
Visual Representation- Obtuse Triangle	How will I remember it?

Lesson 2 Pre-Assessment

Name: _____
Date: _____

1. Construct a perpendicular bisector on the segment below:

2. Construct a angle bisector on the angle below:

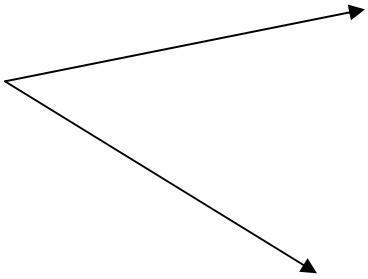


Lesson 2 Pre-Assessment

Name: _____
Date: _____

1. Construct a perpendicular bisector on the segment below:

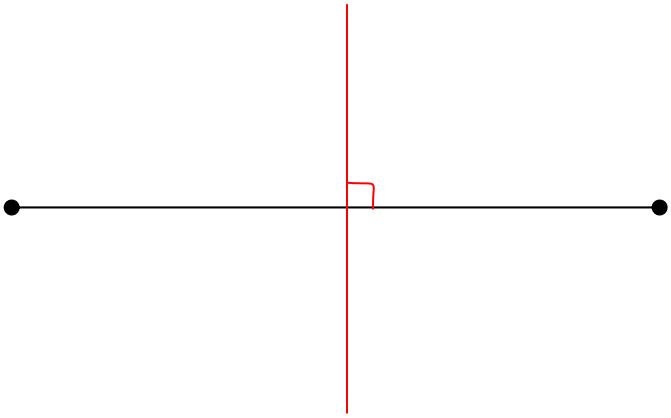
2. Construct a angle bisector on the angle below:



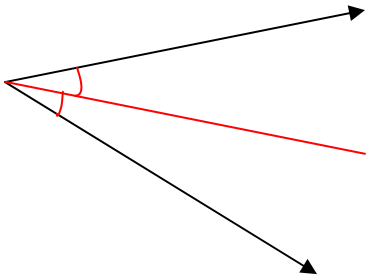
Lesson 2 Pre-Assessment

Name: _____ **ANSWER KEY** ___
Date: _____

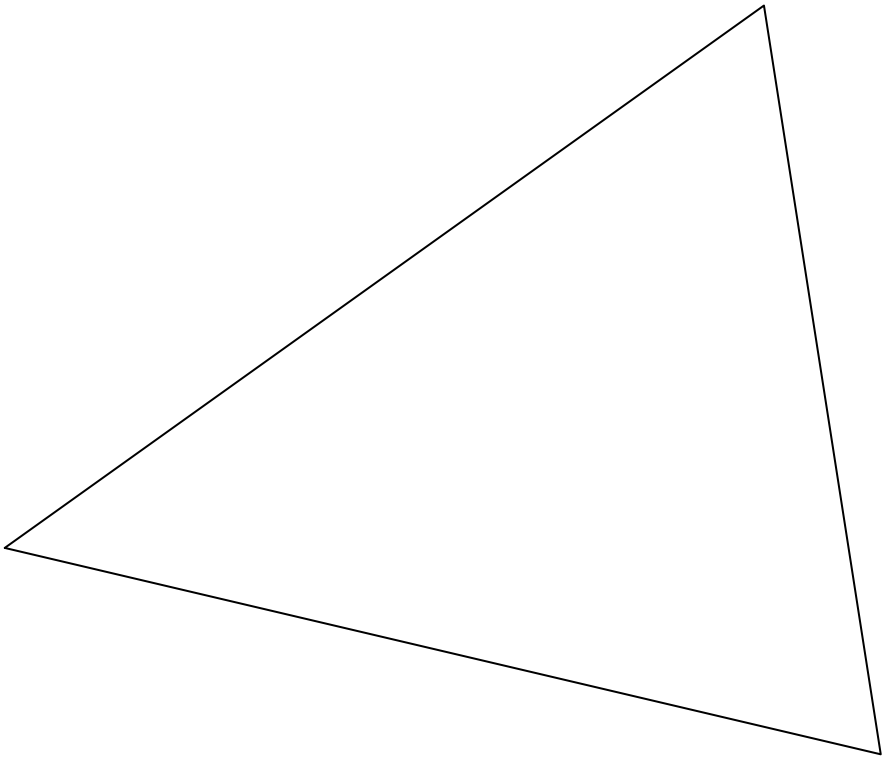
1. Construct a perpendicular bisector on the segment below:



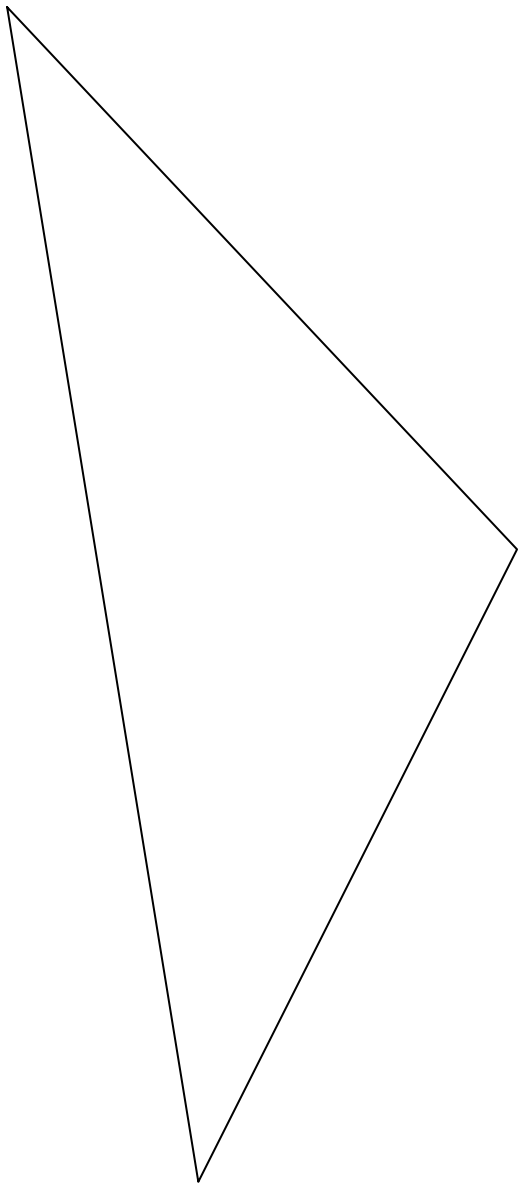
2. Construct a angle bisector on the angle below:



Sample Acute Triangle



Sample Obtuse Triangle



To construct the circumcenter of a triangle, you must make the three perpendicular bisectors by:

- *construct a line that is perpendicular (90 degrees) to each side*
- *The point where these three lines intersect is the circumcenter.*

To construct the incenter of a triangle, you must make the three angle bisectors by:

- *Construct an angle bisector for each angle.*
- *The point where these three lines intersect is the incenter.*

To construct the centroid of a triangle, you must make the three medians by:

- *Construct the midpoint of all three sides.*
- *Draw a line that connects the midpoint to the vertex on the opposite side.*
- *Repeat this for all three sides*
- *The point where these three lines intersect is the centroid.*

To construct the orthocenter of a triangle, you must make the three altitudes by:

- *Construct a line from the vertex that is perpendicular to the opposite side*
- *Repeat this for all three sides*
- *The point where these three lines intersect is the orthocenter.*

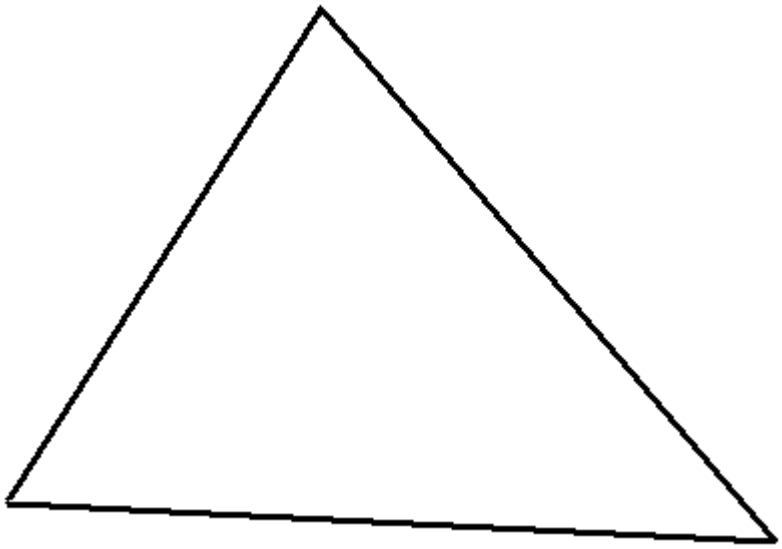
Math-A-Round
Round Table Activity

Names:	**Directions: Use the word**
	MEDIAN

Person 1 Task: Define the word.

Person 2 check and initial: _____

Person 2 Task: Construct all three of the given segments in the triangle. Be sure to label the construction so that you can clearly identify the segments. Use mathematics to explain the process you use to construct. Use words, symbols, or both in your explanation.



Person 3 check and initial: _____

Person 3 Task: Name the intersection point created in the sketch above.

Person 1 check and initial: _____

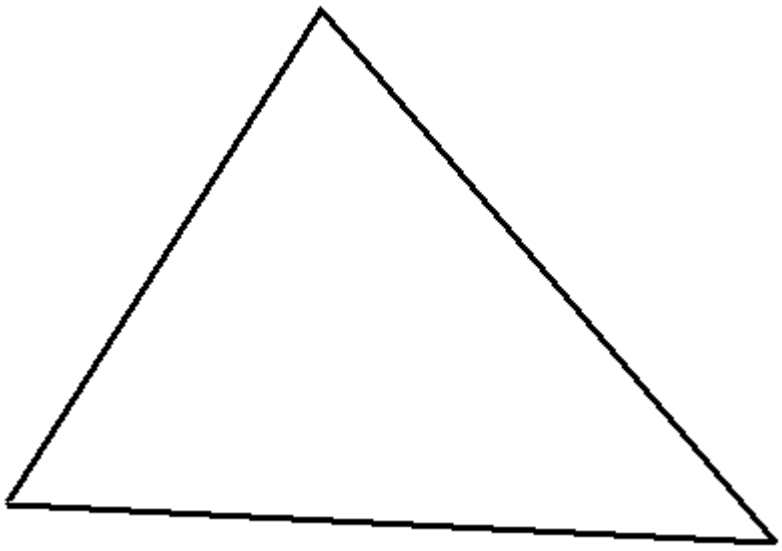
Math-A-Round
Round Table Activity

Names:	**Directions: Use the word**
	ANGLE BISECTOR

Person 1 Task: Define the word.

Person 2 check and initial: _____

Person 2 Task: Construct all three of the given segments in the triangle. Be sure to label the construction so that you can clearly identify the segments. Use mathematics to explain the process you use to construct. Use words, symbols, or both in your explanation.



Person 3 check and initial: _____

Person 3 Task: Name the intersection point created in the sketch above.

Person 1 check and initial: _____

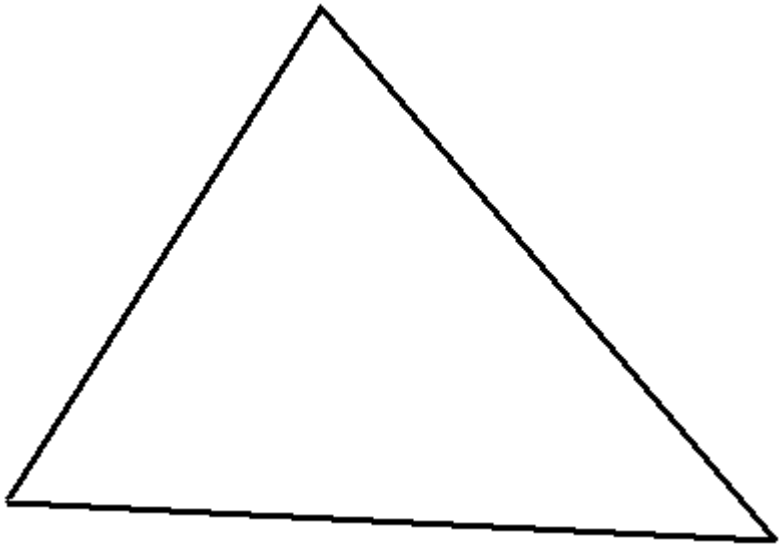
Math-A-Round
Round Table Activity

Names:	**Directions: Use the word** **PERPENDICULAR BISECTOR**

Person 1 Task: Define the word.

Person 2 check and initial: _____

Person 2 Task: Construct all three of the given segments in the triangle. Be sure to label the construction so that you can clearly identify the segments. Use mathematics to explain the process you use to construct. Use words, symbols, or both in your explanation.



Person 3 check and initial: _____

Person 3 Task: Name the intersection point created in the sketch above.

Person 1 check and initial: _____

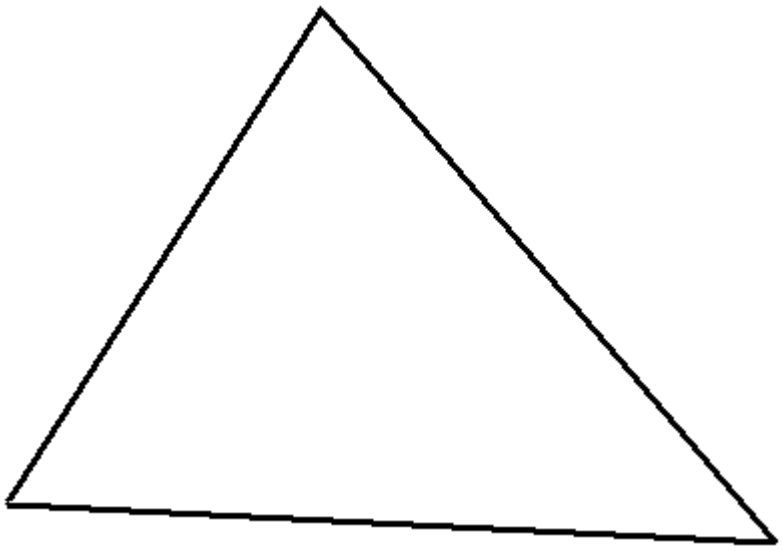
Math-A-Round
Round Table Activity

Names:	**Directions: Use the word**
	ALTITUDE

Person 1 Task: Define the word.

Person 2 check and initial: _____

Person 2 Task: Construct all three of the given segments in the triangle. Be sure to label the construction so that you can clearly identify the segments. Use mathematics to explain the process you use to construct. Use words, symbols, or both in your explanation.



Person 3 check and initial: _____

Person 3 Task: Name the intersection point created in the sketch above.

Person 1 check and initial: _____

Math-A-Round ANSWER KEY
Round Table Activity

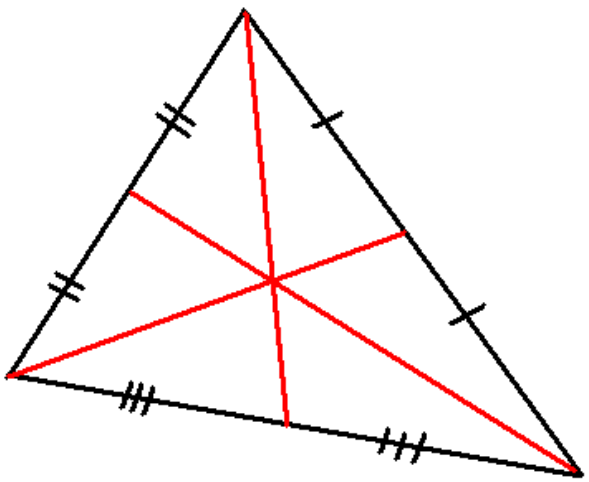
Names:	**Directions: Use the word**
	MEDIAN

Person 1 Task: Define the word.

A segment from a vertex of a triangle to the midpoint of the opposite side of the triangle.

Person 2 check and initial: _____

Person 2 Task: Construct all three of the given segments in the triangle. Be sure to label the construction so that you can clearly identify the segments. Use mathematics to explain the process you use to construct. Use words, symbols, or both in your explanation..



Person 3 check and initial: _____

Person 3 Task: Name the intersection point created in the sketch above.

centroid

Person 1 check and initial: _____

Math-A-Round ANSWER KEY
Round Table Activity

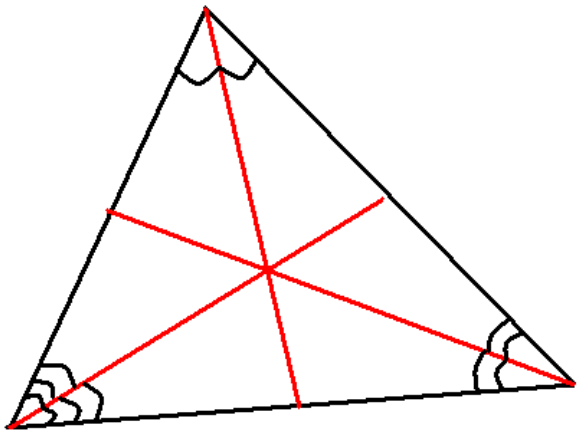
Names:	**Directions: Use the word**
	ANGLE BISECTOR

Person 1 Task: Define the word.

A ray that divides an angle into two congruent angles

Person 2 check and initial: _____

Person 2 Task: Construct all three of the given segments in the triangle. Be sure to label the construction so that you can clearly identify the segments. Use mathematics to explain the process you use to construct. Use words, symbols, or both in your explanation..



Person 3 check and initial: _____

Person 3 Task: Name the intersection point created in the sketch above.

Incenter

Person 1 check and initial: _____

Math-A-Round ANSWER KEY
Round Table Activity

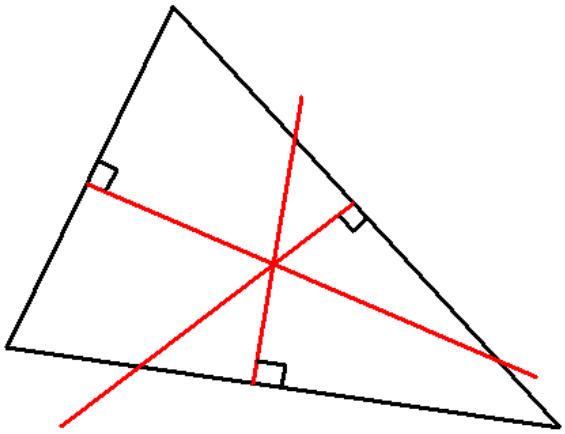
Names:	**Directions: Use the word** **PERPENDICULAR BISECTOR**

Person 1 Task: Define the word.

A line which cuts another line into two equal parts at 90°.

Person 2 check and initial: _____

Person 2 Task: Construct all three of the given segments in the triangle. Be sure to label the construction so that you can clearly identify the segments. Use mathematics to explain the process you use to construct. Use words, symbols, or both in your explanation..



Person 3 check and initial: _____

Person 3 Task: Name the intersection point created in the sketch above.

Circumcenter

Person 1 check and initial: _____

Math-A-Round ANSWER KEY

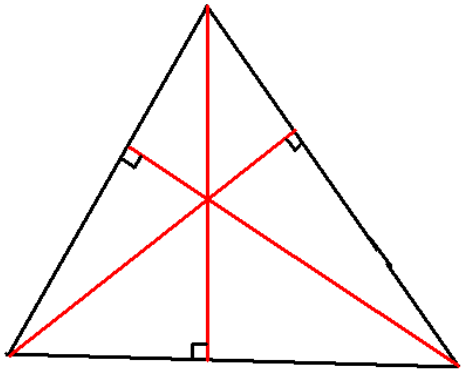
Names:	**Directions: Use the word**
	ALTITUDE

Person 1 Task: Define the word.

A segment from the vertex of a triangle perpendicular to the opposite side of the triangle.

Person 2 check and initial: _____

Person 2 Task: Construct all three of the given segments in the triangle. Be sure to label the construction so that you can clearly identify the segments. Use mathematics to explain the process you use to construct. Use words, symbols, or both in your explanation.



Person 3 check and initial: _____

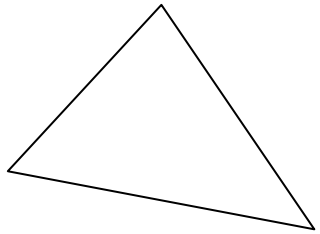
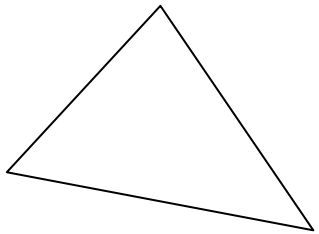
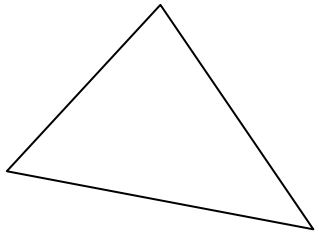
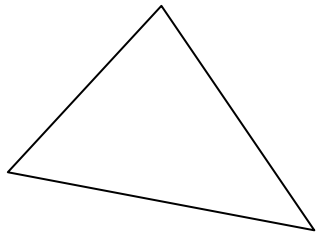
Person 3 Task: Name the intersection point created in the sketch above.

Orthocenter

Person 1 check and initial: _____

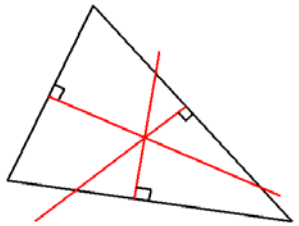
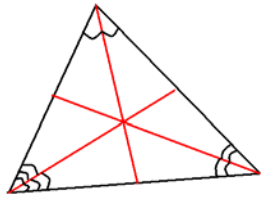
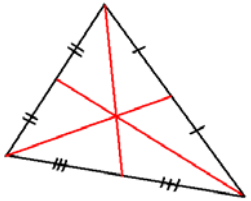
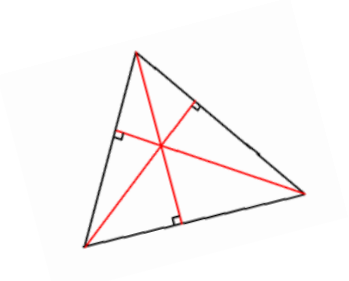
CICO PAMA

Name: _____

C	is created by constructing	**P**	
I		**A**	
C		**M**	
O		**A**	

CICO PAMA

Name: _____ ANSWER KEY _____

Circumcenter	is created by constructing	**P**erpendicular Bisectors	
Incenter		**A**ltitudes	
Centroid		**M**edians	
Orthocenter		**A**ngle Bisectors	

Contemplating Constructions

Name: _____
Date:_ _____

Directions: Using the centroid construction, measure and record the longer part of the medians, then the shorter part, and make a conjecture about how these distances are related.

Median 1:
Length of longer part _____ Length of shorter part _____

Median 2:
Length of longer part _____ Length of shorter part _____

Median 3:
Length of longer part _____ Length of shorter part _____

Describe any relationships you notice:

Directions: Using the incenter construction, measure the shortest distance from the incenter to each side and make a conjecture about how these distances are related.

Approximate distance from Incenter to Side 1 (try to measure the shortest length)

_____

Approximate distance from Incenter to Side 2 (try to measure the shortest length)

_____

Approximate distance from Incenter to Side 3 (try to measure the shortest length)

_____

Describe any relationships you notice:

Contemplating Constructions Name: _____**ANSWER KEY**_____
Date: _____

Directions: Using the centroid construction, measure and record the longer part of the medians, then the shorter part, and make a conjecture about how these distances are related.

Median 1:
Length of longer part _**Answers will vary**_ Length of shorter part _ **Answers will vary** __

Median 2:
Length of longer part _ **Answers will vary** _ Length of shorter part _ **Answers will vary** __

Median 3:
Length of longer part _ **Answers will vary** _ Length of shorter part _ **Answers will vary** _

Describe any relationships you notice:

They should see that the longer part is twice as long as the shorter part – The centroid is 2/3 of the way from one vertex to the midpoint of the opposite side. The centroid is also the center of mass (Each of the six small triangles formed has equal area.

Directions: Using the incenter construction, measure the shortest distance from the incenter to each side and make a conjecture about how these distances are related.

Approximate distance from Incenter to Side 1 (try to measure the shortest length)

_ Answers will vary __

Approximate distance from Incenter to Side 2 (try to measure the shortest length)

_ Answers will vary __

Approximate distance from Incenter to Side 3 (try to measure the shortest length)

__ Answers will vary __

Describe any relationships you notice:

They should see that the all the distances are the same – The incenter is equidistant from the sides

THE SETUP

While walking along the street one day to get some lollipops for your cousin, a wild-eyed stranger wearing an eye-patch and holding a parrot approaches you and says, “Hey man, aren’t triangles cool?”

“Uh, yeah I guess,” you respond.

“No man, they’re sooo awesome, you don’t even know!” he asserts.

“Sure guy…,” you say as you start creeping away.

He suddenly pulls out several pieces of crumply old papers from his satchel. It catches your eye…there’s gold dust on it! This wild-eyed stranger surprises you by getting serious for a moment, glancing around to make sure no one is listening in, as he whispers, “Today is your lucky day!” and hands you the map of an island. He started talking about this island and buried treasure. He talked fast, but you remember hearing something about a triangle and a lost treasure. The lost treasure belonged to Pythagoras. The old man also shared with you that this lost treasure is buried at a point that is equidistant from a Palm Tree, a Tiki Hut, and a Volcano. Then he started babbling about the volcano involving something called altitudes, the tiki hut involving angle bisectors, and the palm tree involving medians. The wild-eyed stranger also said that you would need to draw the angle bisectors, altitudes and medians and find their respective points of concurrency. He said, “Them things do kinda sound familiar from high school geometry, but dagnabit, I’ve forgotten all of my geometry from school. Good thing I found you though, it looks like you might have some success with this riddle. I can see it in your eyes that you have the tools and know-how to find this treasure. All I ask is that you send me back enough money for some golden dentures. Good luck kiddo, I got me a train to hop.” As he ran off he yelled, “Remember, the treasure is equidistant from the points of concurrency found in the Palm Tree, in the Tiki Hut and in the Volcano!”

So he was off, and he left you the attached map. Now if only you can remember enough to find this treasure!

Construction Instructions

Name: _____
Date: _____

Using the papers and the hints that the wild-eyed stranger left, you will find the hidden treasure. Within the island, he told you that you should find certain locations.

THE PALM TREE: The Medians

The first hint that the wild-eyed stranger gave indicated that you had to construct the three medians on the sheet titled, "THE PALM TREE" and find the point of concurrency. When you are finished, make sure you clearly indicate the point of concurrency and that it is located within the Palm Tree.

Describe how to construct a median and be sure to include which materials you used:

What is the name of the point of concurrency of these three medians?

THE VOLCANO: The Altitudes

The second hint that the wild-eyed stranger gave indicated that you had to construct the three altitudes on the sheet titled, "THE VOLCANO" and find the point of concurrency. When you are finished, make sure you clearly indicate the point of concurrency and that it is located within the picture of the Volcano.

Describe how to construct an altitude:

What is the name of the point of concurrency of these three altitudes?

THE TIKI HUT: The Angle Bisectors

The third hint that the wild-eyed stranger gave indicated that you had to construct the three angle bisectors on the sheet titled, "THE TIKI HUT" and find the point of concurrency. When you are finished, make sure you clearly indicate the point of concurrency and that it is located within the picture of the Tiki Hut.

Describe how to construct an angle bisector:

What is the name of the point of concurrency of these three angle bisectors?

Construction Instructions Name: ___**ANSWER KEY**_____
Date: _____

Using the papers and the hints that the wild-eyed stranger left, you will find the hidden treasure. Within the island, he told you that you should find certain locations.

THE PALM TREE: The Medians
The first hint that the wild-eyed stranger gave indicated that you had to construct the three medians on the sheet titled, "THE PALM TREE" and find the point of concurrency. When you are finished, make sure you clearly indicate the point of concurrency and that it is located within the Palm Tree.
Describe how to construct a median and be sure to include which materials you used:
To find the centroid of a triangle, you must make the three medians by:

- Find the midpoint of all three sides.
- Draw a line that connects the midpoint to the vertex on the opposite side.
- Repeat this for all three sides

What is the name of the point of concurrency of these three medians?
The point where these three lines intersect is the centroid.

THE VOLCANO: The Altitudes
The second hint that the wild-eyed stranger gave indicated that you had to construct the three altitudes on the sheet titled, "THE VOLCANO" and find the point of concurrency. When you are finished, make sure you clearly indicate the point of concurrency and that it is located within the picture of the Volcano.
Describe how to construct an altitude:
To find the orthocenter of a triangle, you must make the three altitudes by:

- Drawing a line that goes through a vertex and is perpendicular to the side opposite this vertex.
- Repeat this for all three sides

What is the name of the point of concurrency of these three altitudes?
The point where these three lines intersect is the orthocenter.

THE TIKI HUT: The Angle Bisectors
The third hint that the wild-eyed stranger gave indicated that you had to construct the three angle bisectors on the sheet titled, "THE TIKI HUT" and find the point of concurrency. When you are finished, make sure you clearly indicate the point of concurrency and that it is located within the picture of the Tiki Hut.
Describe how to construct an angle bisector:
To find the incenter of a triangle, you must make the three angle bisectors by:

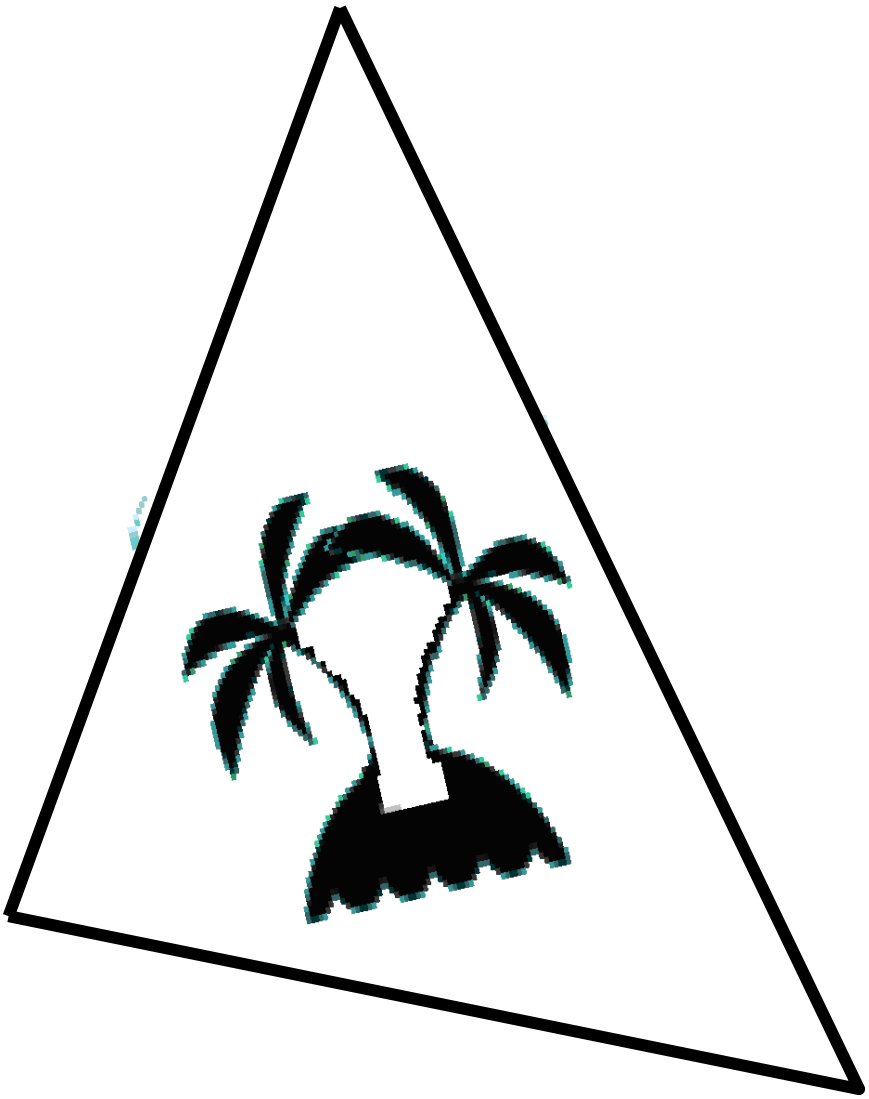
- Drawing a line that goes through a vertex and bisects the angle.
- Repeat this for all three sides

What is the name of the point of concurrency of these three angle bisectors?
The point where these three lines intersect is the incenter.

Name:

THE PALM TREE

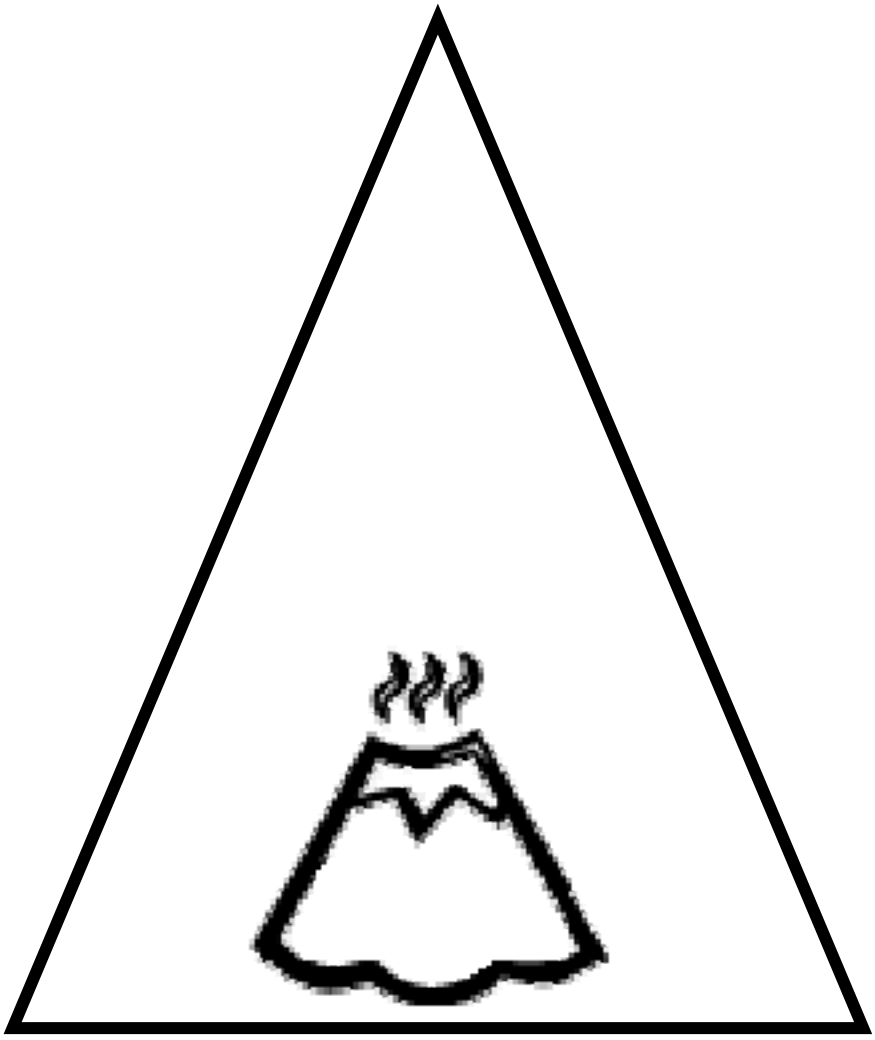
Constuct all medians



Name:

THE VOLCANO

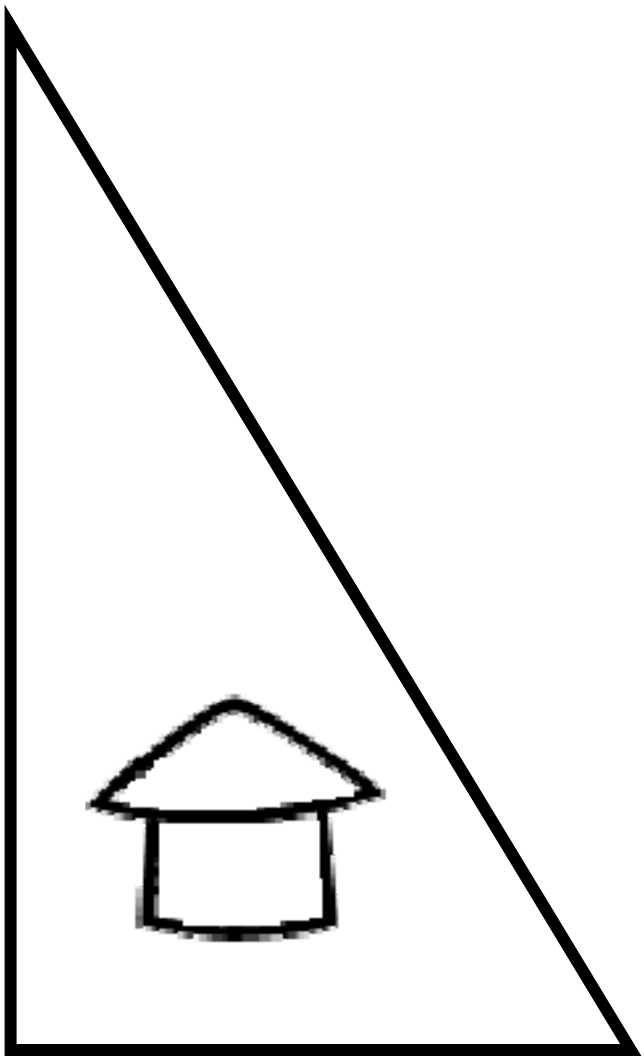
Construct all altitudes



Name:

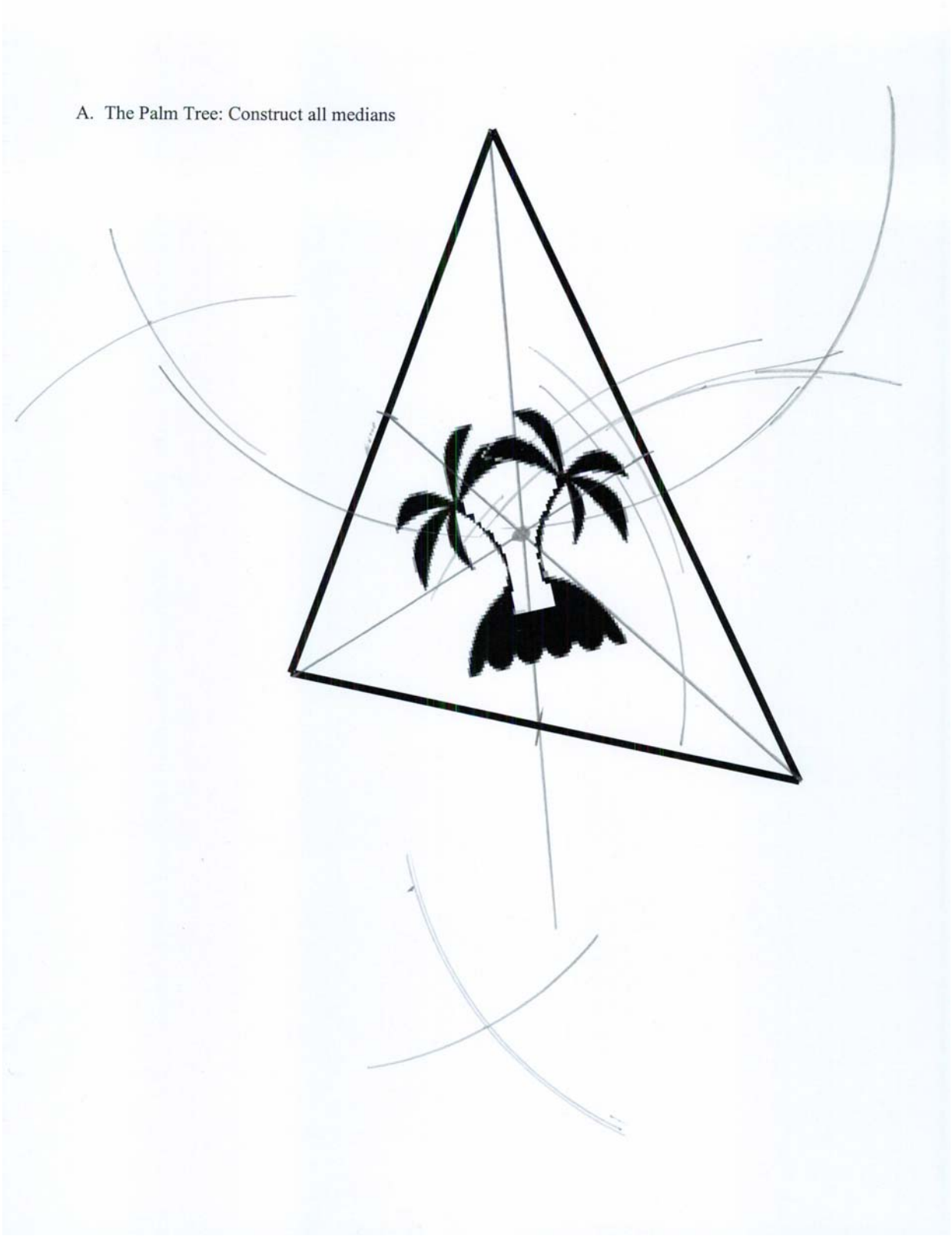
THE TIKI HUT

Construct all angle bisectors



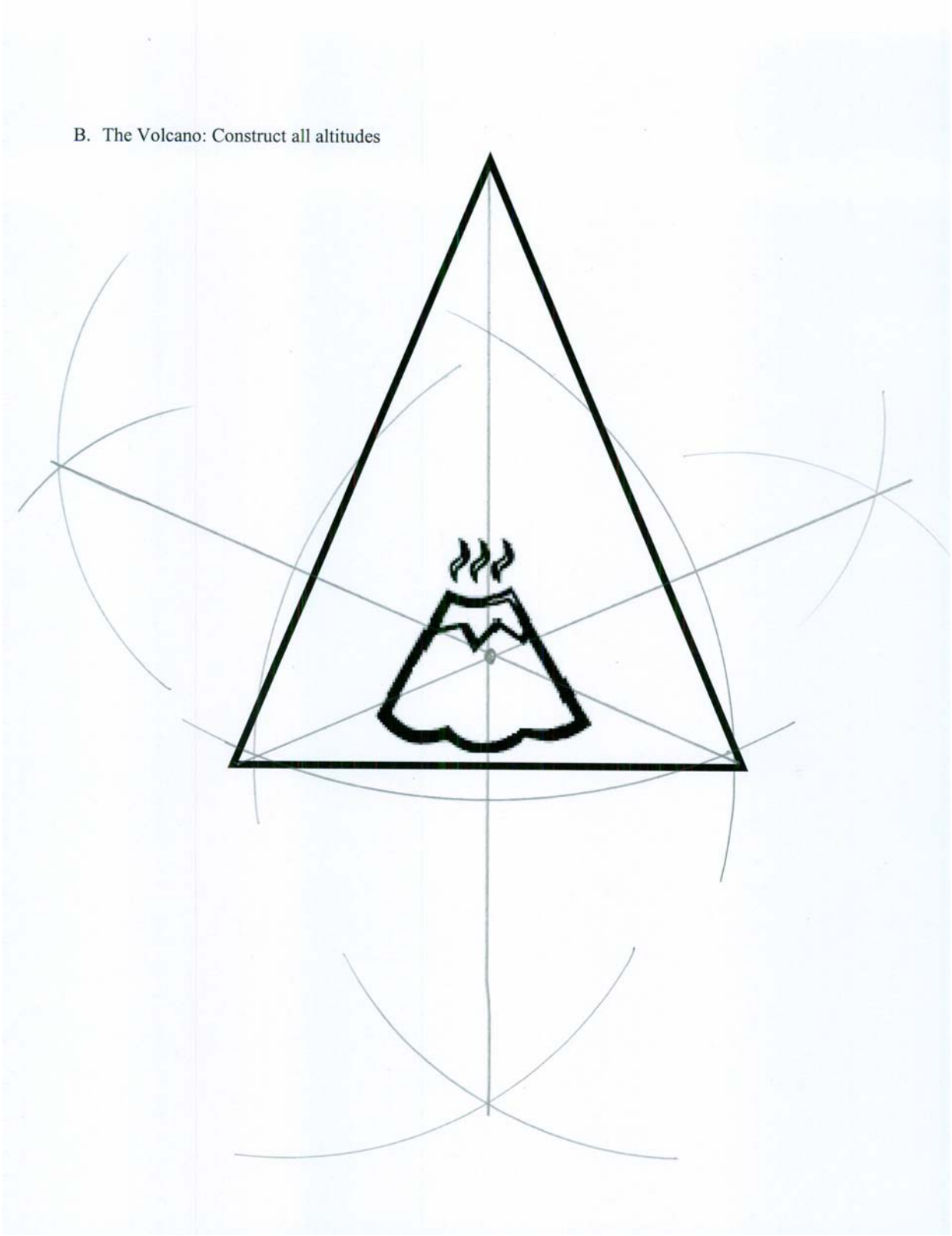
<u>THE PALM TREE</u> – Key

A. The Palm Tree: Construct all medians



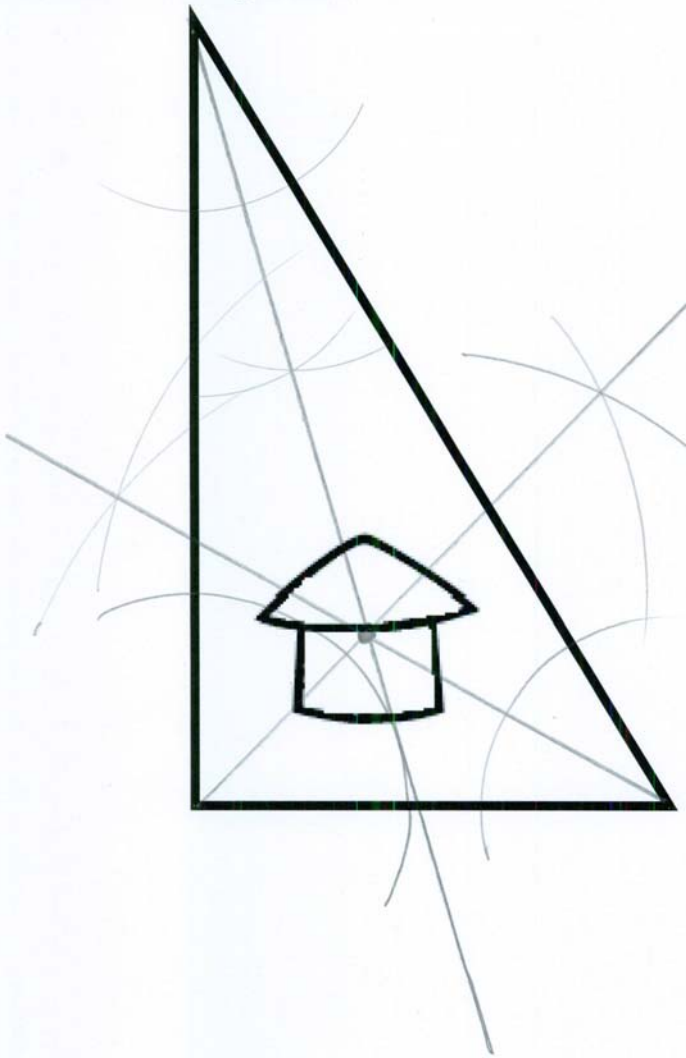
<u>THE VOLCANO</u> – Key

B. The Volcano: Construct all altitudes



THE TIKI HUT – Key

C. The Tiki Hut: Construct all angle bisectors



Triangle Island Map Clues

Name: _____
Date: _____

The last hint that the wild-eyed stranger gave you was, “Remember, the treasure is equidistant from the points of concurrency found in the Palm Tree, in the Tiki Hut and in the Volcano!”

What does this mean? Where is this point located? How will I find it? There are the questions that you should be asking yourself?

1. Using THE PALM TREE, THE TIKI HUT and THE VOLCANO constructions, cut out these shapes that contain the Points of Concurrency and paste them onto its respective shape on the TRIANGLE ISLAND MAP of the island.
2. What shape is formed by the Palm Tree, Skull and Volcano that you pasted on the TRIANGLE ISLAND MAP?

   _____
3. Draw this shape on the TRIANGLE ISLAND MAP by using three line segments. **Make sure that you use the actual point that you constructed.**
4. Classify the shape that you drew: _____
5. In the shape that you named above, what would the three locations correspond to?

   _____
6. How can you use a construction to find the point that the old man is talking about?

7. What is the name of this point that you must construct? _____
8. Make a list of steps that you need to follow to construct this point.

9. Construct this point on the TRIANGLE ISLAND MAP.
10. Where is the treasure located?

Triangle Island Map Clues Name: _____ **ANSWER KEY** _____
Date: _____

The last hint that the wild-eyed stranger gave you was, "Remember, the treasure is equidistant from the points of concurrency found in the Palm Tree, in the Tiki Hut and in the Volcano!"

What does this mean? Where is this point located? How will I find it? There are the questions that you should be asking yourself?

1. Using THE PALM TREE, THE TIKI HUT and THE VOLCANO constructions, cut out these shapes that contain the Points of Concurrency and paste them onto its respective shape on the TRIANGLE ISLAND MAP of the island.
2. What shape is formed by the Palm Tree, Skull and Volcano that you pasted on the TRIANGLE ISLAND MAP?

   __Triangle_____
3. Draw this shape on the TRIANGLE ISLAND MAP by using three line segments. **Make sure that you use the actual point that you constructed.**
4. Classify the shape that you drew: __Obtuse Triangle_____
5. In the shape that you named above, what would the three locations correspond to?

   __Vertices of the triangle_____
6. How can you use a construction to find the point that the old man is talking about?
   Construct the Perpendicular Bisectors

7. What is the name of this point that you must construct? _Circumcenter_____
8. Make a list of steps that you need to follow to construct this point.

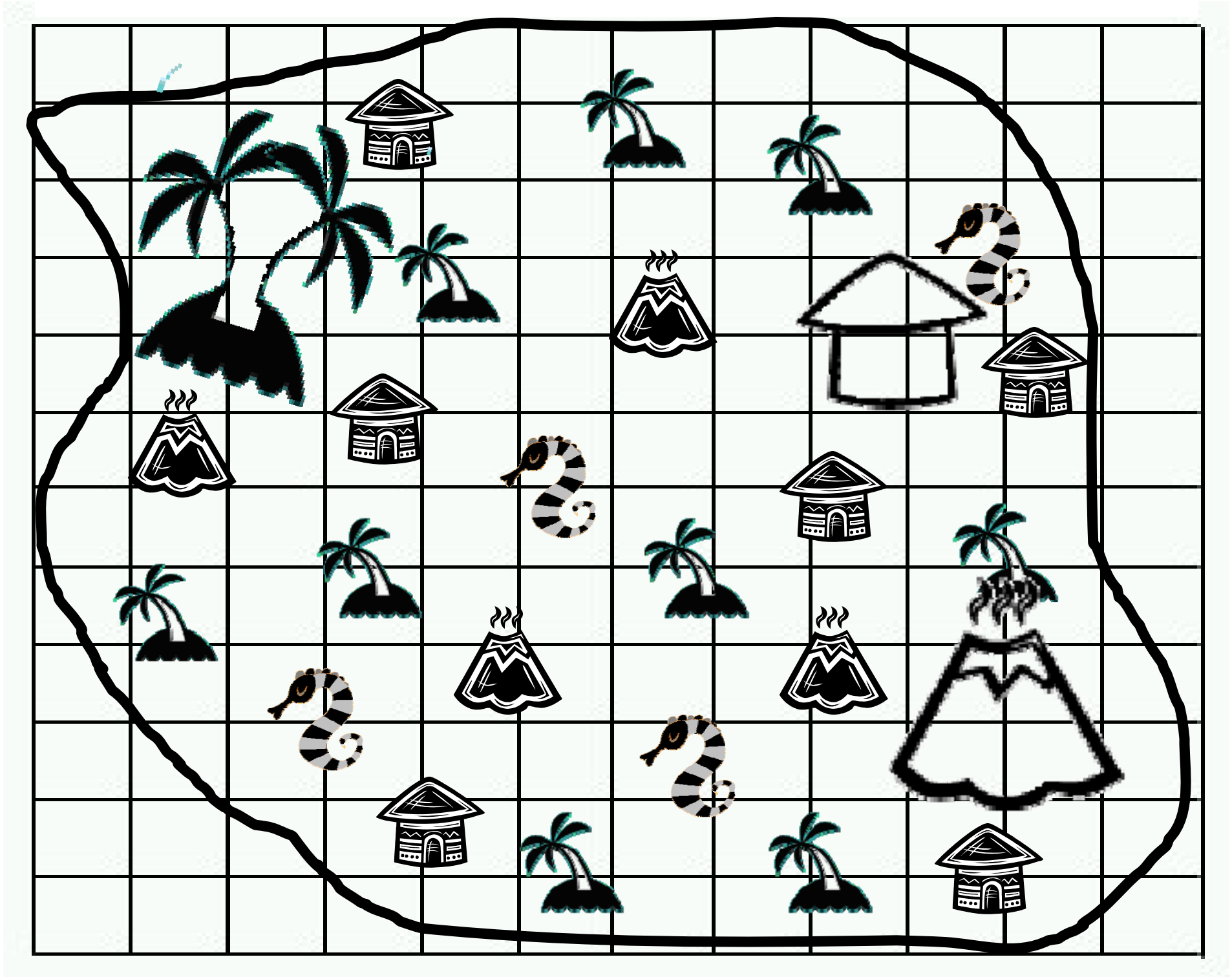
   To find the circumcenter of a triangle, you must make the three perpendicular bisectors by:
   - *finding the midpoint of the three sides of the triangle*
   - *drawing a line that is perpendicular (90 degrees) to each side and goes through that side's midpoint*
   - *The point where these three lines intersect is the circumcenter.*

9. Construct this point on the TRIANGLE ISLAND MAP.
10. Where is the treasure located?

Triangle Island Map Key

At the lowest volcano

Triangle Island Map



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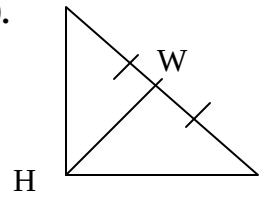
Summative Assessment Name: _____
Date: _____

Match the correct letter with each definition.

___**1.** drawn from a vertex to the midpoint of the opposite side	**a.** concurrent
___**2.** the point at which the angle bisectors intersect	**b.** altitude
___**3.** the point at which the medians intersect	**c**. circumcenter
___**4.** the point at which the altitudes intersect	**d.** angle bisector
___**5.** drawn from a vertex to opposite side at a right angle	**e**. incenter
___**6.** drawn from the midpoint of a side at a right angle	**f.** median
___**7.** drawn from a vertex; divided an angle into congruent angles	**g.** orthocenter
___**8.** the point at which the perpendicular bisectors intersect	**h.** perpendicular bisector
___**9.** lines that intersect at one point	**i.** centroid

10 - 13. Identify the special segment $\overline{HW}$ that represents in each diagram.

10.



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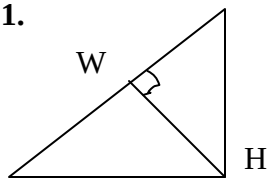

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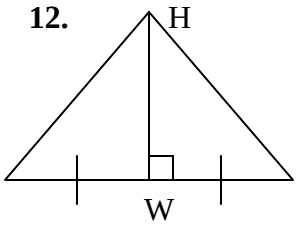

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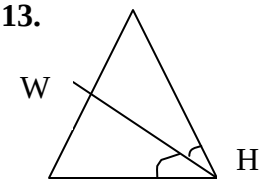
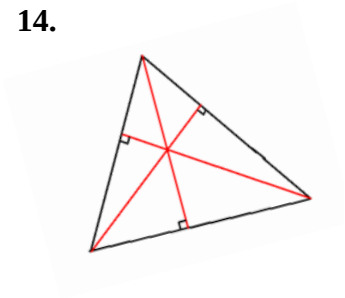


14 - 17. Identify the point of concurrency represented in each diagram

14.



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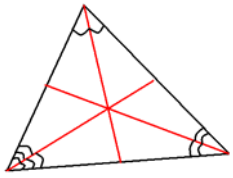

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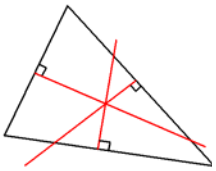

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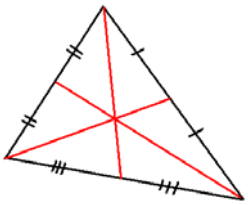
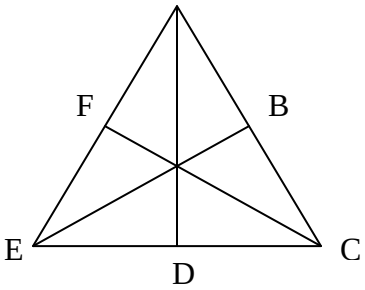


18 - 21. Find the missing lengths.
Give: S is the centroid of ΔACE. AE = AC AD = 24 AF = 10 EC = 18



18. DC =

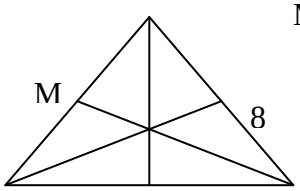
19. AC =

20. AS =

21. SD =

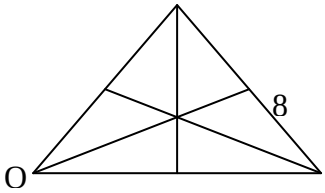
22. Find the missing length. E is the incenter.

ME =



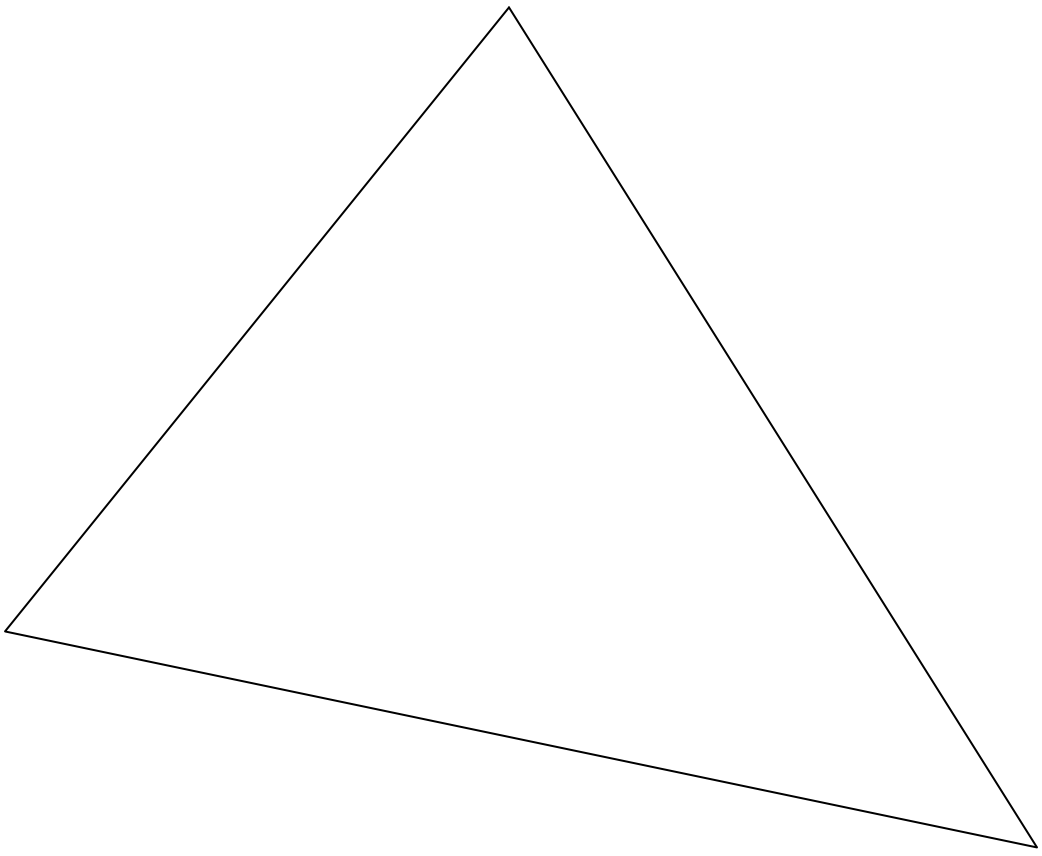
23. Find the missing length. S is the circumcenter.

SO =



24. In a neat, well written paragraph compare the medians and perpendicular bisectors of a triangle. Be sure to explain the similarities and differences between the two.

25. Construct the orthocenter of the triangle below.



Summative Assessment Name: _____**ANSWER KEY** ___
Date: _____

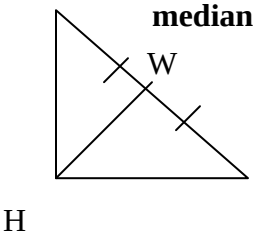
Match the correct letter with each definition.

_f__**1.** drawn from a vertex to the midpoint of the opposite side
_e__**2.** the point at which the angle bisectors intersect
_i__**3.** the point at which the medians intersect
_g__**4.** the point at which the altitudes intersect
_b__**5.** drawn from a vertex to opposite side at a right angle
_h__**6.** drawn from the midpoint of a side at a right angle
_d__**7.** drawn from a vertex; divided an angle into congruent angles
_c__**8.** the point at which the perpendicular bisectors intersect
_a__**9.** lines that intersect at one point

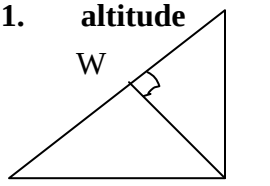
a. concurrent
b. altitude
c. circumcenter
d. angle bisector
e. incenter
f. median
g. orthocenter
h. perpendicular bisector
i. centroid

10 - 13. Identify the special segment $\overline{HW}$ that represents in each diagram.

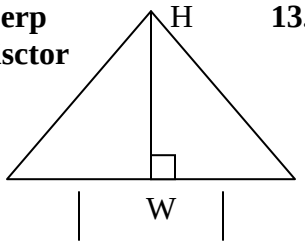
10. **median**



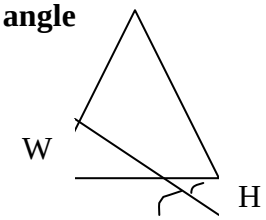
11. **altitude**



12. perp bisctor

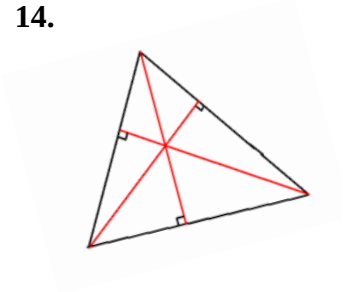


13. angle



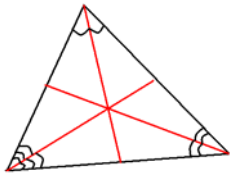
14 - 17. Identify the point of concurrency represented in each diagram

14.



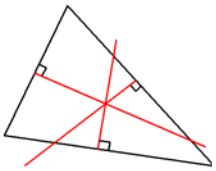
Orthocenter

15.



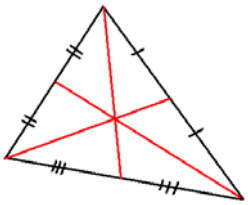
Incenter

16.



Circumcenter

17.



Centroid

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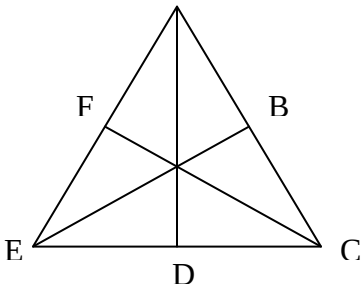
Give: S is the centroid of ΔACE. AE = AC AD = 24 AF = 10 EC = 18



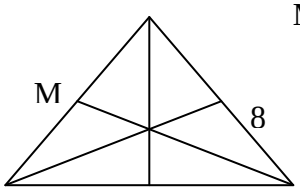
18. DC = **9**

19. AC = **20**

20. AS = **16**

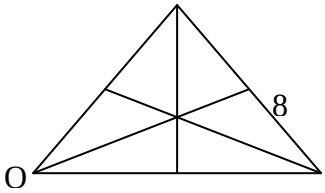
21. SD = **8**

22. Find the missing length. E is the incenter.



ME = **6**

23. Find the missing length. S is the circumcenter.



SO = **10**

24. In a neat, well written paragraph compare the medians and perpendicular bisectors of a triangle. Be sure to explain the similarities and differences between the two.

- **Both bisect a side**
- **Medians meet at the centroid (always inside the triangle), perpendicular bisectors meet at the circumcenter (not always inside the triangle)**
- **Both use the same construction with a compass**

25. Construct the orthocenter of the triangle below.