8th Grade Assignment – Week #7

Individual Homework:

- Do **Pythagorean Theorem – Practice Sheet #2**.

Group Assignment:

For Tuesday

- Do **Pythagorean Theorem – Group Sheet #3**.

For Thursday

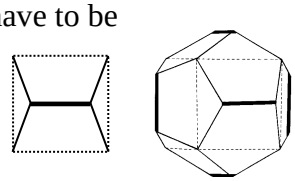
- *Loci Puzzle #1*. On a clean page (in landscape orientation), mark two points (labeled A and B) **8 inches** apart, and horizontally across from each other. From any specific location on the page, there is a distance to A and a distance to B. What is the locus of points such that the **sum** of these two distances is equal to **10 inches**? (In other words, for a point to be located on the required curve, the distance to point A plus the distance to point B must add to 10.)
- *Loci Puzzle #2*. On a clean page (in landscape orientation), mark two points (labeled A and B) **6 inches** apart, and horizontally across from each other. From any specific location on the page, there is a distance to A and a distance to B. What is the locus of points such that the **difference** of these two distances is equal to **4 inches**? (In other words, for a point to be located on the required curve, the distance to point A minus the distance to point B must be 10, or the distance to point B minus the distance to point A must be 10.)

Main Lesson Work (geometry) **Coming out of Lecture #1**

Clay work. (See notes and tips on clay work from last week.)

- **Cube → Octahedron**. (This is described in last week's assignment.) If you haven't yet felt successful at it, keep working on the transformation of the cube into the octahedron (pushing in the points of the cube, etc.).
    - **Cube → Dodecahedron**. This is what I did in clay in today's lecture.

      Instructions: This process grows roofs off each of the faces of the cube. Each roof is designed like the drawing on the left, but any two neighboring roofs have to be oppositely oriented (i.e., the top lines of neighboring roofs are perpendicular to one another). After the roofs grow higher off the faces of the cube, sections of neighboring roofs merge together to form pentagons. In the drawing on the right, the cube is shown with dotted lines, and the top lines of the roofs are shown with heavy lines. When working with clay, it makes it considerably easier to start with a small cube and *add* small bits of clay, thereby slowly building roofs off each face of the cube.



Paper work

- The paper models are now getting more complex. Here are some reminders and tips:
- All work needs to be done with exactness! This includes drawing the net with a sharp pencil with very straight lines, and cutting with scissors very exactly.
- Use colored pencil rather than painting your models. (Painting tends to wrinkles the paper.)
- Make sure there are tabs everywhere needed, and that each tab runs the whole length of the edge. Imagine that after gluing the whole model together, a small bug would have no place to crawl inside!

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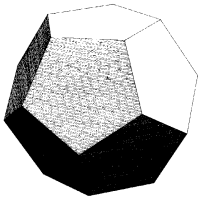
- The folds are super important. They need to be perfectly straight and sharp. As I said in the instructions: "After the net is cut out, folds need to be made along certain edges by placing a ruler along the edge, folding the paper up, and then going over the fold a couple of times with your finger nail."
- **The Dodecahedron.** This is the next paper model. (See "Notes for making a Dodecahedron", below.)

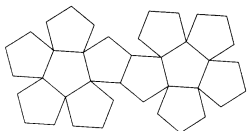
Loci Main Lesson Book Drawing. **The Parabola**

- Instructions: (These are the same instructions I gave in the lecture – watch it again if needed!)
    - Draw your fence (in blue pencil) 6cm up from the bottom of the page, and then lightly in pencil (and very carefully!) draw horizontal lines up the page that are 1 cm apart.
    - Place your "tree" (in blue) in the middle of the line that is your birth-month-number of centimeters above the fence (i.e., for March, your tree should be 3 cm above the fence.)
    - Carefully draw circles around the tree, lightly in pencil and growing by 1 cm.
    - Identify all the points that are equidistant from the tree and the fence. Smoothly connect these points to form the parabola. With color (pink?), shade in the curve, but don't color in anything else. Add the statement "The locus of points equidistant from a point and a line is a *parabola*."

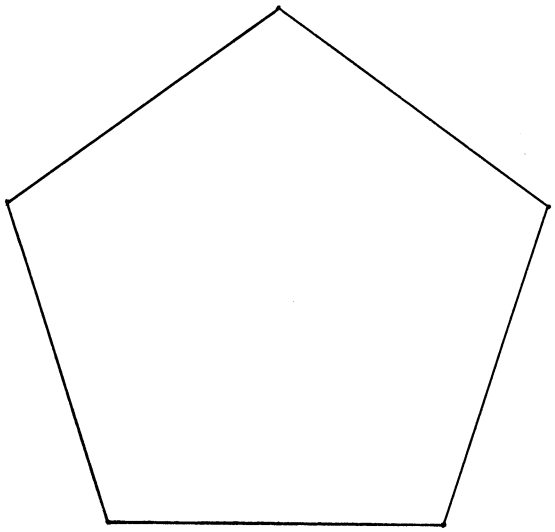
Notes for making a Dodecahedron Paper Model

Here's a drawing of a dodecahedron and one possible net.



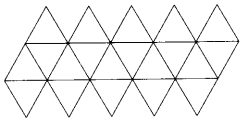


The form on the right is the size that you'll need to cut out for a dodecahedron. (See "Tips for Constructing Paper Models" under the section *Making the Polygon Form*, to see how to do this properly)



Main Lesson Work (geometry) **Coming out of Lecture #2**

- *Clay work.* Keep working, as needed on the two transformations I gave previously:
    - Cube → Octahedron.
    - Cube → Dodecahedron.
- *Paper work.*
    - **The Icosahedron.** This is the last of the five Platonic Solids. It has 20 equilateral triangular faces. You should make each edge 2.5 inches long (6.3cm). A possible net is shown on the right.



    - **The Platonic Solids.** Finish up with your work on the first four Platonic solids: the cube, tetrahedron, octahedron, and dodecahedron.
- *Extra Lecture!!* There is an extra lecture for this week, in the Vimeo collection, titled "JYMA – W07 – L3". You should watch it before Monday's lecture.

Loci Main Lesson Book Drawing.

- **The Ellipse**

  Instructions:

  1. Start by drawing a circle (called the "directrix circle", which is the "fence" for the treasure problem) that has a radius measuring a whole number of centimeters, and is as large as possible. Lightly in pencil, draw concentric circles from the directrix circle going **inward** to the center, and having the radius get **smaller** by one centimeter with each circle.

2. A focus point (the "tree") is now to be chosen. Take your birth month, divide it by 2, and round up if you get a decimal. Call this number M. Your focus point (the "tree") should be M centimeters **inside** the directrix circle (the "fence"). Mark the focus point clearly.
3. Using your focus point as the center, draw concentric circles (lightly in pencil) out from the focus, allowing the radii to grow by one centimeter with each circle. These circles should not cross past the directrix circle.
4. Identify all the points that are equidistant from the directrix circle and the focus. Smoothly connect these points to form the *ellipse*.
5. With a colored pencil (pink?), shade in the curve, but don't color in anything else. Use a blue colored pencil to highlight the directrix circle and the focus point.
6. Add the statement "The locus of points equidistant from a directrix circle and a focus point inside that circle is an *ellipse*."

- **The Hyperbola (Optional)**

Instructions:

1. With the page in portrait orientation, start by drawing a circle with a 3cm radius that is 6cm from the bottom of the page. Lightly in pencil, draw concentric circles from the directrix circle going **outward**, and having the radius get **larger** by one centimeter with each circle. (You will likely need a compass with an extended arm in order to draw the larger circles.)
2. A focus point (the "tree") is now to be chosen. Let M be the number of your birth month. Your focus point (the "tree") should be M centimeters **outside** and directly above the directrix circle (the "fence"). Mark the focus point clearly.
3. Using your focus point as the center, draw concentric circles (lightly in pencil) out from the focus, allowing the radii to grow by one centimeter with each circle. These circles should not cross past the directrix circle.
4. Identify all the points that are equidistant from the directrix circle and the focus. Smoothly connect these points to form the *hyperbola*. Make sure the curve goes to the edge of the page.
5. With a colored pencil (pink?), shade in the curve, but don't color in anything else. Use a blue colored pencil to highlight the directrix circle and the focus point.
6. Add the statement "The locus of points equidistant from a directrix circle and a focus point outside that circle is a *hyperbola*."

Pythagorean Theorem – Practice Sheet #2

1) Use the square root algorithm to calculate each of the following.

a) $\sqrt{7}$

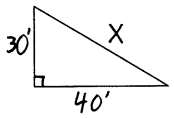
b) $\sqrt{8}$

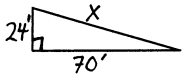
c) $\sqrt{10}$

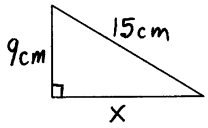
2) What is special about a Pythagorean triple?

3) What does the formula $c^2 = a^2 + b^2$ mean and how is it used?

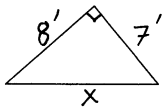
4) Find X. (Hint: The lengths of the sides are a Pythagorean triple.)

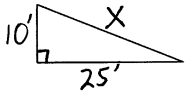
a) 

b) 

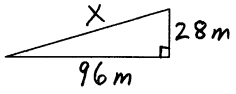
c) 

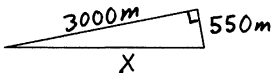
5) Use $c^2 = a^2 + b^2$ in order to find X.

a) 

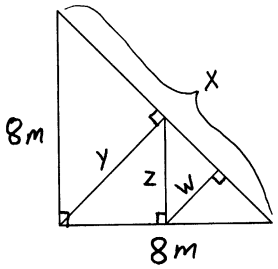
b) 

6) Do each problem first by using Pythagorean triples, and then check your answer by redoing the problem using the formula $c^2 = a^2 + b^2$.

a) 

b) 

7) *Challenge!*
Find W, X, Y, Z.



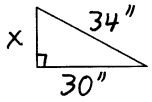
Pythagorean Theorem – Group Sheet #3

Note: The *Table of Squares and Square Roots* may be used on all sheets from here on.

1) $c^2 = a^2 + b^2$ is used to calculate the length of a right triangle's hypotenuse (c) when both of the legs (a and b) are known.

What is the formula that can be used to calculate the length of one leg, when the other leg and the hypotenuse are known?

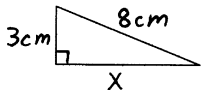
2) Make sure that the above formula is correct, and then use it to find X.



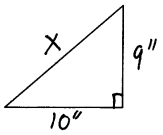
3) Calculate the length of the diagonal of a rectangle that measures 1.5m by 2m.

4) Find X, either by using the formula $c^2 = a^2 + b^2$, or the one that you found in #1.

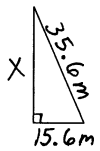
a)



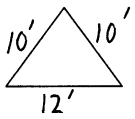
b)



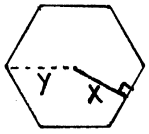
c)



d) Calculate the height of this triangle.



5) Calculate the long radius (y) and the short radius (x) of a regular hexagon that has 4cm long sides.



6) *Challenge!* Find X.