MAT 310
Homework 9

1. Re-read theorems 6.2.1 through theorem 6.2.6 along with the corresponding definitions. Write a brief paragraph that summarizes the key concept of Section 6.2 as conveyed by the theorems. How might this key concept be intuitively contradictory? How is the concept used in Section 6.3?

2. Complete Exercises 6.2.3, 6.2.4, 6.2.7, and 6.3.4.

3. Use NonEuclid to construct a line segment of specific length "1".
    a. What happens to this segment as you move it around the Poincaré disk? Does the length of the segment change?
    b. To further investigate this property of the Poincaré disk, use this segment to create a circle with radius one. As you move the circle around what happens to the circle as you move closer to the outer boundary of the disk? What happens to the center of the circle in relation to the edge of the circle? What does this mean about things in the center of the Poincaré disk verses things near the edge of the Poincaré disk?

4. Use NonEuclid to construct a line, a perpendicular, and a perpendicular to the perpendicular.
    a. Move these lines around.
    b. Will the line ever intersect the perpendicular to the perpendicular as long as the intersection of the perpendiculars does not lie on the line? Justify your answer using results from Section 6.2
    c. Hide unnecessary objects used during the construction of these objects and save the file as "Perpendiculars_ABC.euc" (where "ABC" is replaced by your initials).

5. Use NonEuclid to construct a Saccheri quadrilateral using the "hyperbolic compass" and "hyperbolic straight edge" constructions.
    a. Verify that you constructed a Saccheri quadrilateral by using the "Measure Angle" tool to measure all the angles and the "Measure Distance" tool to measure the sides.
    b. Hide unnecessary objects used during the construction of the Saccheri quadrilateral and save the file as "Saccheri_ABC.euc" (where "ABC" is replaced by your initials).
    c. Justify your construction using results from Neutral geometry.
    d. By moving your points, how close can you get the length of the summit to the length of the base? How is the length of the summit related to the length of the base? (Be careful when you move points, pay attention to your measurements of angles and distances to make sure that what you are looking at is still a Saccheri quadrilateral.)
    e. How close can you get the summit angles to 90°? How small can you get the summit angles? How big? Can you get them bigger than 90°?

6. Use NonEuclid to create a Lambert quadrilateral using the "hyperbolic compass" and "hyperbolic straight edge" constructions.
    a. Make sure that you have constructed a Lambert quadrilateral by using the "Measure Angle" tool to measure all the angles.
    b. Hide unnecessary objects used during the construction of the Lambert quadrilateral and save the file as "Lambert_ABC.euc" (where "ABC" is replaced by your initials).
    c. Complete Exercises 6.3.6 (i) – (iii).
        i. For (iii), you have likely already used some of these constructions in answering the previous questions. For those that you haven't done, try it in NonEuclid to see if the construction works! If it works, explain why. If it does not work, explain why.

7. Complete Exercise 6.3.12. In fact a rhombus can be constructed in hyperbolic geometry.
    a. Construct one in NonEuclid. Use the "Measure Distance" tool to indicate that all the distances are identical.
    b. Move your construction around. What happens to the Rhombus as you move one of its points toward the edge of the Poincaré disk? It doesn't look like a Rhombus, but it is. Why?
    c. Hide unnecessary objects used during the construction and save the file as "Rhombus_ABC.euc" (where "ABC" is replaced by your initials).

8. Construct Figure 6.3.7 using NonEuclid.
    a. Hide unnecessary objects used during the construction and save the file as "Transversal_ABC.euc" (where "ABC" is replaced by your initials).
    b. How does theorem 6.3.8 relate to the Alternate Interior Angle Theorem?

9. Use NonEuclid to create a triangle.
    a. Hide unnecessary objects used during the construction and save the file as "Triangle_ ABC.euc" (where "ABC" is replaced by your initials).
    b. How big can you make the sum of the angles? How small?

10. How might one better visualize hyperbolic geometry? Read http://www.josleys.com/article_show.php?id=83.
    a. Why are the views inside the chambers based on the Poincaré disk not really hyperbolic?
    b. How does this author propose to make the views more "spectalular" (I didn't say that the author could spell)?

Prior to class on the due date for this homework, attach the files

Perpendiculars_ABC.euc
Saccheri_ABC.euc
Lambert_ABC.euc
Rhombus_ABC.euc
Transversal_ABC.euc
Triangle_ ABC.euc
(where "ABC" is replaced by your initials)

to one email addressed to Jason.H.Martin@asu.edu.
The rest is due at the beginning of class on the due date.