Project 1: Axiomatic Systems, Measurement and Constructions

The purpose of this problem set is to make connections and apply the material. You may work alone or in a group of 2 people and turn in one project writeup. Be sure to show work and explain your reasoning in your own words. In addition, be sure to acknowledge any sources outside me or your group, like "The insight for this solution came from a conversation with Joel."

1. 1.1 # 8 on pp. 6–7 (Geometric Perspectives)

   (a) Follow the instructions in the book to make a diagram, calculate the circumference in various units (show work), and compare to present-day estimates.

   (b) What assumption did Eratosthenes make about the light rays coming in at the two cities?

   (c) Does this assumption about the light rays precisely hold (i.e. mathematically hold) in real life?

   (d) What geometry theorem did Eratosthenes apply after he abstracted the data to form a geometric figure that included the center of the earth?

2. 1.3 # 6 on p. 25 (Geometric Perspectives)

   (a) Follow the instructions in the book to create the axioms (convert the axioms, not the theorems).

   (b) Sketch a model for this axiomatic system.

3. 1.4 #4 on p. 31 with the model on p. 32 (Geometric Perspectives)

   Be sure to explain your reasoning as you answer the three questions. Note that parallel is defined as nonintersecting lines on p. 29.

4. Angle Bisector (Interactive Geometry Software and Proof Considerations)

   (a) Follow Construction 4.9.4 on page 210 to construct an angle bisector in an Interactive Geometry Software with only straightedge, compass, and intersection features. (One option that may make things easier is to select s to have the same length as $\overline{PQ}$.)

   (b) Measure the angles to show they are equal.

   (c) Move one of the points to ensure you have constructed an angle bisector for a wide range of examples.

   (d) Select one view and print your construction and measurements.

   (e) Print your script/commands.

   (f) 4.9 #8. Write a rigorous proof in paragraph form with your justifications. You may refer to Euclid's definitions, postulates, common notions, and up through I-8.

   (g) Are there any additional underlying assumptions you needed in your proof?

   (h) Later in the semester we will look at the application of this construction in other geometries as well as its limitations. For a different type of application, how can I-9 be applied to prove I-10?

5. (Career Connections—Individual component)

   (a) What are your major(s), minor(s), and concentration(s), if any?

   (b) What are your future plans/thoughts for immediately after graduation?

   (c) What is your intended career?

   (d) Research one item broadly related to geometry and your intended career and report back on it. Include the source.