Math 331 Worksheet 1

Note: None of these problems are for a grade, though you may obtain extra credit for writing up proofs on the board.

1) Make sure everyone understands at least one diagrammatic proof of the Pythagorean Theorem!

2) The section "Undefined Terms" in the text contains several curious statements, including the following:

a) Page 12, 'The adjective "straight" is problematic when it modifies the noun "line," so we won't use it.'

b) Page 14, 'A "line," however, is not a set of points in our treatment.'

c) Page 15, '*The selection of undefined terms and axioms is arbitrary and a matter of convenience and aesthetics.*'

What could Greenberg possibly mean by these cryptic remarks? Were there any other comments made in this section that you felt were confusing?

3) On pages 16-17, Greenberg observes, "after all, if we can imagine an abstract line without breadth and an abstract point that has no part, neither of which exists in the physical world, why are we forbidden to imagine an abstract infinitely long line or an infinite set?" Do you agree with his point? Why or why not?

4) True or False: The "Euclidean Parallel Postulate" and "Euclid's Fifth Postulate" are the same.

5) a) Discuss Gauss' treatment of Lobachevsky and János Bolyai. Provided you accept Gauss' assertion that he was the first to discover a non-Euclidean geometry, what do you think about his decision to suppress his findings?

6) Regarding Lobachevsky and Bolyai, Greenberg notes on page 247 that they both "had a constant in their formulas that they could not explain; the later work of Riemann showed it to be the *curvature* of a hyperbolic plane." Perhaps you recall the notion of curvature from Calculus III with respect to

curves in 3-dimensional Euclidean space. What we are now discussing is the curvature of a *space*.

a) Without looking up the definitions try to imagine an object with "constant curvature" looks like.

b) What would an object with "nonconstant curvature" look like?

7) Break open your book and turn to page 43. Pick two parts of Exercise 1 and two parts of Exercise 2 and work through your own definitions. Remember that you can only use terms that have already been defined!

8) Prove that $\sum_{k=1}^{n} k = \frac{n(n+1)}{2}$. If your proof was not pictorial, can you find a way to make a pictorial proof?