Directions: Be sure to include in-line citations, including page numbers if appropriate, every time you use the results of discussion, a text, notes, or technology. **Only write on one side of each page.**

“Reductio ad absurdum, which Euclid loved so much, is one of a mathematician’s finest weapons. It is a far finer gambit than any chess play: a chess player may offer the sacrifice of a pawn or even a piece, but a mathematician offers the game.” – Godfrey H. Hardy

**Type I Problems**

1. Determine if the following are tautologies.
   
   (a) $p \implies (q \implies p)$
   
   (b) $[p \implies (q \implies r)] \implies [q \implies (p \implies r)]$
   
   (c) $(p \lor q) \iff (\neg p) \land (\neg q)$
   
   (d) $p \land \neg p$
   
   (e) $(p \land \neg q) \implies (r \land \neg r) \implies (p \implies q)$

2. (Number 9 page 30 of Greenberg) Can you think of any way to prove from the postulates in chapter 1 that for every line $l$?
   
   (a) There exists a point lying on $l$?
   
   (b) There exists a point not lying on $l$?

3. (Number 12 page 31 of Greenberg) What is the flaw in the ‘proof’ that all triangles are isosceles?

0.1 **Type II Problems**

1. In each of the below, give examples of sets $A, B$ that satisfy the specified property.
   
   (a) $A \subset B$
   
   (b) $A \not\subseteq B$
   
   (c) $A \in B$
   
   (d) $A \notin B$
   
   (e) $A \subset A$
   
   (f) $A \not\subset A$
   
   (g) $A \notin A$
   
   (h) $A \in A$

2. Let $S$ be the collection of all sets that do not contain themselves as elements. Is $S$ in $S$ or is it not in $S$?
   
   (a) Look up Russell’s paradox and give a brief explanation of how mathematicians now deal with this paradox in set theory.
3. Show that it is impossible for any set to be in one-to-one correspondence with its power set. (Include infinite sets in your presentation.)

4. Do Major exercise 1 page 31 of Greenberg.

5. Do Major exercise 2 page 32 of Greenberg.