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The answers must be the original work of the author. While discussion with others is permitted and encouraged, the final work should be done individually. You are not allowed to work in groups. You are allowed to build on the material supplied in the class. Any other source must be specified clearly.

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Consider the following sets for questions **1** and **2**:

$$X = \{1, 11, \{1\}, \emptyset\} \quad Y = \{1, 11, [11, 11], \{\emptyset\}\}$$

**1.** (30 points) Write out each of the sets listed below.

- (a)  $X \cup Y$
- (b)  $X \cap Y$
- (c)  $X \cup \emptyset$
- (d)  $Y \cap \emptyset$
- (e)  $X \cap \{\emptyset\}$
- (f)  $X - Y$
- (g)  $Y - X$
- (h)  $P(X)$
- (i)  $X \times Y$
- (j)  $X \times Y \cap \{[11, 11, 11]\}$

**2.** (30 points) State whether the following propositions are TRUE or FALSE.

- (a)  $1 \in X$
- (b)  $\{1\} \in X$
- (c)  $1 \in Y$
- (d)  $\{1\} \in Y$
- (e)  $\{1\} \subseteq X$
- (f)  $\{1\} \subseteq Y$
- (g)  $\emptyset \in X$
- (h)  $\emptyset \in Y$
- (i)  $\emptyset \subseteq Y$
- (j)  $\{[1, 1]\} \in X \times X$

**3.** (40 points) Suppose that sets  $X$  and  $Y$  have  $n$  and  $m$  elements, respectively. How many elements do the following sets have? Explain your answer. No points will be given to answers without accompanying explanations.

- (a)  $X \cup Y$    (b)  $X \cap Y$    (c)  $X \times Y$    (d)  $P(X)$