MA383 Foundations in Mathematics
Lesson 21: Review of Sets

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1. Let the universal set be $U = \{0, 1, 2, 3, \ldots, 20\}$, and let $A = \{1, 2, 3, 4, 5\}$, $B = \{0, 1, 4, 8\}$, and $C = \{2, 5, 7, 9, 11, 13, 17\}$. Compute each of the following:

   (a) $A \cup B$

   (b) $A \cap B$

   (c) $A \cap C$

   (d) $A - B$

   (e) $A - (B \cup C)$

   (f) $(A - B) \cup (A - C)$

   (g) $A \cap (B \cup C)$

   (h) $(A \cap B) \cup (A \cap C)$

   (i) $A \cup (B \cap C)$

   (j) $(A \cup B) \cap (A \cup C)$

   (k) $A^c \cup B^c$

   (l) $(A^c \cup C)^c$

   (m) $|A \cup C|$

   (n) $|B \cup C|$

   (o) $\mathcal{P}(A - B)$

2. Label each of the following true or false:

   (a) $3 \in \{1, 2, 3\}$
   (b) $1 \subseteq \{1\}$
   (c) $\{2\} \in \{1, 2\}$
   (d) $1 \in \{1\}$
   (e) $\{3\} \in \{1, \{2\}, \{3\}\}$
   (f) $\{1, 2\} \subset \{1, 2, 3\}$
   (g) $\{2\} \in \mathcal{P}(A)$ where $A = \{1, 2, 3\}$.
   (h) $\{1\} \subseteq \{1\}$
   (i) $\{3\} \subseteq \mathcal{P}(A)$, where $A = \{1, 2, 3\}$.
   (j) $\emptyset \in A$, where $A = \{1, 2, 3\}$.

3. Prove or give a counterexample:

$$(A - B) \cup (B - C) = A - C$$

4. Prove or give a counterexample:

$$(A \cup B) - C = (A - C) \cup (B - C)$$

5. Suppose A, B, and C are subsets of a universal set U. Prove the distributive law that states

$$(A \cup B) \cap C = (A \cap C) \cup (B \cap C).$$

(Note: A Venn diagram will not suffice!)

6. Prove or give a counterexample: If $A \cup C = B \cap C$, then $A \subseteq B$.