1. (20 points) True or False:
   (a) $4 \in \{3, 4, 6, 8\}$
   (b) $\{4\} \in \{3, 4, 6, 8\}$
   (c) $4 \subset \{3, 4, 6, 8\}$
   (d) $\{4\} \subset \{3, 4, 6, 8\}$
   (e) $4 \in \{3, \{4\}, 6, 8\}$
   (f) $\{4\} \in \{3, \{4\}, 6, 8\}$
   (g) $4 \subset \{3, \{4\}, 6, 8\}$
   (h) $\{4\} \subset \{3, \{4\}, 6, 8\}$
   (i) $\{3, 4\} \cup \{4, 5\} \subset \{3, 4, 5, 6\}$
   (j) $\{3, 4\} \cap \{4, 5\} \in \{3, 4, 5, 6\}$

2. (18 points) In this problem, $A = \{2, 4, 6, 8\}$, $B = \{1, 2, 3, 4\}$, $C = \{\{2, 3\}, 4, \{5, 6\}\}$ and $D = \{1, 3, 5, 7\}$. Give the set defined by each of the following statements.
   (a) $A \cup B$
   (b) $B \cup C$
   (c) $A \cap C$
   (d) $(A \cap B) \cup D$
   (e) $A \cap (B \cup D)$
   (f) $D - B$
   (g) $B - C$
   (h) $\mathcal{P}(A - B)$
   (i) $(B - A) \times C$

3. (27 points) In each blank, write either $\subset$, $\supset$, or $\;=$. Use $\;=$ whenever possible. Capital letters represent sets.
   (a) $A \cap B$ $\subset$ $B$
   (b) $A$ $\subset$ $(A \cap B) \cup (A - B)$
(c) $A - (A - B) \subseteq B$
(d) $A - (B - A) \subseteq A - B$
(e) $A \cap (B - C) \subseteq (A \cap B) - (A \cap C)$
(f) $A \cup (B - C) \subseteq (A \cup B) - (A \cup C)$
(g) $(A \times B) \cup (C \times D) \subseteq (A \cup C) \times (B \cup D)$
(h) $(A \times B) \cap (C \times D) \subseteq (A \cap C) \times (B \cap D)$
(i) $(A \times B) - (C \times D) \subseteq (A - C) \times (B - D)$

4. (7 points) List all partitions of the set \{1, 2, 3\}.

5. (10 points) Use the set identities from the class handout to simplify the following expression. At each step use only one identity and list which one you are using.

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

6. (18 points) For each statement below, either prove that it is true or prove that it is false.

   (a) For all sets $A, B$ and $C$, if $B \cap C \subset A$, then $(C - A) \cap (B - A) = \emptyset$.
   (b) For all sets $A$ and $B$, $\mathcal{P}(A) \cup \mathcal{P}(B) = \mathcal{P}(A \cup B)$.
   (c) For all sets $A, B$ and $C$, $(A - B) - C = A - (B \cup C)$. 
