Name_____Stud. No._____

1.   (15) Let $A = \{1, 2\}$ and $B = \{2, 3, 4\}$. Find each of the following sets.
    (a) $A \cap \overline{B}$.

    (b) $\mathcal{P}(A)$.

    (c) $A \times B$.

2.   (10) Prove that for all sets A and B, $A - B = \emptyset$ iff $A \subseteq B$.

3. (15) Prove that for all sets A, B, and C, $(\overline{A \cup B}) \cup (\overline{B \cup C}) = \overline{B} \cap (\overline{A} \cup \overline{C})$.

4. (10) Show that the following statement is NOT a theorem of set theory: For all sets A and B, $\mathcal{P}(A \cup B) \subseteq \mathcal{P}(A) \cup \mathcal{P}(B)$.

5. (10) If $f(x) = (7 - \sqrt{x+1})^{1/3}$, express f as the composition of four functions, none of which is the identity function.

6. (15) Define a relation ρ on $\mathbb{Z}$ such that $x\rho y$ iff $x - y = 5k$ for some integer k.
   (a) Prove that ρ is an equivalence relation.

   (b) Describe the equivalence classes of ρ.

7. (10) Sketch a graph of the relation $\rho = \{(x, y) \in \mathbb{R} \times \mathbb{R} : |x + y| \leq 1\}$.

8. (15) Let $f : X \to Y$ be a $1-1$ function mapping X onto Y and let B and C be any subsets of Y. Prove that $f^{-1}[B - C] = f^{-1}[B] - f^{-1}[C]$.