Problem 1. Suppose that $A$ and $B$ are two events. Write expressions involving unions, intersections, and complements that describe the following:

1. Both events occur
2. At least one occurs
3. Neither occurs
4. Exactly one occurs
Problem 2. Suppose a family contains two children of different ages, and we are interested in the gender of these children. Let $F$ denote that a child is female and $M$ that the child is male and let a pair such as $FM$ denote that the older child is female and the younger is male. There are four points in the set $S$ of possible observations:

$$S = \{FF, FM, MF, MM\}.$$  

Let $A$ denote the subset of possibilities containing no males; $B$, the subset containing two males; and $C$, the subset containing at least one male. List the elements of $A$, $B$, $C$, $A \cup B$, $A \cap B$, $A \cup C$, $A \cap C$, $B \cup C$, $B \cap C$, and $C \cap \bar{B}$. 
Problem 3. Define the sequence of sets $A_j = (1 - 1/j, 2 + 1/j)$, for $j = 1, 2, \ldots$. Then what are

$$\bigcup_{j=1}^{\infty} A_j \text{ and } \bigcap_{j=1}^{\infty} A_j?$$