1. (a) $S \cap M$, 3;  
   (b) $(S \cup M)^c$, 13;  
   (c) $S \cup M$, 12;  
   (d) $S \cap M^c$, 7;  
   (e) $(S \cup M) \cap (S \cap M)^c$, (alternatively $(S \cap M^c) \cup (S^c \cap M)$), 9.

2. (a) False; roll a die and let $A = \{1,2\}$, $B = \{2,3\}$, and $C = \{1,3\}$.  
   (b) False; roll a die and let $A = \{1,2,3,4\}$, $B = \{1,2,3,4,5\}$, and $C = \{1,2,3,4,5,6\}$.

3. (a) (i) $x(1) = 1$. The first entry of $x$. 
   (ii) $y(x) = [10,6,4,5,8]$. The vector consisting of the 1st, 3rd, 5th, 4th, and 2nd elements of $y$ in that order. 
   (iii) $y < 7 = [0,0,1,1,1]$. (0 = FALSE, 1 = TRUE). Therefore $x(y < 7) = [5,4,2]$, the 3rd, 4th, and 5th elements of $y$.
   (b) (i) $2 \times x \leq y = [1,1,0,0,1]$. Therefore, $y(2 \times x \leq y) = [10,8,4]$, the 1st, 2nd, and 5th elements of $x$. 
   (ii) $y > 5 = [1,1,1,0,0]$ and $z = [3,3,3,3,3] + [1,3,5,4,2] + [10,8,6,5,4] = [14,14,14,12,9]$. Therefore, $z(y > 5) = [14,14,14]$, the 1st, 2nd, and 3rd elements of $z$.

4. $P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.2 + \beta - P(A \cap B)$. Therefore, $\beta = 0.6 - 0.2 + P(A \cap B) = 0.4 + P(A \cap B)$.
   (a) $A$ and $B$ mutually exclusive means that $A \cap B = \emptyset$. Thus $\beta = 0.4 + 0 = 0.4$.
   (b) $A$ and $B$ independent means that $P(A \cap B) = P(A)P(B) = 0.2\beta$. Thus, $\beta = 0.4 + 0.2\beta \implies \beta = 0.5$.

As $A \cap B \subset A$, $P(A \cap B) \leq P(A) = 0.2$. Thus, $0 \leq P(A \cap B) \leq 0.2 \implies 0.4 \leq \beta \leq 0.6$. 