(1) Consider the set $A = \{0, 1, 2, 3\}$ and $B = \{1, 2, 3, 4\}$. Determine the following:

(i) $A \cup B =$

(ii) $A \cap B =$

(iii) $A \times B =$

(iv) $|2^A| =$

(v) $\{C \subset A \ : \ |C| = 3\} =$

(vi) $\{C \subset A \ : \ |C| = 3\} \quad \setminus \quad \{C \in 2^A \ : \ |C| = 3\} =$

(vii) $\big|\{R \subset A \times B \ : \text{ where } R \text{ is a function}\}\big| =$

(2) Prove by induction or any other means:

$$\sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}.$$

(3) 3 identical dice are rolled, each with 6 sides labelled $1, 2, 3, 4, 5, 6$. How many possible outcomes are there?