1. Complete the table. (12)

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Binary</th>
<th>Octal</th>
<th>Hexadecimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>171</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1111</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>171</td>
<td>EA</td>
</tr>
</tbody>
</table>

2. Fill in the blanks, (2)

(a) _________________ Is a predicate that is true during every execution of a loop.

(b) _________________ Is a common running time worse than \( n \) but better than \( n^2 \)

(c) _________________ Refers to a set of problems which have no known polynomial time solution

(d) _________________ The type of algorithm which calls itself
3. Let $f(x) = 3x + 5$ and $g(x) = 5x + 3$.

(a) Prove or disprove that $f(x)$ is $O(g(x))$ (8)

(b) Prove or disprove that $f(x)$ is $\Omega(g(x))$ (8)

(c) Prove or disprove that $f(x)$ is $\Theta(g(x))$ (8)
4. Use induction to prove that $\sum_{i=1}^{n} i = \frac{n(n + 1)}{2}$. 

(20)
5. Given sets $A_1, A_2 \ldots A_n$ and $B_1, B_2 \ldots B_n$ such that $A_i \subseteq B_i$, use induction to prove that
\[\bigcup_{j=1}^{n} A_j \subseteq \bigcup_{j=1}^{n} B_j.\]
6. Let $f(0) = 1$ and $\forall n > 0, f(n) = n \cdot f(n - 1)$. Compute $f(1)$ through $f(4)$. 

7. Let $S = \mathbb{Z}^+ \cup \{x|\exists s, t \in S, x = s/t\}$. Prove that the positive rational numbers are a subset of $S$. 