1. Suppose $a, b \in \mathbb{N}$ are even. Prove using the direct proof method that $a + b$ is even.

2. Prove that for every $n \in \mathbb{N}$ such that $n \geq 1$, $\lceil lg(n+1) \rceil = 1 + \lfloor lg(n) \rfloor$

3. Prove by contradiction that $\sqrt{2} \notin \mathbb{Q}$.

4. Prove by induction that for all $n \in \mathbb{N}$, $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$.

5. Given the below fragment of pseudo-code, how many arithmetic operations occur?

```
var = 0
for (int i = 1; i ≤ n; i = i + 1)
    var = var + 1
    for (int j = 1; j ≤ n; j = j + 1)
        var = var + 1
    end for
end for
```

6. Given the below fragment of pseudo-code, how many arithmetic operations occur?

```
var = 0
for (int j = 1; j ≤ n; j = j * 3)
    var = var + i + j
    if (j < floor(n/2))
        var *= 5
    end if
end for
```