Section 2: Asymptotic Analysis

Q1: Functions to Big-Theta

Given the following functions, simplify them to determine their respective big-Theta bounds (in terms of N).

1. $3n^5 + 6n^3 + n$

2. $2^n + 3^n$

3. $2^{n/2}$

4. 9,000,000

5. n/5 + 5

Then, order them from best (fastest) to worst (slowest).

Q2: True or False

For each of the following statements, determine if they are true or false. Draw an example or provide a written explanation for why.

1. If a function is in $\Theta(N)$, then it can also be in $\Omega(N)$.

2. If a function is in $O(N^2)$, then it is always in $\Theta(N^2)$.

3. If a function is in $\Omega(1)$, then it can also be in $O(N^2)$.

4. In the worst case, removing an element from an ArrayList is in $\Omega(N)$.

5. In the worst case, adding an element into an ArrayList is in $O(N)$.

Q3: Case Analysis

Given the below code, determine the worst case and its corresponding runtime.

```
this.size = // some value
this.arr = // some list
// ..other fields
void foo(int val) {
    size++;
    if (size >= arr.length) {
        temp = new int[arr.length * 2];
        for (int i = 0; i < size; i++) {
            temp[i] = arr[i];
        }
        temp[size] = val;
        this.arr = temp;
    } else {
        arr[size] = val;
    }
}
```

Worst Case:

Runtime: