

Problem 1: Comparing Growth Rates

$$\frac{2}{N} < 128 < \log N < \sqrt{N} < N \log N < 23N < N! = N^2 < 42N^3 < 2^n = 2^{n+1} < 3^n$$

Problem 2: Running Time Analysis (16 pts)

```
1. int sum = 0;
for (int i = 0; i < n; i++)
    for (int k = i; k < n; k++)
        sum++;
```

Big – Theta running Time : this one is $\Theta(N^2)$

```
2. int sum = 0;
for (int i = 0; i < 23; i++)
    for (int j = 0; j < n; j++)
        sum++;
```

Big – Theta running Time: this one is $\Theta(N)$

```
3. public int foo(int x, int k) {
    if (x <= k)
        return 1;
    else
        return foo(x / k, k) + 1;
}
```

Big – Theta running Time: this one is $\Theta(\log N)$

Problem 3: Re-arranging Train Cars

(a) Firstly, put the 3 in S3, then put 6 in S2, then put 9 in S1, then put 2 in S3, then put 4 in S2, then put 7 in S1, then let 1 to the back of the output track. Then move the 2 from the S3 to the output track. Next

move the 3 from S3 to the output track. Then move 4 from S2 to the output track. Then move 8 to the S3. Then move the 5 to the output track. Then move 6 from the S2 to the output track. Then move 7 from S1 to the output track. Next move the 8 from S3 to the output track. Finally move the 9 from the S1 to the output track. We are done.

(b) No. In some case it will not have the solution. If we have 2, and 3 in the front of track, it will not have solution. For example, if the input track is 5,8,1,7,6,9,4,3,2. The 2 is front, and the 5 is back. This case will not have solution.