

Name: _____

Date: _____

Point values are assigned for each question.

Points earned: ____ / 42, = ____ %

1. Use the definitions of O , Θ , and Ω to determine whether the following assertions are true or false. If true, give values for the appropriate constants. If false, explain the contradiction. (3 pts. each)

a. $n(n+1)/2 \in O(n^3)$ _____

b. $n(n+1)/2 \in O(n^2)$ _____

c. $n(n+1)/2 \in \Theta(n^3)$ _____

d. $n(n+1)/2 \in \Omega(n^3)$ _____

2. Write the following asymptotic efficiency classes in **increasing** order of magnitude.

$O(n^2)$, $O(2^n)$, $O(1)$, $O(n \lg n)$, $O(n)$, $O(n!)$, $O(n^3)$, $O(\lg n)$, $O(n^n)$, $O(n^2 \lg n)$ (1 pt. each)

_____, _____, _____, _____, _____, _____, _____, _____, _____, _____

3. Determine the largest size n of a problem that can be solved in time t , assuming that the algorithm takes $f(n)$ milliseconds. (1 pt. each)

a. $f(n) = n$, $t = 1$ second _____

b. $f(n) = n \lg n$, $t = 1$ hour _____

c. $f(n) = n^2$, $t = 1$ hour _____

d. $f(n) = n^3$, $t = 1$ day _____

e. $f(n) = n!$, $t = 1$ minute _____

4. (3 pts.) Suppose we are comparing two sorting algorithms and that for all inputs of size n the first algorithm runs in $8n^2$ seconds, while the second algorithm runs in $48n \lg n$ seconds. For which integral values of n does the first algorithm beat the second algorithm? _____

Explain how you got your answer:

5. Give the complexity of the following methods. Choose the most appropriate notation from among O , Θ , and Ω . (3 pts. each)

```
int function1(int n) {
    int count = 0;
    for (int i = n / 2; i <= n; i++) {
        for (int j = 1; j <= n; j *= 2) {
            count++;
        }
    }
    return count;
}
```

Answer: _____

```
int function2(int n) {
    int count = 0;
    for (int i = 1; i * i <= n; i++) {
        count++;
    }
    return count;
}
```

Answer: _____

```
int function3(int n) {
    int count = 0;
    for (int i = 1; i <= n; i++) {
        for (int j = 1; j <= n; j++) {
            for (int k = 1; k <= n; k++) {
                count++;
            }
        }
    }
    return count;
}
```

Answer: _____

```
int function4(int n) {
    int count = 0;
    for (int i = 1; i <= n; i++) {
        for (int j = 1; j <= n; j++) {
            count++;
            break;
        }
    }
    return count;
}
```

Answer: _____