Computer Science 302 Fall 2018 Practice Examination for the First Examination, September 19, 2018

Name:_____

No books, notes, or scratch paper. Use pen or pencil, any color. Use the rest of this page and the backs of the pages for scratch paper. If you need more scratch paper, it will be provided.

The entire examination is 100 points.

1. True or False. [5 points each]

   (a) _____ $n = O(n^2)$

   (b) _____ $n = \Theta(n^2)$

   (c) _____ $\log(n^2) = \Theta(\log n)$

   (d) _____ In the worst case, mergesort uses $O(n \log n)$ comparisons to sort n items

   (e) _____ In the worst case, quicksort uses $O(n \log n)$ comparisons to sort n items

   (f) _____ $\sum_{i=1}^{n} \log(i) = O(n)$

2. Fill in the blanks.

   (a) [10 points] The two Divide and Conquer sorting algorithms we have covered are:

   _____

   _____

   (b) [10 points] The asymptotic complexity of the expression `mary(n)` is _____where `mary` is given as follows:

```
int mary(int n)
 {
  if (n < 1) return 1;
  else return mary(n-1) + mary(n-1);
 }
```

3. Using asymptotic notation, give how many times "Hello world" will be printed for each of the code fragments below, in terms of n. Use "Θ" if possible.

   (a) [5 points]

```
for(int i=1; i<n; i++)
  cout << "Hello world" << endl;
```

   (b) [5 points]

```
for(int i=1; i<n; i++)
  for(int j=i; j<n; j++)
    cout << "Hello world" << endl;
```

   (c) [5 points]

```
for(int i=1; i<n; i++)
  for(int j=1; j<i; j=2*j)
    cout << "Hello world" << endl;
```

   (d) [5 points]

```
for(int i=1; i<n; i++)
  for(int j=i; j<n; j=2*j)
    cout << "Hello world" << endl;
```

   (e) [5 points]

```
for(int i=2; i<n; i=i*i)
  cout << "Hello world" << endl;
```

4. [10 points] **This one is harder.** Using asymptotic notation, state how many times "Hello world" will be printed for the code fragment below, in terms of n. Use "Θ" if possible.

```
for(int i=1; i<n; i=2*i)
  for(int j=i; j<n; j=2*j)
    cout << "Hello world" << endl;
```

5. [15 points]

   Write a complete C++ program which prompts the user to enter three integers, then prints the largest of those. An execution of your program should look like this:

```
Enter three integers: 4 -6 2
The largest of those integers is 4
```