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) [5 points] Any comparison-based sorting algorithm on a list of $n$ items uses ________ comparisons in the worst case. (Give an asymptotic answer.)
   (b) [10 points] The two Divide and Conquer sorting algorithms we have covered are:
       ________________________________________________________________
       ________________________________________________________________
       ________________________________________________________________

   (c) [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 pseudo-code fragments below, in terms of \( n \).

(a) [5 points]

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

(b) [5 points]

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

(c) [5 points]

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

(d) [5 points]

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

(e) [5 points]

```cpp
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 pseudo-code fragment below,

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