1. **Compare Functions**: (10 points) What is the smallest integer value of $n > 3$ such that an algorithm whose running time is $7n$ runs *slower than* an algorithm whose running time is $7(\log_2 n)^4$ on the same machine? Justify your answer. (Hint: You may write a program, draw a plot, or/and proof)

2. **Pseudocode and Loop Invariant**: (15 points) textbook, Exercise2.1-3, p22, Searching Problem

3. **Sorting Algorithms**: (20 points) Using textbook Figure 2.2 and Figure 2.4 as models to illustrate the operations of Insertion_Sort and Merge_Sort on the array A = <30, 7, 95, 56>

4. **Analysis**: (20 points) There is a mystery function called Mystery(n) and the pseudocode of the algorithm is shown as below. Please analyze the worst-case asymptotic execution time of this algorithm using the method we learn in the class. Express the execution time as a function of the input value n. Assume that $n = 3^k$ for some positive integer $k \geq 1$. Justify your answer.
   Hint:
   (a) Draw a recursion tree to help with your analysis.
   (b) Appendix A may help with your calculation

```
    Mystery(n)
1       if  n≤1
2           return 1
3       for  i=1  to  5
4          for j = 1 to n^2
5              print "this is a recursive call."
6       Mystery (n/3)
7       Mystery (n/3)
8       Mystery (n/3)
```

5. **Divide and Conquer:**
   a. (20 points) textbook, Exercise 2.3-5, p39
   b. (15 points) textbook, Exercise 2.3-7, p39