1. Consider the list of numbers: 21 12 26 15 49 33 7
a) After each of the first two passes of Insertion Sort, the list will be
　　Pass 1: 12 21 26 15 49 33 7
　　Pass 2: 12 21 26 15 49 33 7
　Complete the list for each of the remaining passes.
b) After each of the first two passes of Selection Sort, the list will be
　　Pass 1: 7 12 26 15 49 33 21
　　Pass 2: 7 12 26 15 49 33 21
　Complete the list for each of the remaining passes.

Given the ordered list of numbers: 7 12 15 21 26 33 49
c) What sequence of numbers will be examined in performing a Sequential Search for the target 27?
d) What sequence of numbers will be examined in performing a Binary Search for the target 27?　　　　(10%)

2. Answer each of the following timing questions concerning an algorithm of a particular order and a data instance of a particular size. Assume that the run time is affected by the size of the data instance and not its composition.

a) For an $O(\log_2 n)$ algorithm, an instance with n = 64 takes 16 seconds. How long will it take with n = 512?
b) For an $O(n^3)$ algorithm, an instance with n = 100 takes 37 milliseconds. If you used a different-sized data instance and it took 37 seconds, how large must that instance be?

Given the following pseudocode segment, answer the questions below for an arbitrary n：

```
x ← 0
for i ← 1 to (2*n) do
   for j ← 1 to (n-2) do
       x ← x + j
```

c) What is the Order of this code segment, in terms of n?
d) What will be the value of x (in terms of n) when the loops end?　　　　(10%)

3. Consider the addition of two decimal digits in BCD, together with a possible carry from a previous less significant pair of digits. Suppose we add the BCD digitals as if they were binary. When the binary sum is greater than or equal to $(1010)_2$, the result is an invalid BCD digit. Explain the reason why the addition of $6=(0110)_2$ to the binary sum will convert to the correct digit and also produces a carry as required .　　　　(15%)

4. (a) How many 32K × 8 RAM chips are needed to provide a memory capacity of 512K bytes ?
　(b) How many lines of the address must be used to access 512Kbytes ?　　　　(20%)

5. Implement the Boolean function F=(A+B)(C+D) with a multiplexer .　(15%)

6. Prove the following for every n > 0,　　　　　　　　(10%)

$$f(n) = \sum_{i=0}^{m} a_i n^i$$

$$= a_m n^m + a_{m-1} n^{m-1} + \cdots + a_1 n^1 + a_0$$

$$a_m > 0 \rightarrow f(n) = O(n^m)$$

7. Prove the fact that for every integer k ≥ 1, n > 0, $\log^k n = O(n)$　　　　(10%)

8. Suppose you have an integer n, $0 <= n < 2^{64}$. You are asked to put the leftmost 32 bits of n into an unsigned long variable L32Bits and the rightmost 32 bits into an unsigned long R32Bits. The value stored in the L32Bits is hDblWord. The value stored in the R32Bits is lDblWord. What is the relationship between n and hDblWord? What is the relationship between n and lDblWord? How to print out the value of n in the hexadecimal format using L32Bits, R32Bits, and printf() function?　　(10%)