1. Using 4 bits and two's complement representation, what is the binary representation of the following signed decimal values:
   (1). +8 (5%)
   (2). −5 (5%)

2. For the following number list, perform a bubble sort, and show the list after each exchange. (10%)

15	3	6	9	1	5	7

3. Assume that a hard disk has the following characteristics:

   Rotation speed = 7,200 rev/min
   Arm movement time = 0.5 msec fixed startup time + 0.05 msec for each track crossed. (The startup time is a constant no matter how far the arm moves.)
   Number of surfaces = 2 (This is a double-sided disk. A single read/write arm holds both read/write heads.)
   Number of tracks per surface = 500
   Number of sectors per track = 20
   Number of characters per sector = 1,024

   (1). How many characters can be stored on this disk? (5%)
   (2). What are the best-case, worst-case, and average-case access times for this disk? (5%)

4. Consider the following structure of the instruction register.

op code	***address-1***	***address-2***
6 bits	12 bits	12 bits

   (1). What is the maximum number of distinct operation codes that can be recognized and executed by the processor on this machine? (3%)
   (2). What is the maximum memory size on this machine? (3%)
   (3). How many bytes are required for each operation? (4%)

5. Using the public key RSA encryption algorithm, let p = 3 and q = 5. Then n = 15 and m = 8. Let e = 11.
   (1). Compute d. (2%)
   (2). Find the code for 3. (4%)
   (3). Decode your answer to part (2) to retrieve the 3. (4%)

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6. Using the parsing expression grammar of the following figure, show the parse tree for the below assignment statement. (10%)

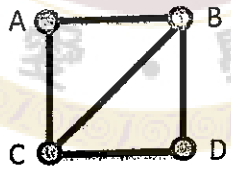
x = x + y + z

Number	Rule
1	<assignment statement> ::= <variable> = <expression>
2	<expression> ::= <variable> | <expression> + <variable>
3	<variable> ::= x | y | z

7. Build and draw a circuit using AND, OR, and NOT gates to implement the following truth table. This operation is termed NAND, for Not AND, and it can be constructed as a single gate. Assume that you do not have access to a NAND gate and must construct it from AND, OR, and NOT gates. (10%)

a	b	Output
0	0	1
0	1	1
1	0	1
1	1	0

8. Consider the following graph:



(1). Draw a tree showing all paths from A and highlighting those that are Hamiltonian circuits. (5%)

(2). How many paths have to be examined? (5%)

9. Write an assembly language program to find the factorial of number 10. (10%)

10. Write a simple program function for linear search in any high-level programming language. Wrap a main program to search an element in an integer array using the linear search function. (10%).

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