Part I (40%). 第 1-20 題為單選題，每題 2 分，答錯不倒扣

1. Which of the following statements is true?
   (1) A stack is known as a first-in-first-out (FIFO) structure.
   (2) A queue is known as a last-in-first-out (LIFO) structure.
   (3) The process of inserting an object on a stack is called a pop operation.
   (4) Stacks and queues can be represented by linked lists.

2. Consider a tree as a connected, acyclic, undirected graph. Which of the following statements is false?
   (1) A tree that has n vertices contains n edges.
   (2) Any two vertices in a tree are connected by a unique simple path.
   (3) If an edge is deleted from a tree, the resulting graph becomes disconnected.
   (4) If a new edge between a pair of nonadjacent vertices is added in a tree, the resultant graph has a cycle.

3. Which of the following sorting algorithms can sort n numbers in $O(n\log n)$ worst-case time?
   (1) bubble sort   (2) insertion sort   (3) quicksort   (4) merge sort

4. What is the maximum number of entries that must be interrogated when applying the binary search method to a sorted list of 100 entries?
   (1) 6   (2) 7   (3) 8   (4) 100

5. Suppose a two-dimensional array of 4 rows and 8 columns is stored in column major order beginning at memory address 10 (decimal). What is the address of the entry in the third row and second column if each entry occupies one memory cell?
   (1) 27   (2) 28   (3) 16   (4) 17

6. The parameter-passing methodology used in the C programming language is
   (1) pass-by-value   (2) pass-by-reference   (3) pass-by-result   (4) pass-by-value-result.

7. Which following sentence is not true for von Neumann architecture?
   (1) It allows self-modifying code.
   (2) Memory holds both data and instructions.
   (3) Most DSP processors use this architecture.
   (4) CPU and memory are separated modules.

8. Which operating system is a micro-kernel operating system?
   (1) Windows ME   (2) Windows XP   (3) Linux   (4) Nucleus.

9. Real-time systems are classified into soft-real-time and hard-real-time systems. Which sentence is true for a hard-real-time system but not for a soft-real-time system?
   (1) Each task has a deadline.
   (2) Tasks are scheduled according to its deadline.
   (3) Missing a deadline results in a failure of the whole system.
   (4) It is mostly used in time-critical applications.

10. Which of the following correctly describes the usage of interrupt vectors?
   (1) determining the processing order of I/O requests   (2) locating a service routine   (3) scheduling tasks on CPU   (4) conducting matrix operations.

11. An Apple II computer has up to 64K bytes of memory. It is a so-called byte-addressable machine, meaning each byte has its own address. How many bits do we need for each memory address?
    (1) 8   (2) 16   (3) 65536   (4) 524288

12. Which of the following techniques can relieve processors from transferring from/to memory?
    (1) DMA   (2) interrupt I/O   (3) memory-mapped I/O   (4) I/O polling

13. What is the 8-bit 2's complement representation of -2?
    (1) $(00000010)_2$ (2) $(10000010)_2$ (3) $(11111110)_2$ (4) $(11111101)_2$

14. What decimal number does the hexadecimal number 0A8h mean?
    (1) 168   (2) 184   (3) 108   (4) 1680

15. Transferring the infix expression (A-B)/(A+C)-C*D to the postfix expression, we get
    (1) A-B/A+C-C*D   (2) AB-/AC+-CD*   (3) AB-AC+CD*/-   (4) AB-AC+/CD*-

16. Which of the following Internet software layers deals with the actual communication details?
    (1) transport layer   (2) link layer   (3) application layer   (4) network layer.

17. Which of the following statements is false?
    (1) A router is a machine connecting two networks that use the same internet protocols.
    (2) A URL is the address of a document in the World Wide Web.
    (3) HTML is a text containing words or images that are linked to other texts in a manner that allows a reader to move between related material.
    (4) A name server is a process who's task is to provide assistance in converting mnemonic names into IP addresses.

18. Which of the following does not belong to the stages in the development phase of the software life cycle?
    (1) analysis   (2) design   (3) implementation   (4) optimization.

19. Which of the following statements is false for the Turing machine?
    (1) A problem that cannot be solved by a Turing machine cannot be solved by any algorithmic system.
    (2) Turing machine is a conceptual device rather than an actual machine.
    (3) A halting problem is unsolvable by any Turing machine.
    (4) An NP problem is unsolvable by any Turing machine.

20. Which of the following statements is true for time complexity?
    (1) A polynomial time solution to a problem is always better than an exponential time solution.
    (2) A problem that has a polynomial time solution can always be solved in a practical amount of time.
    (3) A polynomial problem is also an NP problem.
    (4) A non-polynomial problem is called an NP problem.

Part II (60%). 第 21-30 題為問答題

21. (6%) What is the output of the following C program?

```
#include <stdio.h>
void SomeFunction (const int [], int);
int main ()
{
  int a[] = {1, 3, 5, 7, 9, 11};
  SomeFunction(a, 5);
  return 0;
}
void SomeFunction (const int b[], int c)
{
  if (c > 0) {
    SomeFunction(&b[1], c - 1);
    printf("%d\n", b[0]);
  }
}
```

22. (6%) Rewrite the following C program segment using the do/while structure.

```
for (i = 0; i < 6; i++)
  counter++;
```

23. (6%) The following table represents a tree stored in a machine's memory. Each node of the tree consists of three consecutive memory cells. The first memory cell contains the data (a letter), the second contains a pointer to the node's left child, and the third contains a pointer to the node's right child. A value of 0 represents a NULL pointer. Suppose the value of the root pointer is 22. Draw a picture of the tree.

Address	Content
10	A
11	16
12	0
13	B
14	0
15	19
16	C
17	0
18	0
19	D
20	0
21	0
22	E
23	10
24	13

24. (6%) Given that the base address of a 3-dim array A[0:m,0:n,0:p] is 1000 (decimal), please calculate the address of A[i,j,k] (in decimal) using column-major memory allocations. Each element of the array takes 2 byte.

25. (6%) Please write a C program that exhibits the problem of memory leakage. Please write another C program that exhibits the problem of a dangling pointer.

26. (6%) Tom bought a hard disk, which claimed to be a capacity of 200 million bytes. But Microsoft Windows said it has only 190.7 MB. Tom called the disk manufacturer to complain about the missing 9 million bytes, but it insisted its claim of 200 million bytes was true. Can you explain why?

27. (6%) A number 100 is stored in an integer variable K. A text string "100" is stored in a string variable S. Are variables K and S stored differently in the memory? How are they most likely stored in the memory?

28. (6%) Give an advantage that a sequential file has over an indexed file.

29. (6%) Please explain the difference between physical address and virtual address and how a virtual address is translated to a physical address.

30. (6%) What is the difference between the two terms in each of the following questions?
    (a) an open network and a closed network
    (b) a worm and a virus