====================================

注意事項：

1、**本科目得使用本校提供之電子計算器。**

2、請於答案卷上規定之範圍作答，違者該題不予計分。

1. Answer the following questions related to processes and threads:
   (1) What two advantages do threads have over multiple processes? (5%)
   (2) What major disadvantage do they have? (5%)

2. Answer the following questions related to deadlock avoidance:
   (1) What is deadlock? (5%)
   (2) What is a safe state? (5%)
   (3) What are the major disadvantages of the Banker's Algorithm? (5%)

3. Consider a logical address space of eight pages of 1024 words each, mapped onto a physical memory of 32 frames.
   (1) Explain the difference between logical and physical addresses. (5%)
   (2) How many bits are there in the logical address and physical address? (5%)
   (3) Why are page sizes always powers of 2? (5%)

4. Answer the following questions related to virtual memory:
   (1) What is virtual memory? (5%)
   (2) The concept of virtual memory can be implemented by demand paging. Which of the following programming techniques and structures are "good" for a demand-paged environment? Which are "not good"? Explain your answers. (5%)
   a. Stack
   b. Hashed symbol table
   c. Sequential search
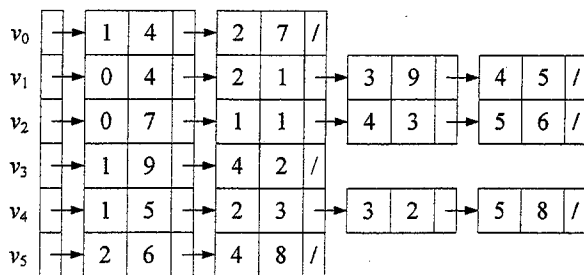   d. Binary search

5. Consider the following program fragment:

```
int mystery(int a, int b){
    if(b == 1){
        return a;
    }else{
        return a + mystery(a, b - 1);
    }
}
```

(1) What does the *mystery*(.) function do? (5%)

(2) Give an analysis of the running time (using the big-Oh notation). (5%)

6. An unsorted sequence 24, 45, 60, 36, 89, 72, 142, 150, 346, 247, 138 is stored in an array and to be sorted in increasing order.

(1) Which of the sorting methods would be especially suitable for such a task? Explain why and justify your answer. (5%)

(2) Demonstrate the contents of the array after the first pass of quick sort (use first item as the pivot). (5%)

(3) Demonstrate the contents of the array after the first pass of heap sort. (5%)

7. Given a binary search tree T_{BST} with its postorder traversal as ⟨24, 45, 60, 36, 89, 72, 142, 150, 346, 247, 138⟩.

(1) Describe the distinctions between a general tree and a binary search tree. (5%)

(2) Draw T_{BST}. (5%)

8. Given an adjacency list shown below. The value field in element of the adjacency list contains edge weight of a graph G.

v_0	→	1	4	→	2	7	/								
v_1	→	0	4	→	2	1	→	3	9	→	4	5	/		
v_2	→	0	7	→	1	1	→	4	3	→	5	6	/		
v_3	→	1	9	→	4	2	/								
v_4	→	1	5	→	2	3	→	3	2	→	5	8	/		
v_5	→	2	6	→	4	8	/								

(1) Represent the given graph G by using an adjacency matrix. (5%)

(2) Find the minimum cost spanning tree using Kruskal's algorithm. Show your work step by step. (5%)

(3) Apply Dijkstra's shortest-path algorithm to determine the shortest paths from vertex v_0 to every other vertex in the graph. Show your work step by step. (5%)