1. (15 points) Decide whether these statements are **True** or **False**. You must briefly justify all your answers to receive full credit.

   (a) If $f(n) \in O(g(n))$ and $g(n) \in O(f(n))$ then $f(n) = g(n)$

   (b) $(\log n)^{10} \in o(n)$

   (c) There exists an $O(n)$ sort algorithm to sort n numbers ranged from 1 to 5n.

   (d) There are $(n-1)^n$ possible tours in a weighted graph with n vertex.

   (e) **Backtracking** is a modified depth-first search of a tree.

2. (10 points) Take an array B such that :

$$B[i][j] = \begin{cases} B[i-1][j-1] + B[i-1][j] & \text{for } 0 < j < i \\ 1 & \text{for } j = 0 \text{ or } j = i \end{cases}$$

Compute B[5][2] using Dynamic programming.

3. (9 points) Define the following Keywords.
(a) **Traveling Salesperson problem**
(b) The set **NP**
(c) **Clique**

4. (10 points) Use Prim's algorithm to find a minimum spanning tree for the graph defined by the following array, starting with vertex V_4. Show the actions step by step.

	1	2	3	4	5	6
1	0	INF	72	50	90	35
2	INF	0	71	70	73	75
3	72	71	0	INF	77	90
4	50	70	INF	0	60	40
5	90	73	77	60	0	80
6	35	75	90	40	80	0

5. (6 points) Find the asymptotic behavior of the function T(n) defined as follows:
   T(1) = 1
   $T(n) = 2T(n/2)$, 　　$n = 2^k$ (Assume that n is power of 2, k>=1)

科目： 軟體設計　　　　　　　　　　　系所組：資訊工程系

6. (50 points) Decide whether the following statements are **True** or **False**. Each correct answer get 2 points, blank answer get 0 point, wrong answer get -1 point. If the total points for Question 6 become negative, the grade for question 6 will reset to 0.

(a) When an array is full, we can replace the array with a larger one. The doubling strategy increase the size by a constant c

(b) Tail recursion occurs when a linearly recursive method makes its recursive call as its last step.

(c) Binary recursion occurs whenever there are two recursive calls for each base case.

(d) Iterative algorithms execute faster than tail-recursion because no stack needs to be maintained.

(e) Algorithm analysis measures the reliability of an algorithm as the input size becomes large.

(f) We can implement a queue with a singly linked list.

(g) Objects of a stack is inserted and removed according to the FIFO principle.

(h) Depth of a node in a tree is the number of ancestors.

(i) Quick-sort is a randomized sorting algorithm based on the divide-and-conquer paradigm.

(j) A heap is a binary tree storing keys at its nodes and satisfying the Heap-Order.

(k) The last node of a heap is the lefttmost node of maximum depth.

(l) Heap-sort is much faster than quadratic sorting algorithms, such as insertion-sort and selection-sort.

(m) Hash collisions occur when different elements are mapped to the same cell

(n) Separate chaining is simple to handle hash collision, but requires additional memory outside the table.

(o) Double hashing uses a secondary hash function to handles collisions by placing an item in the first available cell of the series.

(p) In practice, hashing is very fast provided the load factor is lower than 20%

(q) Multiple items with the same key are not allowed in Dictionary.

(r) An inorder traversal of a binary search trees visits the keys in decreasing order.

(s) An AVL Tree is a binary search tree such that for every internal node v of T, the heights of the children of v can differ by at most 1.

(t) The height of an AVL tree storing n keys is O(log n).

(u) AVL Tree Trinode Restructuring has to perform only with double rotation.

(v) A prefix code is a binary code such that no code-word is the prefix of another code-word.

(w) A connected component of a graph G is a minimal connected subgraph of G.

(x) A spanning tree of a connected graph is a spanning subgraph that is a tree.

(y) A tree is an abstract model of a hierarchical structure.

※ 注意：1.考生須在「彌封答案卷」上作答。
　　　　2.本試題紙空白部份可當稿紙使用。