※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

一 選擇題 (40%)

1) If a queue contained the entries w, x, y, z (from head to tail), which of the following would be the contents after three entries were removed and the entries a and b were inserted?

   A. z, b, a　　B. a, z, b　　C. z, a, b　　D. a, b, z

2) Which of the following is often connected with "dictionary" in data structures?

   A. associative array　B. set　C.　priority queue　D. none of the above

3) Self-balancing binary search tree is often implemented by the following data structures except

   A. 2-3 tree　B. AVL tree　C. Red-Black tree　D. R-tree

4) The time complexity for fastest possible comparison sort is

   A. $O(\log n)$　　B. $O(n^2)$　　C. $O(n \log n)$　　D. none of the above

5) _____ is the ability in computer programming to present the same interface for differing underlying forms (data types).

   A. Polymorphism　B. Inheritance　C. Strong coupling　D. Abstract data type

6) A pointer points to a location in memory, and obtaining the value stored at that location is known as _____ the pointer.

   A. disengage　　B. dereferencing　C. disembarking　D. none of the above

7) Which of the following sorting algorithms gives best time and space complexity?

   A.　merge sort　B. quick sort　C. selection sort　D. heap sort

8) Which of the following sorting algorithms gives optimal data movement?

   A.　merge sort　B. quick sort　C. selection sort　D. heap sort

9) Suppose that a social networking website FRIENDS needs to support two operations: (i) declare A and B to be friends (thus making all of As friends and all of Bs friends friends of each other); and (ii) determine whether A and B are friends.

   Which APIs should FRIENDS use to support these operations?

   A. Queue.

   B. Union-find.

   C. Stack.

   D. Priority queue.

10) Continue the above problem, give the worst case order of growth of the running time that FRIENDS can guarantee for M operations, where N is the number of people listed on the website.

   A. N log M.　　B. M log N.　　C. N log N.　　D. M.

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系所組別：會計學系乙組
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第 2 頁，共 3 頁

二 問答題

1. (5%) How many bits are in the Huffman encoding of the following message?

   (Do not count the bits to encode the table.)

   a b a a b a c a b a a b a c d a b a a b a c a b a a b a c d e

   For reference, the frequency of each symbol is given in the table below.

a	b	c	d	e
16	8	4	2	1

2. (30%) Match up each application with an algorithm or data structure that one can use to solve it. Use each answer exactly once.

   1)_____ 1D range search

   2)_____ 2D range search

   3)_____ Document similarity

   4)_____ Traveling salesperson problem

   5)_____ Sudoku solver

   6)_____ Arbitrage detection in currency exchange rates

   7)_____ Mark-sweep garbage collector

   8)_____ Web crawler

   9)_____ Google maps

   (0)_____ Longest repeated substring

   A. Hashing

   B. 3-way radix quicksort

   C. Binary search tree

   D. Kd tree

   E. Depth-first search

   F. Breadth-first search

   G. Dijkstra's algorithm

   H. Bellman-Ford

   I. Enumerate permutations

   J. Enumerate base-R integers

3. (20%) Consider the following code fragment.

```
MaxPQ<Integer> pq = new MaxPQ<Integer>();
int N = a.length;
for (int i = 0; i < N; i++) {
    pq.insert(a[i]);
    if (pq.size() > k) pq.delMax();   /* MARK */
}
for (int i = 0; i < k; i++}
    System.out.println(pq.delMax());
```

Assume that a[] is an array of integers, MaxPQ is implemented using a binary heap, and $N \geq k \geq 1$.

(a) What does it output?

(b) What is the order of growth of its worst-case running time. Choose the best answer below.

　A. k log k

　B. k log N

　C. N log k

　D. N log N

　E. N^2

Now suppose the marked line was deleted. Repeat the previous two questions.

(c) What does it output?

(d) What is the order of growth of its worst-case running time. Choose the best answer below.

　A. k log k

　B. k log N

　C. N log k

　D. N log N

　E. N^2

4. (5%) Modern computers have memory caches, which speed up reads and writes if they are to locations near recently-accessed memory. This makes sequential access to memory faster, in general, than random access. Which of the sorting algorithms below you would expect to benefit least from caching?

A. insertion sort

B. mergesort

C. quicksort

D. heapsort