1. Single choice (Each i points and total to point	I.	Single choice	(Each 4	points and	total 40	points
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1 Given	four	algorithms	with th	ne following	different	time	complexities,	which	one is	the	most
inefficien	nt?	()									

A. O(n^{0.1})

B. $O(\log(n))$

C. O(nlog(n))

D. O(n)

2 Of the following data structures, which one is nonlinear?

A. Stack

B. Queue

C. Chain

D. Binary Tree

3 Given a push-to-stack sequence "12345", which one is not the possible pop-from-stack sequence? ()

A. 12354

B. 23541

C. 54321

D. 35412

4 If a binary tree with linked representation has n nodes, then there is ($\,$) empty pointers.

A. n-1

B. n+1

C. 2n-1

D.2n+1

5 In an undirected graph with 50 vertices, the maximum number of edges is ().

A. 1250

B. 1225

C. 2450

D.2500

6 Given a binary tree with **post-order** traversal sequence "BAECD" and **in-order** traversal sequence "BDACE", what is the **pre-order** traversal sequence of the tree? ()

A. BDECA

B. DBECA

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C. DBCAE D. BCDEA

7 What is the maximum number of inner nodes of a B-tree of order 4 with height 5? ()

- A.43
- B. 21
- C. 85
- D. 341

8 Assume there is a ordered list consisting of 200 data items, using binary search to find whether a special item is in it, the maximum comparisons is () times.

- A. 9
- B. 8
- C. 7
- D. 6

9 In the worst case, which one of the following sort algorithms has the least efficiency in time?

- ()
- A. Heap sort
- B. Quick sort
- C. Merge sort
- D. Insertion sort

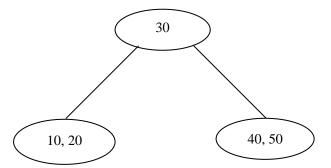
10 There is a Hash table with the size of 11. The Hash function is $H(k)=3k \mod 11$. Every key in the sequence $\{32, 13, 49, 24, 38, 21, 5\}$ is inserted into this table one by one according its Hash value. How many times of comparison are made when the key 5 is inserted.

- A. 5
- B. 6
- C. 7
- D. 8

II. Answer the following questions (Each 10 points and total 40 points)

1 Given a weighted graph G=(V, E) with $V=\{1, 2, 3, 4, 5, 6, 7\}$; $E=\{(1,2) 3, (1,3) 5, (1,4) 8, (2,5) 10, (2,3) 6, (3,4) 15, (3,5) 12, (3,6) 9, (4,6) 4, (4,7) 20, (5,6) 18, (6,7) 25\}$, please use **Prim's Algorithm** to build a minimum-cost spanning tree T by adding edges one at a time.

- 2 Given a list (20, 15, 14, 18, 21, 36, 40, 10, 22), please describe the process that we use **Quick Sort** algorithm to sort it.
- 3 Let T be a initially empty **AVL tree**, draw the process of inserting 2, 11, 1, 13, 7, 17, 5, and 3 into T one by one, and write down the balance factors for each node and every rotating types if any.
- 4 For the following B-tree of order 3, please:
- (1) draw the process of inserting 15 and 60 into it.
- (2) draw the process of deleting 10,30,20 from the original B-tree.



III. Design algorithms (total 20 points)

1 Assume that there is a singular list (chain), in which the node structure is **<data, next>**, and the first node is pointed by **theFirst** pointer. Please design an algorithm to find the **k-th** (k is a positive integer) node **in the reversed order**. If it is successful, the algorithm outputs **data** of this node, and then returns 1; otherwise, the algorithm returns by 0.

The points you can get depend on the efficiency of the algorithm.

- (1) Describe the idea of your algorithm in English or Chinese. (4 points)
- (2) Write this algorithm in C++ language. Annotations in key points are required. (14 points)
- (3) Analyze the time complexity and space complexity of your algorithm. (2 points)

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