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C. DBCAE

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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  $H(k)=3k \bmod 11$ . 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  $V=\{1, 2, 3, 4, 5, 6, 7\}$ ;  $E=\{(1,2) \text{ 3}, (1,3) \text{ 5}, (1,4) \text{ 8}, (2,5) \text{ 10}, (2,3) \text{ 6}, (3,4) \text{ 15}, (3,5) \text{ 12}, (3,6) \text{ 9}, (4,6) \text{ 4}, (4,7) \text{ 20}, (5,6) \text{ 18}, (6,7) \text{ 25}\}$ , please use **Prim's Algorithm** to build a minimum-cost spanning tree T by adding edges one at a time.

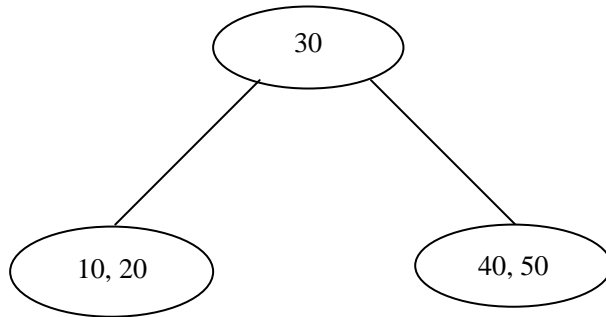
2 Given a list (20, 15, 14, 18, 21, 36, 40, 10, 22), please describe the process that we use **Quick Sort** algorithm to sort it.

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)