

**一、单项选择题 (本大题共 15 小题, 每小题 2 分, 共 30 分)** 提示: 在每小题列出的备选项中只有一个符合题目要求的, 请将其代码写到答题纸上。错选、多选或未选均无分。

1. Which of the following should NOT be viewed as an ADT?
  - a) list
  - b) integer
  - c) array
  - d) none of the above
2. If  $R$  is a binary relation over set  $S$ , then  $R$  is reflexive if
  - a)  $aRa$  for all  $a$  in  $S$ .
  - b) whenever  $aRb$ , then  $bRa$ , for all  $a, b$  in  $S$ .
  - c) whenever  $aRb$  and  $bRa$ , then  $a = b$ , for all  $a, b$  in  $S$ .
  - d) whenever  $aRb$  and  $aRc$ , then  $aRc$ , for all  $a, b, c$  in  $S$ .
3. Pick the growth rate that corresponds to the most efficient algorithm when  $n = 4$ .
  - a)  $5n$
  - b)  $20 \log n$
  - c)  $2n^2$
  - d)  $2^n$
4. For a list of length  $n$ , the linked-list implementation's prev function requires worst-case time:
  - a)  $O(1)$ .
  - b)  $O(\log n)$ .
  - c)  $O(n)$ .
  - d)  $O(n^2)$ .
5. The Full Binary Tree Theorem states that:
  - a) The number of leaves in a non-empty full binary tree is one more than the number of internal nodes.
  - b) The number of leaves in a non-empty full binary tree is one less than the number of internal nodes.
  - c) The number of leaves in a non-empty full binary tree is one half of the number of internal nodes.
  - d) The number of internal nodes in a non-empty full binary tree is one half of the number of leaves.
6. Huffman coding provides the optimal coding when:
  - a) The messages are in English.
  - b) The messages are binary numbers.
  - c) The frequency of occurrence for a letter is independent of its context within the message.
  - d) Never.
7. The most space efficient representation for general trees will typically be:
  - a) List of children
  - b) Left-child/right sibling
  - c) A  $K$ -ary tree.
8. When sorting  $n$  records, Quicksort has worst-case cost:
  - a)  $O(\log n)$ .
  - b)  $O(n)$ .
  - c)  $O(n \log n)$ .
  - d)  $O(n^2)$
  - e)  $O(n!)$
  - f) None of the above.
9. The most effective way to reduce the time required by a disk-based program is to:
  - a) Improve the basic operations.
  - b) Minimize the number of disk accesses.

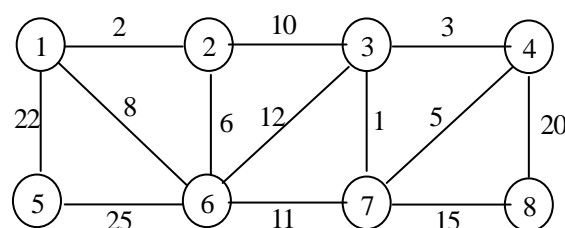
- c) Eliminate the recursive calls.
  - d) Reduce main memory use.
10. The 80/20 rule indicates that:
- a) 80% of searches in typical databases are successful and 20% are not.
  - b) 80% of the searches in typical databases are to 20% of the records.
  - c) 80% of records in typical databases are of value, 20% are not.
11. Indexing is:
- a) Random access to an array.
  - b) The process of associating a key with the location of a corresponding data record.
  - c) Using a hash table.
12. The goal of a topological sort is to:
- a) Sort all of the graph vertices by value.
  - b) Sort all of the graph vertices so that each vertex is listed prior to any others that depend on it.
  - c) Sort all of the graph vertices by distance from the source vertex.
13. The basic unit for disk allocation under DOS or Windows is:
- a) A byte.
  - b) A sector.
  - c) A cluster.
  - d) A track.
  - e) An extent.
14. When sorting  $n$  records, Insertion sort has best-case cost:
- a)  $O(\log n)$ .
  - b)  $O(n)$ .
  - c)  $O(n \log n)$ .
  - d)  $O(n^2)$ .
  - e)  $O(n!)$ .
  - f) None of the above.
15. If a node is at position  $r$  in the array implementation for a complete binary tree, then its parent is at:
- a)  $(r - 1)/2$  if  $r > 0$
  - b)  $2r + 1$  if  $(2r + 1) < n$
  - c)  $2r + 2$  if  $(2r + 2) < n$
  - d)  $r - 1$  if  $r$  is even
  - e)  $r + 1$  if  $r$  is odd.

**二、名词解释题 (本大题共 2 小题, 每小题 4 分, 共 8 分)** 提示: 对题目名词进行解释, 英文缩写的需要给出全称并解释。

1. Full Binary Tree
2. BST

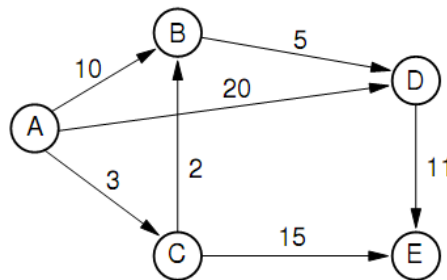
**三、应用题 (本大题共 4 小题, 每小题 8 分, 共 32 分)**

1. Consider the following undirected graph.



In what order are edges added to the minimum spanning tree by Kruskal's algorithm? List the edges by giving their endpoints, and compute the cost of the minimum spanning tree.

2. Dijkstra shortest path. Show the process of Dijkstra's algorithm operating on the following graph.



3. Show the max-heap that results from running buildHeap on the following values stored in an array:

10 5 12 3 2 1 8 7 9 4

4. Some characters in the preorder, inorder and postorder sequences of a binary tree are missed. Please fill in each blank with an appropriate character.

Preorder: B F ICEH G  
 Inorder: D KFIA EJC  
 Postorder: K FBHJ G A

#### 四、编程、设计及分析题 (本大题共 2 小题, 共 20 分)

提示: 题目给出了一个程序设计要求, 请按照要求写出源程序代码, 如果源程序代码中出现语法错误或逻辑错误, 则酌情扣分。

1. The class AList is given below.

```

class AList{
private:
    int maxSize;      // Maximum size of list
    int listSize;     // Actual elem count
    int* listArray; // Array holding list
public:
    void rightShift(int k) {
    }
}
  
```

The member method rightShift shifts the elements of the linear list right by k positions and fills the empty positions at the left end with null. For example, if the list listArray[0:5] = [1, 2, 3, 4, 5, 6], whose size is 6, is shifted right by 3, the result is [0, 0, 0, 1, 2, 3, 4, 5, 6], whose size is 9. Write C/C++ code for the rightShift method. What is the time complexity of your code as a function of the list size?

2. The classes BinaryTreeNode and LinkedBinaryTree are given below.

```

public class BinaryTreeNode
{
    Object element;
    BinaryTreeNode *leftChild; // left subtree
    BinaryTreeNode *rightChild; // right subtree
}
  
```

```

public class LinkedBinaryTree
{
    BinaryTreeNode *root; // root node

    public void swapChildren()
    {
        // code for this method comes here
    }
}

```

The method swapChildren swaps the left and right children of every node in the binary tree this.

- (a) Write code for the method swapChildren. You may define and implement new private member methods as needed. You may not create or delete any nodes or invoke any binary tree methods not defined in this problem unless you provide code for these methods.
- (b) What is time complexity of your code as a function of the number of nodes in the binary tree?