



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

**FACULTY OF COMPUTING AND INFORMATICS
DEPARTMENT OF SOFTWARE ENGINEERING**

QUALIFICATION: BACHELOR OF COMPUTER SCIENCE	
QUALIFICATION CODE: 07BCMS	LEVEL: 7
COURSE: DATA STRUCTURES AND ALGORITHMS 2	COURSE CODE: DSA711S
DATE: JULY 2024	PAPER: THEORY
DURATION: 2 HOURS	MARKS: 90

SECOND OPPORTUNITY / SUPPLEMENTARY EXAMINATION QUESTION PAPER	
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INSTRUCTIONS
<ol style="list-style-type: none">1. Answer ALL the questions.2. Read all the questions carefully before answering.3. Number the answers clearly

THIS QUESTION PAPER CONSISTS OF 9 PAGES
(Including this front page)

PERMISSIBLE MATERIALS

1. NON-PRGRAMMABLE CALCULATOR

SECTION A: Multiple Choice Questions

[20 Marks]

- Answer all the questions in the provided booklet.
- The section consists of 10 problems.

Problem A1

What is a hash table?

[2 Marks]

- A. A structure that maps values to keys
- B. A structure used for storage
- C. structure that maps keys to values
- D. None of the above

Problem A2

Which of the following statements is true?

[2 Marks]

Statement A: Dynamic programming is an optimization technique.

Statement B: NOT all recursive problems can be implemented iteratively.

- A. Statement A is true, and Statement B is false.
- B. Statement A is false, and statement B is true.
- C. Both Statement A and Statement B are true.
- D. Both Statement A and Statement B are false.

Problem A3

When several elements/values are competing for the same bucket in the hash table, what is it called?

[2 Marks]

- A. Tabulation
- B. Replication
- C. Duplication
- D. None of the above

Problem A4

Study the code snippet below and answer the questions that follows.

```
int countDown(int number)
{
    if(number== 0)
        return 0;
    return (number % 10 + countDown(number / 10));
}
```

What is the output of the function countDown if the input; number=2945?

[2 Marks]

- A. Function will generate an error
- B. 2945
- C. 2
- D. 9
- E. 20
- F. 5
- G. None of the above

Problem A5

Which of the following algorithm can be designed using recursion?

[2 Marks]

- A. Factorial of a number n
- B. Tower of Hanoi
- C. Fibonacci Series
- D. All of the above

Problem A6

A binary search tree is constructed by inserting the following elements in order:

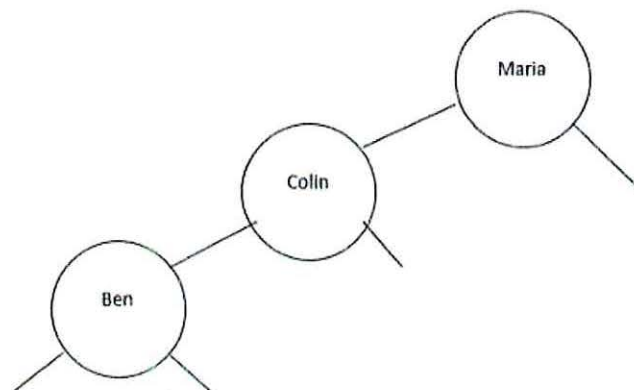
60 25 72 15 30 68 100 13 18 47 70. How many number of left subtree nodes?

[2 Marks]

- A. 3
- B. 5
- C. 7
- D. 6

Problem A7

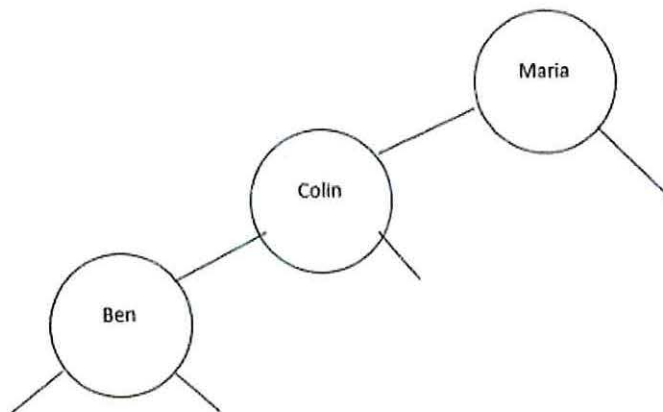
What would be the worst case complexities of inserting the name **Abel**, deleting the name: **Abel** and searching for the name: **Abel** in the Binary Search tree below? [2 Marks]



- A. $O(\log n)$ for all operation; insertion, Searching and deletion
- B. $O(n)$ for insertion and searching, $O(\log n)$ deletion
- C. $O(n)$ for all operation; insertion, Searching and deletion
- D. $O(n)$ for insertion and deletion, $O(\log n)$ searching

Problem A8

Study the BST below and answer the question that follow;



If we compute; $2^h - 1$: where h is "height", what are we computing or trying to find out? [2 Marks]

- A. 3
- B. Minimum number of nodes in tree
- C. 2
- D. Minimum number of internal nodes in tree
- E. Maximum number of nodes in tree
- F. 4
- G. Minimum height

- H. Invalid computation
- I. Maximum number of leaf nodes in tree
- J. Maximum number of internal nodes in tree
- K. Maximum height
- L. Minimum number of leaf nodes in tree

Problem A9

The operation for visiting each node in the data structure is known as.....

[2 Marks]

- A. inserting
- B. Merging
- C. Sorting
- D. Traversal

Problem A10

Which traversal algorithm is satisfying the following order?

[2 Marks]

- 1 - Go left and perform x
- 2 - Perform an action on current node
- 3 - Go right and perform x

HINT: x is the name of the traversal being performed

- A. PostOrder
- B. PreOrder
- C. InOrder
- D. None of the above

SECTION B: True and False Questions

[20 Marks]

- Answer all the questions in the provided booklet.
- The section consists of 10 problems.

Problem B1

A recursive function without a base case will not result in an infinite loop.

[2 Marks]

Problem B2

The head of a singly-linked always points to the first node.

[2 Marks]

Problem B3

The postorder traversal processes the left subtree first, then the root, and finally the right subtree.

[2 Marks]

Problem B4

Hashing is aimed at achieving searches, deletions and insertions in $O(1)$.

[2 Marks]

Problem B5

Two distinct keys hashing to the same index is known as collision.

[2 Marks]

Problem B6

When inserting data into a dynamic queue with data already in it, the only pointer that needs to be updated is the rear pointer, which is set to point to the new node.

[2 Marks]

Problem B7

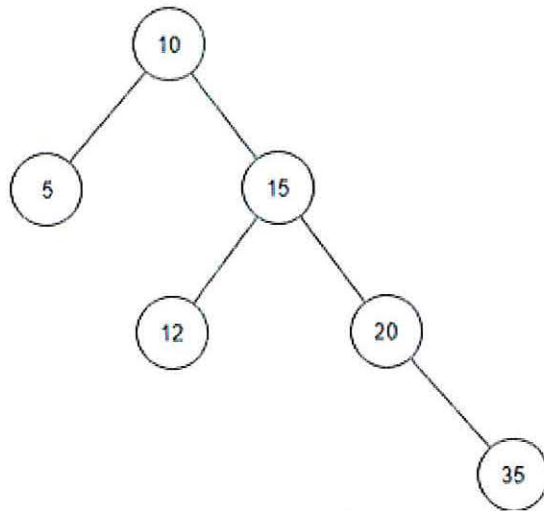
When inserting data into a dynamic queue with data already in it, the only pointer that needs to be updated is the rear pointer, which is set to point to the new node.

[2 Marks]

Problem B8

Based on the AVL trees studied, the tree below is an AVL tree.

[2 Marks]



Problem B9

A Red-black tree is a type of Binary Search tree.

[2 Marks]

Problem B10

A Red-black tree has a linear height.

[2 Marks]

SECTION C: Structured questions

[50 Marks]

- Answer all the questions in the provided booklet.
- The section consists of 6 problems.

Problem C1

Huffman Coding is a technique of compressing data to reduce its size without losing any of the details. Some of the benefits of compressing data are that it can be transmitted faster over the network and can reduce "data" costs for mobile subscribers for example. Huffman Coding is one of many examples of binary tree applications.

Suppose we have the following data compression table;

Character	Frequency	Code	Code Length
B	1	00	2
C	4	1	1
D	2	01	2

Task:

- a) Redraw the Huffman tree for the above table. [12 marks]
- b) What is the total size of the string as it is or before compression (in bits)? [4 marks]
- c) What is the size of the encoded string? [4 marks]

Problem C2

What is the time complexity of the following function?

[4 marks]

```
void Myfunction(int n) {
  for(int i=0; i < n; i++) {
    for(int j=0; j < 5; j++) {
      for(int k=0; k < n; k++) {
        for(int m=0; m < 5; m++) {
          System.out.println("DSA711S Exam");
        }}}
    }
}
```


Problem C3

Constructs an AVL tree for the following elements: 45, 70, 35, 74, 25, 81, 60 inserted in that order. [4 marks]

Problem C4

What is the time complexity of the function below?

[4 marks]

```
void Myfunction(int n) {
  for(int i=0; i < 5; i++) {
    for(int j=0; j < 5; j++) {
      for(int k=0; k < n; k++) {
        for(int m=0; m < 5; m++) {
          System.out.println("DSA711S Exam");
        }
      }
    }
  }
}
```

Problem C5

Name and briefly explain any four (4) properties of red-black tree.

[8 marks]

Problem C6

When given a recursive problem and you are required to write a recursive function to solve it, what are the most important information you need to know about recursive functions that will assist you in successfully writing one? [10 marks]

***** End of Exam*****