1. (a) Explain the meaning, purpose and importance of 'unit testing'.

   (b) All algorithms must be tested for multiple situations. For example when testing a file reading algorithm you might need to test for the file being empty, the wrong type, read only etc.

   List five (5) situations that you need to test for a sorting algorithm.

   [5 + 5 = 10]

2. Draw the UML high level class diagram that matches the Data Dictionary below.

Class Identifier	**Identifier**	**Type**	**Notes**
Date			All dates are read in as type String and then parsed
	m_day	integer	
	m_month	integer	
	m_year	integer	
String			A character string
	m_str	an array of char	
Person			Stores basic information about a person
	m_id	integer	a unique id key for each person
	m_company	String	the company, department, school etc to which the person belongs
	m_firstName	String	the name by which the person is called
	m_secondName	String	the person's family name
	m_phoneNumber	String	the person's contact phone number
	m_birthDate	Date	the person's date of birth
Node			A node for use in a list
	m_person	Person	
	m_next	pointer	A pointer to a Node
DoubleNode			A node for use in a list or tree. It has two links and inherits from Node
	m_prev	pointer	A pointer to a Node

[10]

3. (a) Define and explain the concept of data abstraction.

   (b) What is a template class?

   (c) List the three conditions under which inheritance is the correct relationship to form between two classes.

   (d) What is the difference between composition and aggregation?

   [3 + 2 + 3 + 2 = 10]

4. A money class is required for use within a set of banking programs. Write down the header file for a complete and minimal money class. You do not need to add comments or any of the normally required # statements, nor do you need to include any inline code.

   [10]

5. When considering quicksort versus mergesort:

   (a) In what two (2) ways are the algorithms similar?

   (b) Why was quicksort the most common fast sort used in the past?

   (c) Why is mergesort possibly preferable today?

   (d) When is mergesort a necessity?

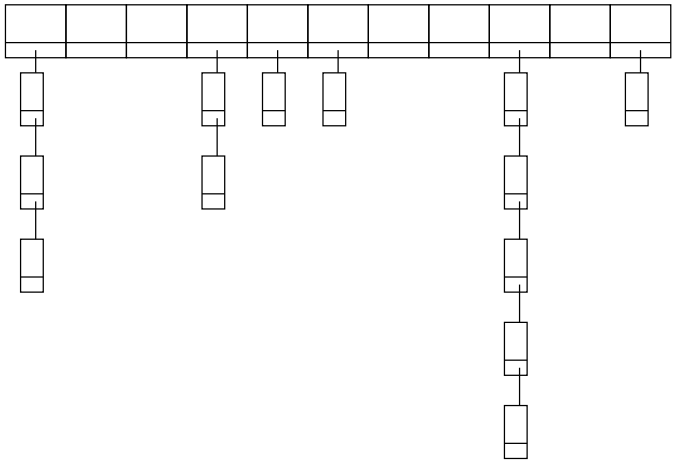
   [2 + 3 + 4 + 1 = 10]

6. There are many different types of algorithm. For example brute force, greedy, heuristic, randomised, divide & conquer, dynamic programming and backtracking.

   Describe any **two** (2) of these in detail.

   [10]

7. A hash table can be coded as a two-dimensional structure with an array plus overflow lists. i.e.



This can be coded as an array of nodes.

Consider the following (incomplete) class descriptions:

```
class Node
{
public:
    Node *GetNext () const {return m_next;}
    // Returns the unique key of the data being stored
    //   in this node
    int   GetKey  () const {return m_data.GetKey();}
private:
    Node     *m_next;
    DataType  m_data;
};

class HashTable
{
    // Returns true or false depending on whether the
    //   target is found in the hash table
    bool Find (const DataType &target);
private:
    Node m_array[TABLE_SIZE];

    // Returns an index into the array based on the key
    int GetHashIndex (int key);
}
```

You are to write the C++ code for the `Find` method declared above.

[10]

8. (a) What is the main difference between a stack and a queue?

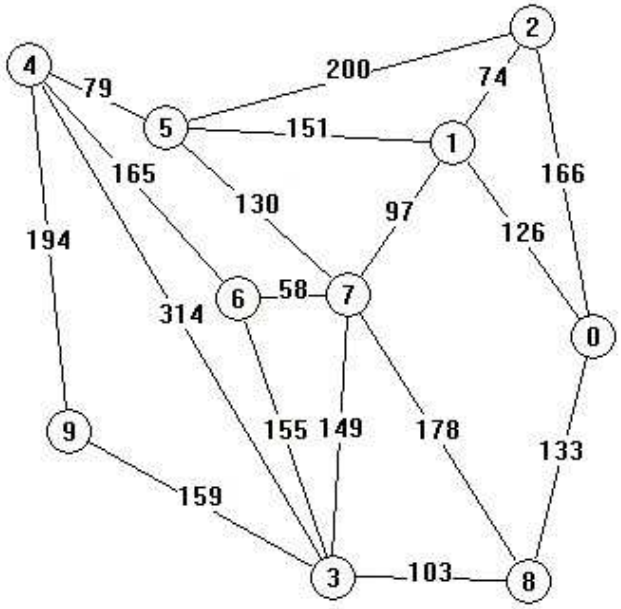
   (b) Give two applications of a binary heap ADS.

   (c) Why are stacks, queues and heaps often coded as templates in C++?

   (d) Write down pseudo-code for the Enqueue and Dequeue methods of a Queue.

[1 + 2 + 1 + 6 = 10]

9. Draw the Minimum Spanning Tree (MST) of the graph below:



[10]

10. Draw the 5-way multiway tree and 5-way B-tree that result if the following numbers are inserted into empty trees: 50, 42, 44, 63, 41, 60, 43, 22, 24

[10]

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