**44-542 Object Oriented Programming Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Exam 03 Part 2 (40 points)** *please print*

1. (5 pts) Suppose we are using the hash function **h(key) = key MOD 10** to store records with keys **11, 21, 31, 89, 99, 59**. Show where each key is stored in the table below. Use chaining to resolve collisions. You must apply **h** to the keys in the order in which they are listed.

|  |  |
| --- | --- |
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1. (7 pts) Write a code segment to do the following: Create a **HashSet** of **String** objects named **myFriends** and add “Sue” and “David” to the hash set. ***No class headings or import statements are needed.***  Do not write on the back. Your code should fit in the space below.
2. (5 pts) For the tree below, show the order in which the nodes are visited in a postorder traversal. Answer: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



1. (10 pts) Suppose we have a class **Books**, as shown below. The tree map **bookList** contains publisher names as key values (Avon Press, Berkley Press, etc.). The value associated with a key is the list of books published by that publisher. Method **addBook** has two arguments – a string representing the name of a publisher, and a string representing the title of a book. This method will add this key-value pair to the tree map.

For example, we might have the following code in a driver program:

**Books myBooks = new Books();**

**myBooks.addBook("Avon Press", "Java 5");**

**myBooks.addBook("Berkley Press", "C#");**

**myBooks.addBook("Avon Press", "Python");**

After this code is executed, we would have two entries in the tree map:

**Avon Press = [Java 5, Python]** and **Berkley Press = [C#]**

In the space provided below, write the code for **addBook**.

**public class Books**

**{**

**private TreeMap<String, ArrayList<String>> bookList;**

**public Books()**

**{**

**bookList = new TreeMap<String, ArrayList<String>>();**

**}**

**public void addBook(String publisher, String bookTitle)**

**{**

**// WRITE CODE HERE**

**}**

**}**

1. (8 pts) Consider the following tree:



* 1. What is the height of this tree? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  2. How many leaves does this tree have? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  3. What is the left child of 20? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  4. How many probes are necessary to discover that 17 is not in the tree? \_\_\_\_\_\_\_\_\_

1. (5 pts) Using the algorithm given in class, insert the following nodes into a binary search tree. The nodes must be inserted in the order given here.

**45 50 18 20 60**

**Draw tree here**

1. (5 pts) Using the algorithm given in class, remove 160 from the binary search tree given below.

**Draw tree here**



1. (5 pts) Using the algorithm given in class, perform a left rotation around 80.

**Draw tree here**



1. (5 pts) Using the algorithm given in class, insert the following nodes into a heap. The nodes must be inserted in the order given here.

**90 85 80 75 70 65 60**

**Draw heap here**

1. (5 pts) Using the algorithm given in class, remove the top element from the heap shown below.

**Draw heap here**

