



### 1. Vocabulary Terms – Matching [ 5 pts ]

Select the **best** definition for each of the words below by writing the appropriate letter in the blank beside the word.

1. \_\_\_\_ .equals()
  2. \_\_\_\_ Polymorphism
  3. \_\_\_\_ Variable Shadowing
  4. \_\_\_\_ Constructor Chaining
  5. \_\_\_\_ Dynamic Binding
- 
- A. The ability for an instance of a subclass to be treated as an instance of its parent class.
  - B. The process by which constructor calls are resolved when **new** is used.
  - C. When a subclass redefines a method of the exact same signature as one in the parent class.
  - D. When there are multiple methods of the same name, in the same class with different parameter lists.
  - E. The process by which method calls are resolved at runtime based upon the type of the actual object present, not the declared type of the reference.
  - F. A method which Objects should define to specify how to test for equivalence.
  - G. A variable whose value cannot be changed once it is initially set.
  - H. The region of the program in which a variable can be “seen” by the compiler.
  - I. When two variables are in scope at the same time and the more local one hides the more global one.
  - J. The process by which a constructor inherits initialization lists from the constructor in a parent class.
  - K. Used when one type is a subtype of another. Functionality of the supertype is in the subtype, unless changed by the subtype.
  - L. A method which Objects should define to specify how they should be represented as String.
  - M. When one constructor calls another using **this()**.

**2. Iteration [ 10 pts ]**

Write the method **public void printDots(int num)**. Which prints a right triangle of Dots of base and height **num**. For example, if this method were called with a parameter of 5, the output should be

```
.  
..  
...  
....  
.....
```

If this method were called with 0 as a parameter, no output would be printed. You must use iteration **ONLY** for this method. If you do not use iteration, or you use any recursion, you will receive no credit for this method. You may assume that **num** will be greater than or equal to 0.

### 3. Multidimensional Array – Coding [ 15 pts ]

- 9 (a) Write the method **public double min(double[][][] data)**. This method should return the smallest element in the array **data**. You may not assume that the array is cubical or rectangular, it may have uneven lengths in any given dimension. You may assume that there is at least one element in the array. You may assume that the array is not *null* and that none of the array references in it are *null*.
- ```
public double min(double[][][] data){
```

```
}
```

- 3 (b) Declare a variable **myArray** to be a 3 dimensional array of shorts, and then initialize it to be a 5 by 7 by 9 array of shorts.

- 3 (c) What is the data type of **myArray[1]**?

4. **.equals()** and **toString()** [ 20 pts ]

Write a class **Box** which has the following:

- a public int **length**
- a public int **width**
- a public String **color**
- a **.equals** method.
- a **toString()** method.

The **.equals** method should behave as follows:

- if the item passed in is not a **Box**, return **false**.
- if the **Box** passed in has the same **length**, **width**, and the **colors** match, then return **true**, else return **false**.

The **toString()** method should yield a String of the following format:

*A **color** Box that is **length** by **width**.*

For example

*A Red Box that is 3 by 5.*

You do NOT need to write accessors and modifiers for your variables, or any constructors.

## 5. References [ 10 pts ]

- (a) Explain what a reference is. Be sure to include the significance of references, what types of variables are reference variables, what types of variables are not reference variables, and how they differ.
- (b) Given the following:
- ```
SomeObject a=new SomeObject(7);  
SomeObject b=new SomeObject(7);  
SomeObject c=b;
```
- (a) What does the expression **a==b** evaluate to? Explain your answer.
- (b) What does the expression **b==c** evaluate to? Explain your answer.
- (c) Assume that **SomeObject** has a public instance variable **int x**, and that the constructor sets **x** to its parameter. If, after the above code we did

```
    a.x=5;  
    c.x=8;
```

What is the value of **b.x**? Explain your answer.

## 6. Inheritance – Coding [ pts ]

Given the following code: Write the class **Circle** as follows:

- **Circle** is a subclass of **Shape**
- **Circle** has a double for **radius**
- **Circle** has an accessor for **radius**
- **Circle** has a constructor that takes a String for **color** and a double for **radius**. It initializes **color** via the parent class constructor. It then initializes **radius**.
- **Circle** has a constructor that takes only a String for **color**. It chains to the two parameter constructor with a size of 1.

Below, write the code for class **Circle** as described above:

## 7. Strings – Coding [ 15 pts ]

Write the method `public int countOccurrencesOf(String s, char c)`. This method should return a count of the number of times that the character `c` appears in `s`. You **MUST** use recursion only for this method. If you do not use recursion, or if you use any iteration, you will receive no credit for this method. You may write any helper methods that you wish to. You may assume that `s` is not *null*. Below is an exclusive list of the methods from the `String` class that you may use. This means that you may use these methods from `String`, but no other methods from the `String` class.

1. `public char charAt(int index)`
2. `public String substring(int beginIndex)`
3. `public boolean .equals(Object o)`

Here are some examples of what should be returned:

```
countOccurrencesOf("", 'b') = -1
```

```
countOccurrencesOf("abceabaa", 'a') = 4
```

```
countOccurrencesOf("abcdefg", 'q') = 0
```

```
public int countOccurrencesOf(String s, char c) {
```

```
}
```

**8. Constructor Chaining – Tracing [ 15 pts ]**

Given the following code: Write the output when the **main** method is run.