To ensure that you receive partial credit whenever possible, be sure to show all your work. Remember: exam is closed book. Cellphones, calculators, slide rules, notes, talking, etc., are not permitted.

1. (15) Consider the ButtonCounter class below.

```java
import java.awt.*;
import javax.swing.*;
import javax.awt.event.*;

public class ButtonCounter extends JPanel implements ActionListener{

    int counter = 0;
    JButton clicker = new JButton("Press me!");
    JLabel count = new JLabel("" + counter);

    public ButtonCounter()
    {
        setBackground(Color.red);
        this.add(clicker);
        this.add(count);
        // on this line, register ButtonCounter as listener for clicker button
    }

    public void actionPerformed(ActionEvent e){
        if (e.getSource() == clicker){
            counter++;
            count.setText("" + counter); repaint();
        }
    }

    a. Explain the connection between the method header on line 19 and the class header on line 5.
    b. What is the type of the JLabel constructor parameter that appears in the constructor call on line 9?
    c. What does "this" refer to on line 14?
    d. On line 16, provide the code that registers ButtonCounter objects as listener for the clicker JButton.
    e. Why can’t you use a different name for the actionPerformed method on line 19, say doAction, for example?
    f. What class does the getSource() method (line 20) belong to?
    g. Describe, in a few sentences, what ButtonCounter is intended to do when the clicker button is clicked multiple times.
```

(10) Consider this for loop, where big is some int value. Then rewrite as while loop:

```java
int value = 0;
for(int j = big; j > 0; j = j / 2)
    value++;
System.out.println(value);
```
3. (15) The Bowl class (text on bottom) describes a bowl for cooking, eating, etc.
   a. Write a setEmpty method for the class that allows you to set a bowl’s empty attribute to true or false.
   b. Explain, in a few sentences at most, how the toString method could possibly work, since the return type is given as String, but the weight instance variable -- a double value -- is part of the method’s return statement.
   c. Write a statement as it would appear in a driver class that creates a bowl called myBowl. myBowl weighs .65 kilograms, is empty, and comes from Italy.
   d. Add a method to the Bowl class called majorityEmpty, which is passed an array of Bowl objects, and returns true if more than half of the bowls in the array are empty. If half or fewer of the bowls are empty, the method should return false.

4. (15) Use inheritance to extend the Bowl class to a new class called OvenProofBowl. This class should add one attribute to the base class, the Boolean attribute “ovenproof”. Be sure to include in your class declaration 1) a constructor that takes four parameters; 2) get and set methods for the ovenproof attribute; and 3) a version of toString that includes an embedded call to toString from the base class.

5. (10) Write a complete, one class application that reads in a single integer from the keyboard using a Scanner object. If that number is negative, the program should print “negative”; otherwise, it should print the square root of that number.

6. (10) Which of these statements is legal, from among a, b, c (more than one may be legal):
   a. int a = 5; double r = 4.3; a = a/r;
   b. int a = 5; double r = 4.3; a = (int)(a/r);
   c. int a = 5; double r = 4.3; a = a/(int)r;

7. (10) Briefly explain what Java’s import command does.

8. (15) Consider the following driver class. Construct a PiggyBank class so that the driver class will work properly. (Precise decimal formatting not required).

```java
public class BankDriver {
    // only pennies, nickels, dimes, quarters
    public static void main(String[] args) {
        int pennies = 143; int nickels = 94; int dimes = 11; int quarters = 44;
        PiggyBank b = new PiggyBank(pennies, nickels, dimes, quarters);
        System.out.println("Decimal fraction of coins that are quarters: "+b.quarterFraction());
        System.out.println("Total dollar value of bank, in dollars and cents: "+b.totalValue());
    }
}

public class Bowl {
    double weight; // kilograms
    boolean empty;
    String origin; // where made

    public Bowl(double w, boolean e, String origin) {
        weight = w;
        empty = e;
        this.origin = origin;
    }

    public double getWeight() { return weight; }
    public boolean getEmpty() { return empty; }
    public String getOrigin() { return origin; }

    public String toString() {
        return "Bowl from " + origin + " weight: " + weight; 
    }
}
```