I. Fill in the Blank (30 pts)

1. __________________ is a binding together of data and the code which operates on the data.

2. We use the method __________________ to request that the paint or paintComponent method be called on a Component as soon as possible.

3. If a class is __________________, its definition is incomplete, and we cannot create an instance of it.

4. If a class definition is declared __________________, we cannot create a subclass of it.

5. The components in the java.awt package are considered __________________ components since they rely heavily on the underlying platform.

6. We use the method __________________ to determine if an ItemEvent was caused by a selection or deselection of a JCheckBox, JRadioButton, or JComboBox.

7. The principle of __________________ says that we should not write class definitions in such a way that changing the internal implementation will affect how outside classes use them.

8. __________________ is the ability to restrict the access to or the visibility of data.

9. We use the __________________ method in the String class to produce an array of tokens separated by a delimiter.

10. __________________ allows a primitive to be automatically converted to its corresponding wrapper type.

11. Casting changes the __________________ of a reference.

12. __________________ refers to a dynamic binding that occurs at runtime between a method call and its correct implementation.

13. If a local variable in a method has the same name as an instance variable in the class definition containing the method, then the local variable is said to __________________ the instance variable.
14. ________________ involves changing the implementation of an instance method we inherit from a superclass.

15. The principle of ________________ says that we shouldn’t include extra things in our class definition that don’t pertain to the problem we are trying to solve.

16. A String is an example of an ________________ object since, once its created, its contents can’t be changed.

17. The method ________________ is found in the ItemListener interface.

18. We use the method ________________ to draw a circle or ellipse using a Graphics object.

19. If A extends B, we call A a ________________ of B.

20. In order to include a “ in a String literal, we must ________________ the character.

21. The variables defined in an interface are implicitly public, ________________, and final.

22. A ________________ is a collection of related classes in Java.

23. We use the method ________________ to get a reference to the component that caused an event to occur.

24. Class methods are ________________ instead of overridden in a subclass.

25. If we do not include a constructor in our class definition, then the compiler supplies a ________________.

26. We use the method ________________ on a JFrame so that when we click on the X in the upper-right corner of the JFrame, our program will exit and close.

27. If an entity is declared ________________, it can be accessed from within the same class, the same package, and any subclass.

28. If C extends B, we call B a ________________ of C.

29. A ________________ is a class which can be used to encapsulate a corresponding primitive type so that it can be used in situations where an object is required.

30. If a variable or method defined in a class definition is not declared static, it is known as an ________________ variable or method.
II. Matching (10 pts)

31. protected _____  A. constructors, initializers, and instance methods.
32. addActionListener _____  B. A Java keyword that allows a variable to be accessed from the same class and the same package only.
33. “is a” _____  C. s.charAt(s.length());
34. Things not inherited by subclasses _____  D. private variables and methods, constructors, and static variables and methods.
35. The last valid position in a String, s _____  E. s.charAt(s.length-1);
36. Mutator method _____  F. Is used to retrieve the value of private members of a class definition.
37. FlowLayout _____  G. s.charAt(s.length()-1);
38. Compile-time type of a reference _____  H. Is used to register a listener on a JButton so that a button click is detected.
39. == _____  I. Is used to change the value of private members of a class definition.
40. . _____  J. When used in a regular expression will match one or more occurrences of a character.

K. When comparing two object references will return true only if both references refer to objects with the same contents.

L. Determines which methods are accessible to a reference.

M. A relationship that exists between A and B if A extends B.

N. A Java keyword that allows a variable to be accessed from the same class, the same package, or any subclass.

O. A layout manager that will lay out components from left to right.

P. A layout manager that will lay out components in a rectangular grid.

Q. When used in a regular expression will match any single character except a newline.

R. s.charAt(s.size()-1);

S. A relationship that exists between A and B if B extends A.

T. A Java keyword that allows a variable to be accessed nowhere.

U. Is used to register a listener so that a change to a JRadioButton is detected in such a way that we can determine whether it was selected or deselected.

V. When used in a regular expression will only match digits.

W. When comparing two object references will return true only if both references refer to the same object.

X. private variables and methods, constructors, and initializers.

Y. Determines the instance method that will be called at run-time.
III. Short Answer (20 pts)

41. (2 pts) Suppose we have a class definition containing a class variable named num. Suppose we create an array, the type of whose elements is the class definition, of size 8,454 and initialize each of the instances. How many copies of the variable num are stored in memory?

42. (3 pts) Suppose a String object referred to as s contains the following characters: floccinaucinihilipilification Show one line of code that will print the position of the second occurrence of the character ‘a’ without using any actual numbers other than the number 1.

43. (2 pts) Will the following produce a compile-time error? Explain.

    Double d = 5;

44. (2 pts) Would it make sense to declare a class both final and abstract? Explain.
45. (3 pts) Suppose we override the paintComponent method in a class definition. How would we obtain a reference to a FontMetrics object and use that object to horizontally center the String “Hello” on the container at the vertical position 55?

46. (2 pts) Suppose we have a reference called button to a JButton object. Suppose the label on the JButton is a number. How can we in one line change the number on the button to its quotient when the number is divided by 50?

47. (3 pts) Suppose we have the following class definitions.

    class A extends B
    class B extends C

Which two of the following declarations will cause a compile-time error? Assume that there are no constructors defined in classes A, B, or C. Explain the compile-time errors.

    A a = new A();
    B b = new A();
    C c = new A();
    A a1 = new B();
    B b1 = new C();
    C c1 = new B();

48. (3 pts) Suppose A extends B and B extends C. In the following code, will there be a compile-time error or a run-time error? Explain.

    B b = new B();
    Object o = (Object)b;
    A a = (A)o;
    C c = (C)o;
IV. Discussion (10 pts)

49. (2 pts) What are two different ways of creating an “is a” relationship?

50. (4 pts) Suppose we want to use the instanceof operator. Assuming that the use of instanceof is of the form
   \texttt{a instanceof B} where \(a\) is an object reference, and \(B\) is a class definition, under what circumstances will this
   use of instanceof produce a compile-time error?

51. (4 pts) Suppose that a class definition includes the phrase “implements ActionListener” in its header.
    Explain the contract that exists between the class definition and the interface. In particular, identify what the
    class definition is required to do and the benefit the class receives for doing it.
52. (5 pts) What is printed when Question52 is executed? Explain the output.

```java
public class Question52 {
    public static void main(String[] args) {
        A a = new A();
        System.out.println(a.isPrimitiveRoot());
        System.out.println(a.num);
        B b = new A();
        b.print();
        System.out.println(b.isPrimitiveRoot());
        System.out.println(b.num);
    }
}
```

53. (5 pts) Suppose we have the following declarations. Are there any syntax errors when we compile Test.java? If not, what is printed? Explain the output.

```java
public interface Feasible {
    public void feaseIt(Object o);
    public boolean canBeFeased();
}

public class Test implements Feasible {
    public void feaseIt() {
        System.out.println("We feased it");
    }
    public boolean canBeFeased() {
        return(true);
    }
    public static void main(String[] args) {
        Test test = new Test();
        test.feaseIt();
    }
}
```
54. (5 pts) Consider the following code. Will there be a compile-time error? If so, what is it? If there is a compile-time error, what line of code could you remove to remove it? What is printed at runtime in that case? If there was no compile-time error to begin with, what is printed at runtime?

```java
public class Question54 {
    private int num;
    public Question54(int num) {
        this.num = num;
    }
    public boolean equals(Object question54) {
        return(num == question54.num);
    }
    public static void main(String[] args) {
        Question54 question541 = new Question54(1);
        Question54[] question54 = new Question54[5];
        for (int counter=0;counter<question54.length;counter++)
            System.out.println(question54[counter].equals(question541));
    }
}
```
55. (7.5 pts) Fill in the following method so that a square of width 70 is drawn centered on the Container containing this paint method with a circle filled in blue inside the square and lines drawn in black from opposite corners of the entire Container. Also draw a quadrilateral (4-sided polygon) in yellow without using the drawLine method whose vertices are the midpoints of the outer edges of the Container.

```java
public void paint(Graphics g) {
    // Your code here
}
```
56. (7.5 pts) Show the definition of a JFrame called DrawStringAndButton that will place a JButton labeled “Press Me” on the JFrame so that when the JButton is clicked the String “Hello” is displayed so that it is horizontally centered and placed at the vertical position which is 3/4 of the height of the JFrame. Fill in all appropriate code. “Hello” should not be displayed initially when the JFrame is first set visible.

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

public class DrawStringAndButton extends JFrame

public static void main(String[] args) {

}