Answer all questions in the space provided. Write clearly and legibly, you will not get credit for illegible or incomprehensible answers. This is a closed book exam. You are allowed one page of hand written notes – This is one side of one sheet of letter sized paper. No other aids are allowed. Print your name at the top of every page.

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A suitable illustration for the morning!
① Classes, Objects, and Inheritance

a) There are a large number of predefined classes in Java. Please list five (5) of them, and what they are good for. [5 points]

b) The following tiny class:

```java
public class Error {
    private int x = 0;
    public static void main(String[] args) {
        System.out.println(x);
    }
}
```

doesn’t compile properly, but gives an error:

```
Error.java:4: non-static variable x cannot be referenced from a static context
System.out.println ( x );
  ^
```

What exactly does that mean? And how do you fix it? [5 points]
c) There are two main keywords associated with inheritance in Java, they are \texttt{extends} and \texttt{implements}.
Please explain the main differences between these two keywords and how they are used. \hspace{1cm} [5 points]

d) If I say that an abstract class with only abstract methods and constants in it is essentially an interface – Would you agree with me, or not? Either way – State your case! Give a few arguments. \hspace{1cm} [5 points]

e) Polymorphism is when a variable of a type higher up in the inheritance hierarchy is used to reference an object instance further down in the hierarchy. The virtual machine’s view of this polymorphism concept is a little different, and it has a different name. Please name this functionality, and briefly explain how it works, as well as giving a small code example showing this functionality. \hspace{1cm} [5 points]
a) There are a multitude of different Exception classes already predefined in Java. Two in particular, the `RuntimeException` and `Exception`, have special significance. What is so special about these two exception classes? [5 points]

b) You are tasked with creating an arbitrary data structure that is going to be used to store some sort of information. The data structure has a hard limit on how much it can store. You will for sure provide methods to check if your structure is empty, or at capacity. Should you still make methods used to add to the structure, and remove from the structure possibly throw exceptions? Why? [5 points]

c) There are five keywords associated with exceptions. They are try, catch, throw, throws, and finally. Try and catch usually go hand in hand, and so does throw and throws. Pick one of these two pairs, and briefly explain how they work together. [5 points]
d) A sample class for an exception you would declare yourself could look something like this:

```java
public class MondoException extends Exception {
    public MondoException ( String msg ) {
        super ( msg );
    }
}
```

If I take out line number 3 (i.e., `super (msg);`), the code will still compile. How come?  [5 points]

e) When declaring classes, we can use multiple modifiers to the class. If you try to declare a class like this:

```java
public final abstract class SampleClass { }
```

you will receive a compiler error. Why doesn’t it make sense to use that declaration?  [5 points]
GUIs - Layouts and Listeners

The following questions are focused on Graphical User Interfaces, assuming the knowledge you have after having been to class, and seen the examples that have been posted on the class blog. They do not assume that you have done extensive testing of GUI principles on an assignment.

a) A Java GUI organizes components on a window according to rules defined by layout managers. Please describe the different fields available in the `BorderLayout`, and how they relate to each other. Draw an picture to illustrate.

b) Components in a Java GUI doesn’t do very much until we explicitly tell them what to do. This is done using an action listeners. The `ActionListener` interface specifies only one method,

```java
public void actionPerformed ( ActionEvent e);
```

that is invoked when an event occurs on the component. There are three ways (that we’ve covered to create an action listener). Please list the steps necessary to create an action listener that reacts to a button press. Use Java nomenclature and code examples where appropriate.
4. Programming assignments

a) Assignment 1 was an implementation of a visualizer for an epicycle. At that point we didn’t know much about GUIs but now I think you can make an educated guess as to what components etc. was necessary to set up that window. What layout managers did I use, etc? [5 points]

b) Assignment 2 was the initial version of Scotland Yard. Here the main idea was to develop a good inheritance structure for the stops marked on the map. In the expected part you were asked to parse (read) a text file to find information about the 199 stops on the map. One line in this text file looks like this: "46 B=1,34,58,78 U=1,13,74,79 T=33,45,47,61". Please show how to create an array consisting of the three strings "1,34,58,78", "1,13,74,79", and "33,45,47,61" assuming that the line above is stored in a String variable called line. Note, you do not have to worry about extra spaces, etc... [5 points]

c) In some detail, please list one interesting and relevant feature that you would like included in the Scotland Yard implementation. Good suggestions may become part of the spec! [15 points]
ALTHOUGH I’VE BEEN FIRED FOR GROSS INCOMPETENCE, I’M PROFESSIONAL ENOUGH TO TRAIN YOU BEFORE I LEAVE.

DON’T BOTHER. I ALREADY CODED A JAVA APP TO DO EVERYTHING YOU DO.

EXCEPT FOR THE INCOMPETENT PARTS.

Hmmm... seems as if Java can be used for *anything*!