CSC 143

Exam 1

Write also your name in the appropriate box of the scantron

Multiple Choice Questions (30 points)

Answer all of the following questions. READ EACH QUESTION CAREFULLY. Fill the correct bubble on your scantron sheet. Each correct answer is worth 1 point. Each question has EXACTLY one correct answer.

1. Consider

```
public class A {
     public void foo() {/* code */}
}

public class B extends A {
    public void foo() { /* code  */}
}
```

When the following lines of code are executed

```
A a = new B();
a.foo();
```

what is the static type of this within the foo method called by the statement a.foo()?

A. `A`
B. `B`
C. `Object`
D. Can't tell without having the code of foo.
E. The above code is illegal.

2. Consider

```
public class A {
     public void foo() {/* code */}
}

public class B extends A {
    public void foo() { /* code  */}
}
```

When the following lines of code are executed

```
A a = new B();
a.foo();
```

what is the dynamic type of this within the foo method called by the statement a.foo()?

A. `A`
B. `B`
C. `Object`
D. Can't tell without having the code of foo.
E. The above code is illegal.

3. Consider the following class definitions

```
public class Vehicle {
   public Vehicle() {}
}

public class Car extends Vehicle implements
Rentable
{
   public Rentable getRentable()
   { return /* ??? */}
}
```

What could be written in place of `/* ??? */` so that the above code compiles correctly?

A. `this;`
B. `new Vehicle();`
C. `new Rentable();`
D. Either A or B
E. Either A or B or C

4. Consider the following inheritance hierarchy

```
public class OopsException extends Exception{}

public class MoreOopsException extends
OopsException {}

public class A {
     public void foo() throws OopsException {}
}

public class B extends A {}
```

What are possible signatures of an implementation of an override of foo in the B class?

A. `public void foo() throws OopsException`
B. `public void foo() throws MoreOopsException`
C. `public void foo() throws MoreOopsException, RuntimeException`
D. `A and B`
E. `A, B and C`

5. Which statements are true?

I. A try-catch block can only be used for checked exceptions
II. You can have multiple catch blocks for one try block
III. return statements and throw statements are legal in a catch block

A. I only
B. II only
C. I, II , & III
D. I & III
E. II, & III

6. Consider the following two class definitions written within the same file

```
package disco;

public class Boogie{
     public void setColor (Color c) { …}
     void display(){ …}

     protected Color color;
}

class Woogie extends Boogie{
     public void setColor(Color c) {
          color = c;              // A
      }
     public void show() {
          display();              // B
          System.out.println(text);
     }

     private String text;
}
```

Are statements A and/or B legal? (Will they compile?)

A. Both statements are legal
B. Neither statement is legal
C. B is legal, A is not
D. A is legal, B is not
E. Can't tell. There is not enough information. I would need to read through the implementation of display.

7. Using these classes one more time... which is true? Assume that any possibly illegal statement (A and/or B) has been removed.

A. Any client can instantiate disco.Woogie, but not disco.Boogie
B. Any client can instantiate disco.Boogie, but not disco.Woogie
C. Any client can instantiate objects of type disco.Boogie and disco.Woogie
D. As long as the client imports disco, then it can instantiate objects of type disco.Boogie and disco.Woogie
E. None of the above (A, B, C and D are all false).

8. To create a top level container (e.g. a graphics window), which javax.swing class(es) could you instantiate?

A. JPanel
B. JFrame
C. JTextArea
D. A and B
E. A, B and C

9. In Java, which of the following is (are) true?

(I) An event listener can listen to more than one component.
(II) A component can send an event to more than one event listener

A. I
B. II
C. I and II
D. None are true

10. When using an MVC framework to program a game (e.g. a chess game), which component would know about the rules of the game (e.g. the motion of the pieces)?

A. Model
B. View
C. Controller
D. Rules are programmed within the View and Controller with no clear separation
E. Rules are programmed within the View, Controller and Model with no clear separation

Short answers (50 points)

1) [10 points] Fill out the following table with Y for Yes and N for No.

	Enables support for multiple inheritance	Supports abstract methods	Implementation allowed (i.e. can you write code within the methods?).	Create an instance of	Partial implementation allowed (i.e. can you only write code within some of the methods?).
interface	Y	Y	N	N	N
abstract class	N	Y	Y	N	Y
concrete class	N	N	Y	Y	N

2) [10 points] Consider the following code:

```
public class Student {
     private double gpa; // must be between 0.0 and 4.0

/**
 * Updates the gpa of this student and returns the new gpa.
 * @param courseGrade the grade received for a course
 * (between 0.0 and 4.0).
 * @param credits the number of credits (greater than 0).
 * @return new gpa value.
 */
public double updateGPA(double courseGrade, int credits) {
/* code */
}

}
```

a) _ Give a class invariant: 0.0 <= gpa <= 4.0

_ How would you use the assert keyword to check that invariant?
assert 0.0 <= gpa && gpa <= 4.0: "gpa = " + gpa;

b) _ Give one precondition of the setGPA method (which is not a class invariant):
0.0 <= courseGrade <= 4.0

_ Write a statement with the throw keyword to check that precondition.
if (courseGrade < 0 || courseGrade >4.0) throw new IllegalArgumentException();

c) Give a postcondition of the setGPA method (other than any condition already mentioned): return == gpa

3) [5 points] In homework 2, you created an abstract class MovingThing that had the two methods

```
public void moveCenterBy (int dx, int dy) {
     // use moveCenterTo
     // x and y are the coordinates of the center
     // of this MovingThing (declared as protected instance
     // fields)
     int newX = x + dx;
     int newY = y + dy;
     moveCenterTo(newX, newY);
}

public abstract void moveCenterTo (int x, int y);
```

MoveCenterTo was implemented in the derived classes (e.g. Spider). However this approach had the potential danger of generating a StackOverflowError exception. Write an implementation of MoveCenterTo that illustrates this problem:

```
public void moveCenterTo (int x, int y) {
     int dx = x – this.x;
     int dy = y – this.y;
     moveCenterBy(dx, dy);
}
```

4) [5 points] What is the difference between an adapter and a listener (for example MouseAdapter and MouseListener)? Explain the difference for a developer using one or the other.

A listener is an interface. An adapter is an empty implementation of that interface. By extending an adapter, one needs only to override the methods that are required. By implementing a listener, one has to implement all of the methods even those that are not needed.

5) [5 points]
The ActionListener interface is defined as follows (… actually this is not true, but it is not relevant for this question).

```
public interface ActionListener {
     public void actionPerformed(ActionEvent e);
}
```

A JButton can send its click event to an action listener using the method with the following signature:

```
public void addActionListener(ActionListener listener)
```

Complete the code below that creates a listener for a JButton myButton. The listener should print "Button has been clicked" whenever the button is clicked. Use an anonymous inner class.

```
JButton myButton = new JButton("Click me!");

// Add your code below
myButton.addActionListener( new ActionListener() {
     public void actionPerformed(ActionEvent e) {
          System.out.println("Button has been clicked");
     }
});
```

6) Consider the following classes [15 points]

```
public abstract class Vehicle {
        public boolean startEngine() {/* code */ }
        public abstract int getMaxSpeed();
        public abstract double getVehicleValue();
}
public interface Rentable {
        public double getWeeklyRate();
}
public interface UsesPremiumGas {
        public void fillTankWithPremiumGas(double gallons);
}

public class Car extends Vehicle implements Rentable {/*code*/}

public class FancyCar extends Car implements UsesPremiumGas
{ /* code */ }

public class Bus extends Vehicle { /* code */ }
```

a) Answer the following questions (must means so that the code compiles).
Which methods must be implemented in the Car class?

```
public int getMaxSpeed()
public double getVehicleValue()
public double getWeeklyRate()
```

Which methods must be implemented in the FancyCar class?

```
public void fillTankWithPremiumGas(double gallons)
```

Which methods must be implemented in the Bus class?

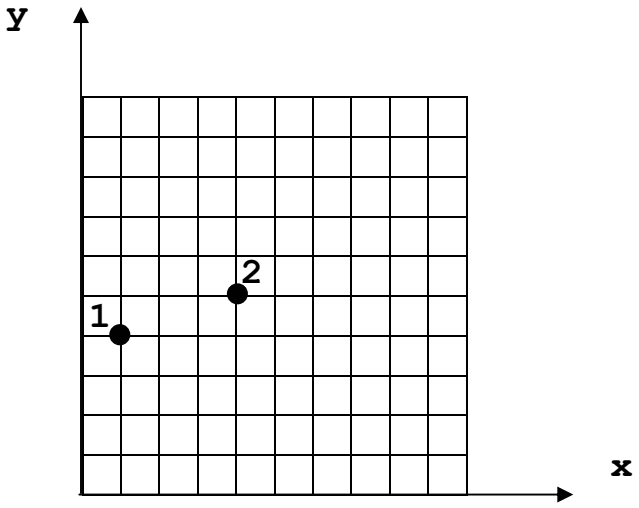
```
public int getMaxSpeed()
public double getVehicleValue()
```

b) A company has a fleet of vehicles. Complete the method below that prints the cheapest weekly rate for the vehicles of the fleet that can be rented? In no vehicle can be rented, the method should state so.
Use an iterator in your implementation. You can assume that v is not null.

```
/**
 * Prints the cheapest weekly rate available among a fleet
 * of vehicles, or prints that no vehicle can be rented.
 * @param v the list of vehicles
 */
public void printCheapestWeeklyRate(List v) {

boolean foundRentable = false;
double lowestRate = Double.MAX_VALUE;

Iterator it = v.iterator();

while(it.hasNext()) {
     Object o = it.next();
     if (o instanceof Rentable) {
          Rentable r = (Rentable) o;
          foundRentable = true;
          if (lowestRate > r.getWeeklyRate()) {
               lowestRate = r.getWeeklyRate();
          }
     }
}

if (foundRentable) {
     System.out.println("Lowest rate = " + lowestRate);
}
else {
     System.out.println("There are no rentable vehicles");
}

}
```

7) Programming question [20 points]

Consider a network of streets laid out in a rectangular grid; for example,



In a *northeast path* from one point in the grid to another, one may walk only to the north (up) and to the east (right). For example, there are four northeast paths from 1 to 2 in the preceding grid:

Write a recursive method to count the number of northeast paths from one point (x1, y1) to another point (x2, y2) in a rectangular grid. Take that the number of northeast paths of a point to itself is 0.

```
public int numberOfNEPaths(int x1, int y1, int x2, int y2) {

      // Base cases
      if (x1 > x2 || y1 > y2) return 0; // can't have a path
      if (x1 == x2 && y1 == y2) return 0; // initial == final
      if (x1 == x2 - 1 && y1== y2) return 1; // 1 step to the East
      if (x1 == x2 && y1 == y2 - 1) return 1; // 1 step to the North

      // Recursion: 2 options
      // make one step to the East
      int n1 = numberOfNEPaths(x1 + 1, y1, x2, y2);
      // make one step to the North
      int n2 = numberOfNEPaths(x1, y1 + 1, x2, y2);
      return n1 + n2 ;
}
```