Exam for OOS component

Name:

Student Number:

Time 2:30. Points: 83

Q0 [5] What is meant by "run-time type safety?"

Q1 [5] What is the output of this program?

```
abstract class A {
    A() { System.out.println( "a" ) ; }
}
class B extends A {
    B(int i) { System.out.println( "b" ) ; }
}
public class C extends B {
    C() { super(23) ; System.out.println( "c" ) ; }
    public static void main(String[] args) {
        System.out.println( "0" ) ;
        C c = new C() ;
        System.out.println( "1" ) ; }
}
```

Q2 [24] Given a context of the following declarations

interface W { ... }
abstract class X **implements** W { ... }
class Y **extends** X { ... }
class Z **extends** X { ... }
Object o = **null** ;
W w = **null** ;
X x = **new** Y() ;
Y y = **null** ;
Z z = **new** Z() ;

(a) x refers to an object; list all types is that object an instance of?

(b) What is the static type of the expression x?

(c) Does the following statement have a compile time error?

$$w = z ;$$

(d) Explain why or why not.

(e) Will the following statement cause a compile time error?

$$y = x ;$$

(f) Explain why or why not.

(g) Will the following statement cause a compile time error?

$$w = \textbf{new } W() ;$$

(h) Explain why or why not.

(k) Explain why or why not.

(l) Will the following statement cause a compile time error?

$$o = w ;$$

(m) Explain why or why not.

Q3 [5] What is the output of this program.

import java.io.IOException;

public class Example {
    public static void fred(**int** i) **throws** IOException {
        System.out.println(10) ;
        if(i == 0) **throw new** IOException() ;
        System.out.println(11) ;
    }

    public static void main(String[] args) {
        try {
            System.out.println(20) ;
            fred(0) ;
            System.out.println(21) ; }
        catch(Throwable e) {
            System.out.println(22) ; }
        System.out.println(23) ;
    }
}

Q4 [20] (a)[10] Design a method that takes as its parameter an array of integers. It should return a new array that contains the same values except in reverse order. The original array must not be altered.

(b)[10] Design a method that returns no result and has one array-of-integers parameter. It should alter the contents of the array so that the final value of the array is the same as the initial value, but is in reverse order.

Q5 [25] Suppose we represent functions from real numbers to real number with objects of the following type.

```
interface Function {
    double apply( double x ) ;
}
```

(a)[5] Design a concrete class, Sine, objects of which represent the sine function. Sine should implemnt the Function interface.

(b)[5] Design a class, Sum, objects of which represent the sum of two functions. These two functions should be passed in to the constructor. Sum should implemnt the Function interface.

(c)[5] Design a class, Composition, objects of which represent the composition of two functions. Again, the two functions should be passed in to the constructor. (The composition of two functions f and g applied to a number x is $f(g(x))$.) Composition should implemnt the Function interface.

(d)[10] Suppose we have an interface

interface Canvas {

    void putDot(**double** x, **double** y, Color c) ;

}

the objects of which represent an area of the screen (or perhaps of a page to be printed). Each call to putDot, places a dot of the given colour on the canvas at the indicated position. (You can assume that any Canvas object will simply not display dots that are outside of its allocated area of the screen.) Complete the following method that will plot n points of a function at equally spaced intervals from $x0$ to (and including) $x1$. You may assume that $n \geq 2$ and that $x1 > x0$.

class Plotter {

    void plot(Canvas canvas, Function f, **double** x0, **double** x1, **int** n, Color color) {

    }

}

(End of exam.)