Student ID: .....

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

EXAMINATIONS – 2015

TRIMESTER 1

SWEN221

Software Development

Time Allowed: TWO HOURS

CLOSED BOOK

Permitted materials: No calculators permitted.
Non-electronic Foreign language to English dictionaries are allowed.

Instructions: Answer all questions
All questions are of equal value

Answer all questions in the boxes provided.
Every box requires an answer.
If additional space is required you may use a separate answer booklet.

Question	Topic	Marks
1.	Code Comprehension	30
2.	Testing	30
3.	Java Masterclass	30
4.	Exceptions and Assertions	30
	Total	120

Question 1. Code Comprehension [30 marks]

Consider the following classes and interfaces, which compile without error:

```
1  // A variable holding a logic (i.e.  boolean) value
2  class LogicVar {
3    private boolean value;
4
5    public LogicVar(boolean value) { this.value = value; }
6
7    public boolean get() { return value; }
8
9    public void set(boolean value) { this.value = value; }
10 }
11
12 // A logic gate reads two inputs and writes one output
13 abstract class LogicGate {
14   private LogicVar[] variables = new LogicVar[3];
15
16   public LogicGate(LogicVar in1, LogicVar in2, LogicVar out) {
17     variables[0] = in1;
18     variables[1] = in2;
19     variables[2] = out;
20   }
21   public void evaluate() {
22     boolean in1 = variables[0].get();
23     boolean in2 = variables[1].get();
24     variables[2].set(evaluate(in1,in2));
25   }
26   public abstract boolean evaluate(boolean in1, boolean in2);
27 }
28
29 // If both inputs true, out is true; othewise, out is false.
30 class AndGate extends LogicGate {
31   public AndGate(LogicVar v1, LogicVar v2, LogicVar v3) {
32       super(v1,v2,v3);
33   }
34   public boolean evaluate(boolean in1, boolean in2) {
35       return in1 && in2;
36 } }
37
38 // If either input is true, out is true; othewise, out is false.
39 class OrGate extends LogicGate {
40   public OrGate(LogicVar v1, LogicVar v2, LogicVar v3) {
41       super(v1,v2,v3);
42   }
43   public boolean evaluate(boolean in1, boolean in2) {
44       return in1 || in2;
45 } }
```

(a) Based on the code given on page 2, state the output you would expect for each of the following code snippets:

(i) [2 marks]

```
1      LogicVar v1 = new LogicVar(true);
2      System.out.println(v1.get());
```

t

(ii) [2 marks]

```
1  LogicVar v1 = new LogicVar(false);
2  LogicVar v2 = new LogicVar(true);
3  LogicVar v3 = new LogicVar(true);
4  LogicGate gate = new AndGate(v1,v2,v3);
5  gate.evaluate();
6  System.out.println(v1.get() + "␣" + v2.get() + "␣" + v3.get());
```

f t f

(iii) [2 marks]

```
1  LogicVar v1 = new LogicVar(true);
2  LogicVar v2 = new LogicVar(false);
3  LogicGate gate = new OrGate(v1,v2,v2);
4  gate.evaluate();
5  System.out.println(v1.get() + "␣" + v2.get());
```

t t

(iv) [2 marks]

```
1  LogicVar v1 = new LogicVar(true);
2  LogicVar v2 = new LogicVar(false);
3  LogicVar v3 = new LogicVar(false);
4  LogicGate gate1 = new OrGate(v1,v2,v3);
5  LogicGate gate2 = new AndGate(v3,v2,v1);
6  gate1.evaluate();
7  gate2.evaluate();
8  System.out.println(v1.get() + "␣" + v2.get() + "␣" + v3.get());
```

t f f

(b) [5 marks] Provide an implementation for a class `XorGate`. This sets the `out` field to **`true`** if exactly one input is **`true`** (i.e. not both); otherwise, it sets it to **`false`**.

(c) [3 marks] Consider the method `LogicGate.evaluate()`. Does it *overload* or *override* the method `LogicGate.evaluate(`**`boolean,boolean`**`)`? Justify your answer.

(d) Suppose the following method were added to class `LogicGate`:

```
1  public boolean equals(Object o) {
2     if(o instanceof LogicGate) {
3        LogicGate lg = (LogicGate) o;
4        for(int i=0;i!=variables.length;++i) {
5           if(variables[i] != lg.variables[i]) { return false; }
6        }
7        return true;
8     }
9     return false;
10 }
```

(i) [6 marks] This method means an `AndGate` can equal an `OrGate`. Briefly, illustrate how you would fix this problem.

(e) Consider the following snippet of code:

```
1       LogicGate gate = new AndGate(v1,v2,v3);
```

(i) [4 marks] The *static type* of variable `gate` is `LogicGate`. Briefly, discuss what this means and how it affects what values variable `gate` may hold.

(ii) [4 marks] The *dynamic type* of variable `gate` is `AndGate`. Briefly, discuss what this means and how it affects the execution of method `LogicGate.evaluate()`

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Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.

Question 2. Testing [30 marks]

(a) [5 marks] Briefly, discuss the difference between *black-box* and *white-box* testing.

(b) [2 marks] What is *branch coverage*?

(c) [2 marks] What is *simple path coverage*?

(d) Consider the following classes which compiles without error:

```
1  class List {
2    private int[] items;
3
4    public List(int[] items) {
5        this.items = items;
6    }
7
8    public boolean hasBetween(int min, int max) {
9        int i = 0;
10       while(i < items.length) {
11          if(min <= items[i]) {
12             if(items[i] <= max) {
13                 return true;
14             }
15          }
16          i = i + 1;
17       }
18       return false;
19 } }
```

(i) [8 marks] Draw the *control-flow graph* for the `List.hasBetween(int,int)` method:

Consider the following test cases for the class `List`:

```
1 public class ListTests {
2   public static final int[] ITEMS = {-1,0,1};
3
4   @Test public void testHasBetween_1() {
5     assertFalse(new List(ITEMS).hasBetween(5,10));
6   }
7   @Test public void testHasBetween_2() {
8     assertFalse(new List(ITEMS).hasBetween(-10,-5));
9 } }
```

(ii) [2 marks] Give the total *branch coverage* obtained for class `List` from the tests provided in `ListTests`.

(iii) [2 marks] Give the total *simple path coverage* obtained for class `List` from the tests provided in `ListTests`.

(iv) [4 marks] Give two additional test cases which increase the simple path coverage obtained for `List` to 100%.

(e) [5 marks] Briefly, discuss why *polymorphism* in Java can result in an infinite number of execution paths for a given method.

Question 3. Java Masterclass [30 marks]

As for the self assessment tool, for each of the following questions, provide in the answer box the code that should replace `[???]`.

(a) [5 marks]

```
1  //The answer must have balanced parentesis
2  interface Joke{
3   int laughingTime();
4  }
5  class FunnyJoke implements Joke{
6   public int laughingTime(){return 5;}
7  }
8  class BadJoke implements Joke{
9   public int laughingTime(){return 0;}
10 }
11 class SoBadItsGoodJoke extends BadJoke{
12  public int laughingTime(){return 10;}
13 }
14 public class Exercise{
15
16   static int time=0;
17
18   static void joke(Joke j){time+=j.laughingTime();}
19
20   public static void main(String[] arg){
21     joke(new FunnyJoke());
22     joke(new SoBadItsGoodJoke());
23     joke(new BadJoke());
24     assert time==[???];
25   }
26 }
```

(b) [4 marks]

```
1 //The answer must have balanced parentesis
2 class Hero{ int strength(){return 10;} }
3 class [???]{ int strength(){return 100;} }
4 public class Exercise{
5   public static void main(String [] arg){
6     Hero h=new Hercules();
7     assert h.strength()==100;
8   }
9 }
```

(c) [5 marks]

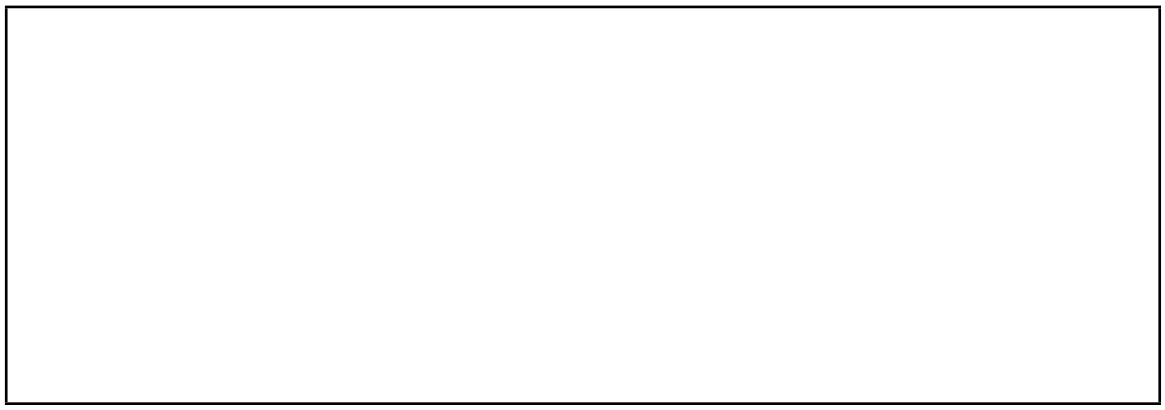
```
1 //The answer must have balanced parenthesis
2 class ThorHammer{[???]}
3
4 public class Exercise{
5   public static void main(String [] arg){
6     ThorHammer h1=ThorHammer.getInstance();
7     ThorHammer h2=ThorHammer.getInstance();
8     assert h1!=null;
9     assert h1==h2;
10 }  }
```

(d) [6 marks]

```
1  //The answer must have balanced parenthesis
2  class Hammer{
3    private int weight;
4    public Hammer(int weight){this.weight=weight;}
5    public int getWeight(){return weight;}
6    public int hashCode() {return this.weight;}
7  }
8  class ThorHammer extends Hammer{[???]}
9
10 public class Exercise{
11   public static void main(String[] arg){
12    assert new ThorHammer().getWeight()==42;
13    assert new Hammer(0).hashCode()==new ThorHammer().hashCode();
14 } }
```

(e) [5 marks]

```
1 //The answer must have balanced parenthesis
2 class A{ int m(){return 1;}}
3
4 public class Exercise{
5   public static void main(String[] arg){
6     A a=[???];
7     assert a.m()==2;
8   }
9 }
```



(f) [5 marks]

```
1  // The answer must have balanced parenthesis
2  import java.util.Arrays;
3  import java.util.List;
4
5  class Point{
6    int x;
7    int y;
8    Point(int x, int y) { this.x=x;this.y=y; }
9  }
10 class ColPoint extends Point {
11   int colour;
12   ColPoint(int x, int y, int colour) {
13     super(x,y);
14     this.colour=colour;
15   }
16 }
17
18 public class Exercise{// make this code compile
19   static void printAll([???]){
20     for(Point p:ps){
21       System.out.println(""+p.x+"␣"+p.y);
22     }
23   }
24   public static void main(String[]arg){
25     List<Point> l1=Arrays.asList(new Point(1,2));
26     List<ColPoint> l2=Arrays.asList(new ColPoint(1,2,0));
27     printAll(l1);
28     printAll(l2);
29   }
30 }
```

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Cross out rough working that you do not want marked.
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Question 4. Exceptions and Assertions [30 marks]

(a) [2 marks] Are Assertions in Java enabled or disabled by default?

(b) [2 marks] Explain how to enable/disable assertions either from the command line or from eclipse.

(c) [4 marks] Insert sensible assertions with appropriate error messages into the following code to ensure that the parameter cannot be null and that the result will be positive.

```
public static int distanceFromOrigin(Point p){

    int x=p.x*p.x;

    int y=p.y*p.y;

    int result=x+y

    return result;

}
```

(d) [6 marks] One of your colleagues has written a method `dbQuery`. This method connects to a database, executes a query and returns a list of all the data produced. If there is an error working with the database, `dbQuery` simply propagates a checked exception.

You are using `dbQuery` to write a function to load employers data from a database.

```
1  class LoadData{
2    private static
3    List<Data> dbQuery(String id) throws DBException {
4      /*omitted*/
5    }
6    public static Data load(String id){
7      try{
8        List<Data> data=dbQuery("select␣..."+id);
9        if(data.size()!=1){
10         throw new UncheckedDBException(
11           "Data␣size␣is␣"+data.size());
12         }
13       return data.get(0);
14     }
15     [???]
16   }
17 }
```

As for the self assessment tool, provide in the answer box the code that should replace `[???]` to make the code compile. At this stage, you can assume a class `UncheckedDBException` is declared elsewhere.

(e) [5 marks] Identify an alternative solution for question **(d)** and discuss its pros and cons.

(f) [4 marks] Provide code for the class `UncheckedDBException`, so that the code before could compile.

(g) "Finally" is an important feature of Java exception handling.

(i) [4 marks] Briefly, discuss what **`finally`** means in Java.

(ii) [3 marks] Briefly, describe a situation where using **`finally`** would be sensible.

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