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**INSTRUCTIONS FOR CANDIDATES**

You are advised (but not required) to spend the first ten minutes of the examination reading the questions

**IMPORTANT:**

**The exam paper is provided in two versions according to the Course you are enrolled on.**

**Answer only the questions in the version corresponding to the programming language that you have been taught during the module:**

**1) Java Version (pages 2 - 4)**: BSc Computer Science, BSc Multimedia Computing, BSc Digital Media Development or BEng Software Engineering

**2) C++ Version (pages 5 - 6)**: BSc Computer Games Development

**Module Title: Object Oriented Programming**

**Module Code: 5COSC001W**

**Exam Period: January 2020**

**Time allowed: 2 hour**

**THIS PAPER MUST NOT BE TAKEN OUT OF THE EXAMINATION ROOM**

**DO NOT TURN OVER THIS PAGE UNTIL THE INVIGILATOR INSTRUCTS YOU TO DO SO**

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## JAVA Version

## Answer the 8 questions in this section only if you are enrolled on BSc Computer Science, BSc Multimedia Computing, BSc Digital Media Development or BEng Software Engineering

DO NOT REPLY to these questions if you are enrolled to BSc Computer Games Development

1) Draw a UML class diagram, of the problem presented below.

*Each airport has a name and it is built in a city. The city has a name and number of inhabitants.*

*Several flights are scheduled in the airport. Each flight is identified by a number, a date, a boarding time and a gate. The flight is operated with a plane, which can be either a boing or an airbus. Each plane has a number of seats and manufacturer’s name.*

*(12 points)*

2) Briefly explain the meaning of the following terms. Use also practical examples to justify your answer:

* 1. Object
  2. Class
  3. Constructor

*(9 points)*

3) Suppose that class FootballPlayer and class BasketballPlayer are subclasses of class Player. Which of the following are legal?

1. FootballPlayer f = new Player();
2. Player p = new BasketballPlayer ();
3. BasketballPlayer b = new FootballPlayer ();

*(5 points)*

4) For all parts of this question, consider the following class definition that represents a pipe:

public class Pipe {

public double diameter; // from 0.5 to 5.0 cm

public double length; // from 10.0 to 100.0 cm

};

1. Provide a redesigned Pipe class that uses more appropriate access modifiers according the encapsulation principle.

*(5 points)*

1. Provide a constructor for the Pipe class that will initialise the instance variables to suitable (valid) start values.

*(5 points)*

1. Provide signatures for set and get methods for one of the instance variables (you can choose which one).

*(5 points)*

1. Write bodies for the methods for which you provided signatures in question (c) above. Note that for the set method, the implementation must prevent the two instance variables from being set to invalid values.

*(8 points)*

1. Write a main method that instantiates the Pipe class and use the set and get methods you designed.

*(5 points)*

5) What are abstract methods and classes in Java? Why are they used? Provide also an example.

*(10 points)*

6) Concurrent data access can be regulated by synchronisation. Explain this problem and how the synchronisation can be solved in Java. You can explain using an example in Java code

*(6 points)*

7) Explain what is an Exception and the try-catch-throw mechanism in Java. You can use some examples in Java code.

*(6 points)*

8) Consider the following class named City:

public class City {

private String name;

private String country;

private int population;

public City(String name){

this.name = name;

}

public void setCountry(String country){

this.country = country;

}

public void setPopulation(int population){

this.population = population;

}

public String getCountry(){

return country;

}

public String getName(){

return name;

}

public int getPopulation(){

return population;

}

public String toString(){

return “ City: “ + name + “Population: “+ pointInLeague”;

}

}

1. Modify the implementation of the class City in order to provide a way to compare different Cities by their population. Write what you would change in the definition of the class and provide the implementation of the method to be used to compare. Note that you can use from java package java.lang.Comparable with the method public int compareTo(Tobj).

You don’t need to rewrite the whole class, just identifying and rewriting the sections that need changing would suffice.

*(10 points)*

1. Write a main method where three Cities are instantiated and stored in an array (or a list) of City. For each team, set the population.

*(8 points)*

1. Within the main method sort the array (or list) of City according to the criteria implemented in point a. and print the ordered list to the terminal.

*(6 points)*

**\*END\***

## C++ Version

## Answer the 7 questions in this section only if you are enrolled on BSc Computer Game Development

## DO NOT REPLY to these questions if you are enrolled to BSc Computer Science, BSc Multimedia Computing, BSc Digital Media Development or BEng Software Engineering

1) Draw a UML class diagram of the problem presented below. (12 points)

*A building has at least one room. Some rooms are bedrooms, and each bedroom has at least one bed. Each bed has a length and width, given in cm. Each room has at least one door. A door can be either internal or external. Each building has at least one external door.*

2) What is the Liskov Substitution Principle? (6 points)

3) Create a Rectangle class. Each rectangle should have:

* a width and height (both integers) (4 points)
* a suitable constructor (5 points)
* a method getArea() returning the area of the instance (5 points)

The class should also:

* keep track of the total area of all rectangles created so far (6 points)
* have a method totalArea() returning this total. (6 points)

4) For this question, assume that we have included all necessary header files. Suppose we have two functions

void foo(int x, bool y) {…}

void bar(string &s) { … }

Complete the following function; the comments indicate what should happen.

void launch(){  
 string s = “sproing”;  
 // launch a thread running bar(s); (4 points)  
   
 // launch another thread running foo(5,false); (4 points)  
 // it should run until the end of the program (4 points)  
  
   
 // Wait for the first thread to finish (4 points)  
  
 // Print “done” to standard output (2 points)

}

5) The following questions revolve around implementing a Pet class.

a) Create an abstract Pet class with subclasses Spider and Snake. Each pet has a name (a string), for which there should be suitable getter and setter methods. They should also include constructors and a method numberOfLegs(), giving the number of legs based on the pet’s class. (12 points)

b) Write a function Pet \*getPet(string name, bool spider) which returns either a Spider (if spider is true) or a Snake (otherwise) with the given name. (6 points)

6) Describe the diamond problem. How can it be solved? (8 points)

7) Describe the purpose and main parts (classes, relations) of these design patterns:

a) Composite (6 points)

b) Strategy (6 points)

**\*END\***