RHODES UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE
EXAMINATIONS, JUNE 2002
COMPUTER SCIENCE HONOURS
PAPER 1

Examiners: Dr M. Preston
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External: Prof E. Blake

Marks: 100
Time: 3 hours

Instructions to candidates:

a) This paper consists of two sections. There are 10 questions and 6 pages. **Please make sure that you have a complete paper.**
b) Answer each section in a separate answer book.
c) In Section A, answer **Questions 1, 2, 3, and 4 and any ONE question from questions 5, 6 and 7.**
d) Answer **ALL** questions in Section B.

Section A: Java Programming [50 Marks]

NOTE: Please read the instructions carefully. You must answer questions 1, 2, 3 AND 4. You must also answer any ONE question from questions 5, 6, or 7.

Answer Question 1, Question 2, Question 3 AND Question 4

Question 1

Explain what you understand by the following terms as used in the Java environment and programming language:

a) Singleton pattern
b) Object Serialization
c) Anonymous classes
d) Swing
e) Synchronization
f) JDBC
g) Java Virtual Machine (JVM)

[2 x 7 = 14 marks]

Question 2

Describe how and when one would use Java's Exception-Handling mechanism.

[4 marks]

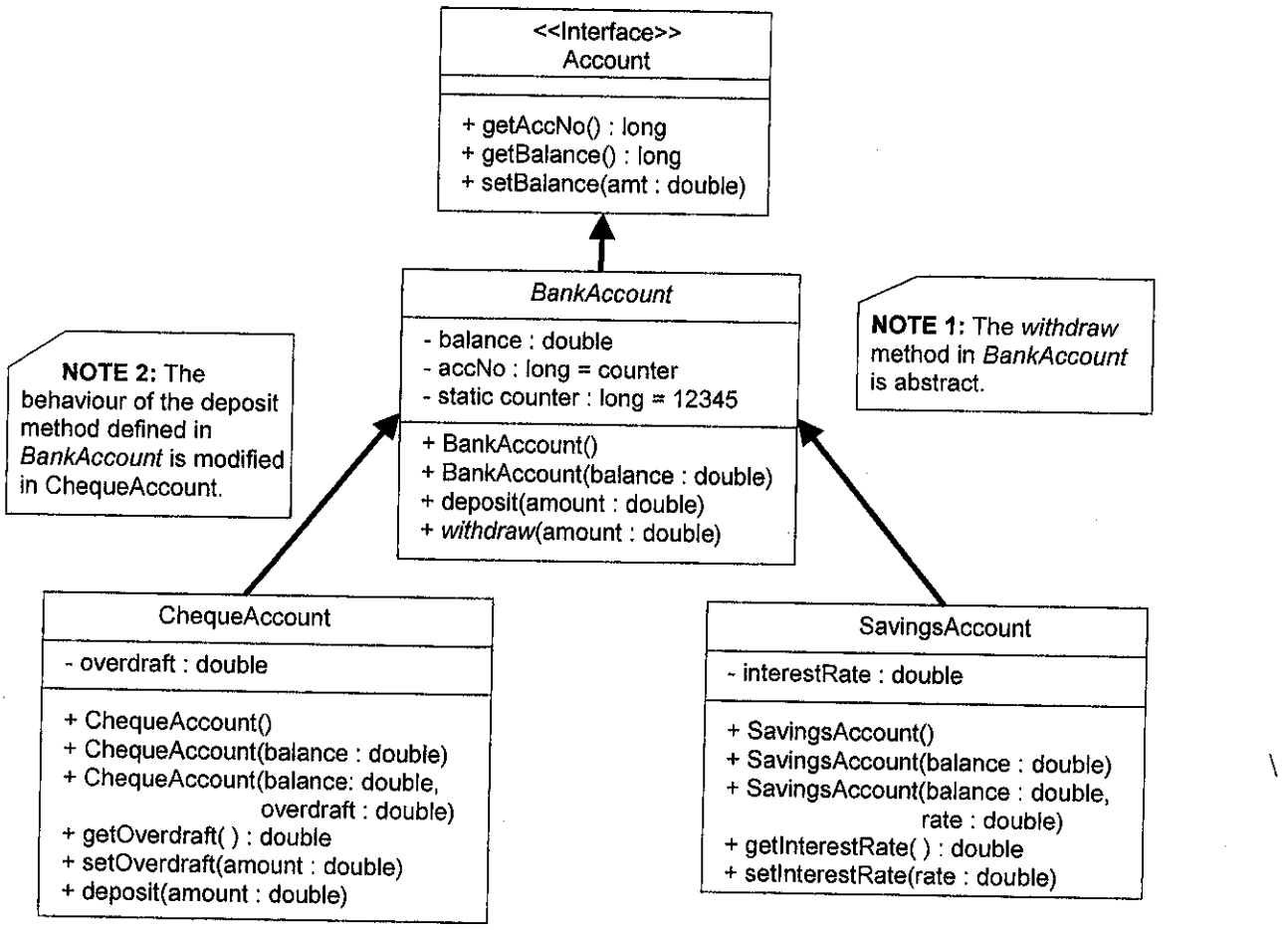
Question 3

Using the class diagram below, and with respect to Java, explain the following concepts:

- Overriding
- Overloading
- Data Hiding and Encapsulation
- Polymorphism
- Inheritance

You should provide concise code examples to illustrate your answer. NOTE: You are NOT required to implement this class diagram.

[16 marks]



Question 4

a) The following code extract shows the outline of the Math class in Java. Discuss the features of the language shown below that are used to provide a very high level of security in the use of this class.

[3 marks]

```
public final synchronized class Math {

    public static final double PI = 3.141592653589793;

    ...

    private Math() {

    } // constructor

    public static double random () {
        ...
    }

    ...

} // class Math
```

b) In the above class we have the declaration of a field called PI. What is the effect of the keywords public static final in this declaration?

[3 marks]

c) Describe what the Reflection API allows Java programmers to do, and discuss what impact the use of the Reflection API has on the security features mentioned in part (a).

[2 marks]

Answer ONE of the following THREE questions

Question 5

Describe the similarities and differences between JavaScript and Java, with reference to: OOP, datatypes/type-checking, compilation/interpretation, as well as when one would use each of these technologies.

[8 marks]

Question 6

a) Describe the Java approach to client-server network computing based on the TCP/IP protocol. As part of your answer outline the structure of the server code and the client code for establishing a connection.

[5 marks]

b) Describe the different tiered client/server architectures discussed during lectures, including the relevant advantages of each of them. [3]

[3 marks]

Question 7

Describe RMI and CORBA **(4 marks)**, including their similarities and differences, as well as when one would use each of these technologies **(4 marks)**.

[8 marks]

SECTION B: GRAPHICS [50 marks]

Answer ALL questions in this section.

Question 8 (Each answer may be worth up to 8 marks depending on the detail you provide)

A movie producer wants to use computer graphics to produce a movie about white-water rafting, an action sequence showing large rubber rafts surfing over waterfalls and rapids. Advise him and his team of animators on the issues below:

a) Describe the techniques you could use to model and render the waterfalls, including the river, spray and mist.

b) Describe the techniques you could use to produce realistic motion of the rafts and their occupants as they travel down the river.

c) OpenGL, Renderman (with the Blue Moon Rendering Tools: BMRT) and Maya were studied in the course. Suggest appropriate roles that these systems could play in the production of the movie.

d) Explain the processes involved in realistically illuminating the various surfaces.

e) What is involved in making sure that hidden surface removal works during the rendering process? What techniques could be used? How will they cope with the (partial) transparency of water and spray.

[20 marks]

Question 9 (Each answer may be worth up to 4 marks depending on the detail you provide)

Briefly explain the following:

a) The difference between raster and vector displays.

b) The working of the accumulation buffer.

c) The relationship between alpha and anti-aliasing.

d) The significant innovations in Bresenham's approach to line drawing.

e) How a colour cast in an image can be identified and quantized.

f) Why a matrix is a suitable representation for a transformation.

g) The difference between object and eye coordinate systems.

h) The benefits of using homogeneous coordinates.

i) The incompatibilities between the human visual system and flat shading.

j) The differences between local and global illumination.

[20 marks]

Question 10 (Each answer may be worth up to 6 marks depending on the detail you provide)

Answer **ANY TWO** of the following:

a) Describe the stencil buffer and explain how it could be used to achieve capping.

b) An orange peel effect is required (so we can draw an orange). Suggest how this could be achieved using Renderman shaders.

c) How can one achieve transparent objects in OpenGL, and why does hidden surface removal have to be considered in this process?

d) How would you go about writing a program to identify whether a point was inside a closed polyhedral object, or not?

e) How can you produce shadows in OpenGL?

[10 marks]