BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

OBJECT ORIENTED PROGRAMMING

Thursday 28th March 2013 - Afternoon

Answer **any** FOUR questions out of SIX. All questions carry equal marks
Time: TWO hours

Answer any Section A questions you attempt in Answer Book A
Answer any Section B questions you attempt in Answer Book B

Calculators are **NOT** allowed in this examination.

The marks given in brackets are **indicative** of the weight given to each part of the question.

Section A
Answer Section A questions in Answer Book A

A1. a) Define the following terms:
i) Abstract data type;
ii) Encapsulation;
iii) Typed language;
iv) Coupling;
v) Cohesion.

(10 marks)

b) A stack is a last in, first out linear data structure. A stack can have any object as an element. It is characterised by two fundamental operations, called *push* and *pop*. The push operation adds a new item to the top of the stack. If the space allocated to hold the stack is full when the push operation is attempted then an error condition is raised. The pop operation removes an item from the top of the stack. A pop reveals previously concealed items, or results in an empty stack. If the stack is empty when a pop operation is attempted then an error condition is raised (it means no items are present in stack to be removed).

Using an object oriented programming language with which you are familiar, write code which implements a stack. Your code should store the stack elements in an array and should not make use of a stack class from a class library.

(15 marks)

A2.a) Define the following terms:

i) Class;
ii) Object;
iii) Data member;
iv) Member Function;
v) Single inheritance;
vi) Multiple inheritance.

(12 marks)

b) Languages which support multiple inheritance can be used to create ambiguous references to methods. Give an example of such a situation.

(6 marks)

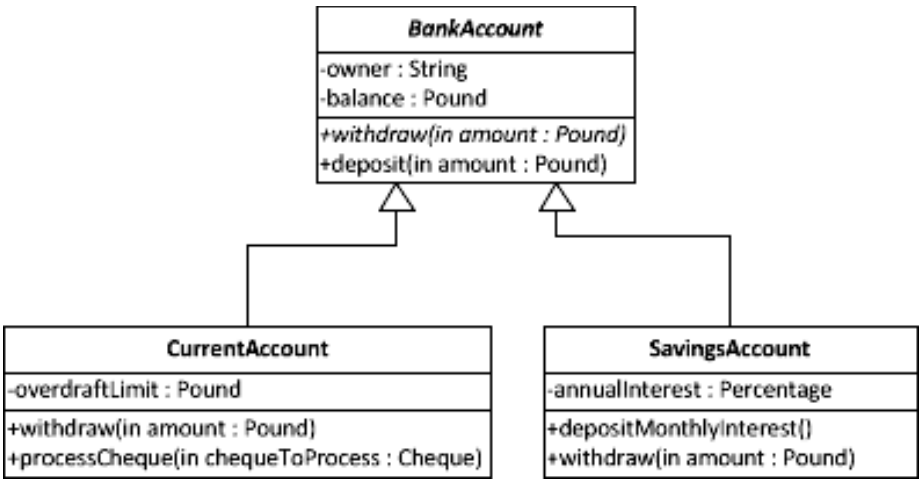
c) Discuss whether support for multiple inheritance is a necessary prerequisite for support for polymorphism in an object oriented programming language.

(7 marks)

A3.a) Describe the way in which the Unified Modelling Language (UML) can be used to design an object oriented program.

(10 marks)

b) Using an object oriented programming language of your choice, write code which represents the UML diagram shown below:



(15 marks)

Section B

Answer Section B questions in Answer Book B

B4. Consider the following class definition, written by a novice programmer, that represents a specific working day in a 12-week project period.

```
public class DayAndWeek
{
  public int day;  // Day of the Week, Varies from 1-5
  public int week; // Week of the Project, Varies from 1-12
};
```

a) Provide a code fragment showing a redesigned DayAndWeek class that more appropriately encapsulates the two instance variables.

(5 marks)

b) Provide instance methods that will enable the two instance variables to be queried and changed via an object of the class.

(5 marks)

c) Incorporate an error-checking routine into your instance variable change methods (above) that prevent data items from assuming invalid values. This may be accomplished either by returning a flag to signify a successful/failed update, or using exception handling.

(5 marks)

d) Provide an instance method that will ensure the instance variables day and week will be initialised to default values (1,1) immediately upon creation of a new instance.

(5 marks)

e) Demonstrate the use of the redesigned DayAndWeek class you developed above by creating and configuring an object, including checking the success/failure of the instance variable changes you apply.

(5 marks)

B5.

a) Construct a UML class diagram showing the structure of a professional society, wherein members pay an annual fee. Your class diagram should incorporate the following 6 classes: member, studentMember, standardMember, seniorMember, society, and governingCommittee, which should be connected with appropriate relationships, and be populated with appropriate instance variables and methods to enable the names, addresses and fees of members to be stored, along with the management committee members, and the name and HQ address of the society. The governing committee will comprise a number of senior members.

(20 marks)

b) A colleague suggests that the member class is abstract. What do they mean by this, and how is an abstract class represented in a UML class diagram?

(5marks)

B6.

a) Some object-oriented programming languages, such as Python, are interpreted. Others, such as C++, are compiled. Distinguish between the terms *interpreted* and *compiled*.

(6 marks)

b) Polymorphism is broadly classified into two types: *parametric* and *ad-hoc*. Distinguish between these two forms of polymorphism.

(6 marks)

c) Distinguish between *mutable* and *immutable* objects, providing one example situation in which each would be an appropriate choice.

(6 marks)

d) One of the principal features of object oriented languages is subtype polymorphism. In this context, explain the terms *covariant*, *contravariant*, and *invariant*.

(7 marks)