THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Diploma

OBJECT ORIENTED PROGRAMMING

13th October 2003, 10.00 a.m.-12.00 p.m.
Answer FOUR questions out of SIX. All questions carry equal marks.
Time: TWO hours.

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

1. *a)* Give definitions of the following:
- *i)* abstract data type
- *ii)* modular programming
- *iii)* structured programming
- *iv)* typed languages
- *v)* untyped languages **(15 marks)**

b) Choose THREE of the above concepts and discuss how EACH has contributed to the development of object oriented languages. **(10 marks)**

2. For each of the following concepts:

- *i)* inheritance
- *ii)* overloading
- *iii)* overriding
- *iv)* collection class

a) Explain what each concept means. **(12 marks)**

b) In an object oriented programming language with which you are familiar, provide sample code that demonstrates the use of EACH of the above concepts. **(13 marks)**

3. *a)* What is the purpose of a design pattern? **(4 marks)**

b) Propose a documentation standard for design patterns with a justification for each decision you make. **(10 marks)**

c) Apply the standard proposed in part *b)* to a design pattern with which you are familiar. **(7 marks)**

d) What benefits does the adoption of a documentation standard bring to the use of design patterns? **(4 marks)**

4. *a)* A class is required to hold basic student details. The proposed Student class has the following instance variables:

studentNo:	String
name:	String
age:	Integer

A class variable is also required, called noOfStudents, which will be incremented each time a Student instance is created.

Using an object oriented programming language with which you are familiar, write code to:

i) Show the declaration of the fields for the Student class. **(4 marks)**

ii) Declare two constructors, the first should be a default constructor that has no parameters and sets the instance variables to either "not known" for the strings, or 0 for the integer. The second should take three parameters, one for each of the instance variables. Both constructors should increment the class variable appropriately. **(8 marks)**

iii) Show how both of the constructors given in *ii)* could be used to instantiate an object of the class Student. **(2 marks)**

iv) Show the declaration of a *setter* and *getter* for each of the instance variables of class Student. **(6 marks)**

b) Discuss how memory management is typically achieved in an object oriented programming language. **(5 marks)**

5. *a)* In the context of the object oriented paradigm define the following:
i) specialisation.
ii) polymorphic substitution. **(4 marks)**

b) How does the use of specialisation and polymorphic substitution improve an object oriented design? **(6 marks)**

c) A sports club has members who only make use of the gymnasium and those who also play a racquet game such as tennis. The latter are charged an extra 10 per cent on their annual fee. All members have their name, membership number, address and the annual fee payable recorded. If applicable the name of the racquet game played is also recorded.

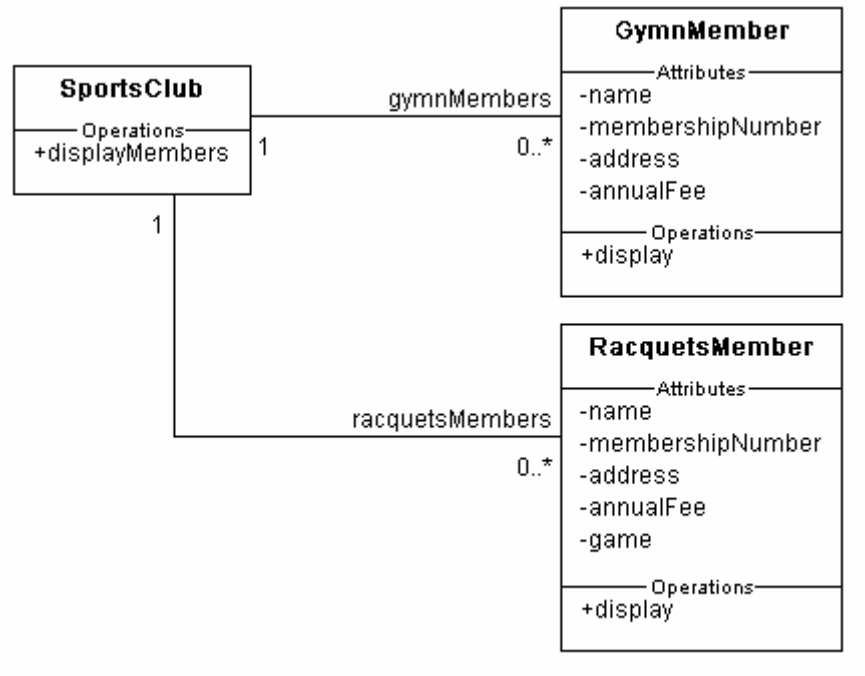
From time to time the club secretary requires a display of the details held on each member, irrespective of whether they use only the gymnasium or also play a racquet game.

The UML class diagram on the next page has been proposed as part of an object oriented design of a software system to help the club maintain its membership details.

The intent of the designer is that a SportsClub object receiving the message displayMembers can make use of the display operation of its GymnMember and RacquetsMember associates. They display the relevant attributes of a GymnMember and RacquetsMember respectively.

Redraw the diagram making at least THREE major changes to improve its design. **(10 marks)**

d) Using the UML class diagram developed in part *c)* draw a UML interaction diagram to illustrate a SportsClub object receiving the message displayMembers. **(5 marks)**



UML Class Diagram (for use in Question 5)

6. *a)* Giving your reasons, state which development style is most appropriate for the construction of a software system when using object technology. **(7 marks)**

b) Illustrate how the UML could be used to support the development style proposed in part *a)*. **(8 marks)**

c) Using an object oriented programming language with which you are familiar, show how you would implement the principles of an object oriented design, such as specialisation, association and aggregation. **(10 marks)**