

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION Diploma

OBJECT ORIENTED PROGRAMMING (Version 2)

13th October 2004, 2.30 p.m.-4.30 p.m.

Answer FOUR questions out of SIX. All questions carry equal marks.

Time: TWO hours.

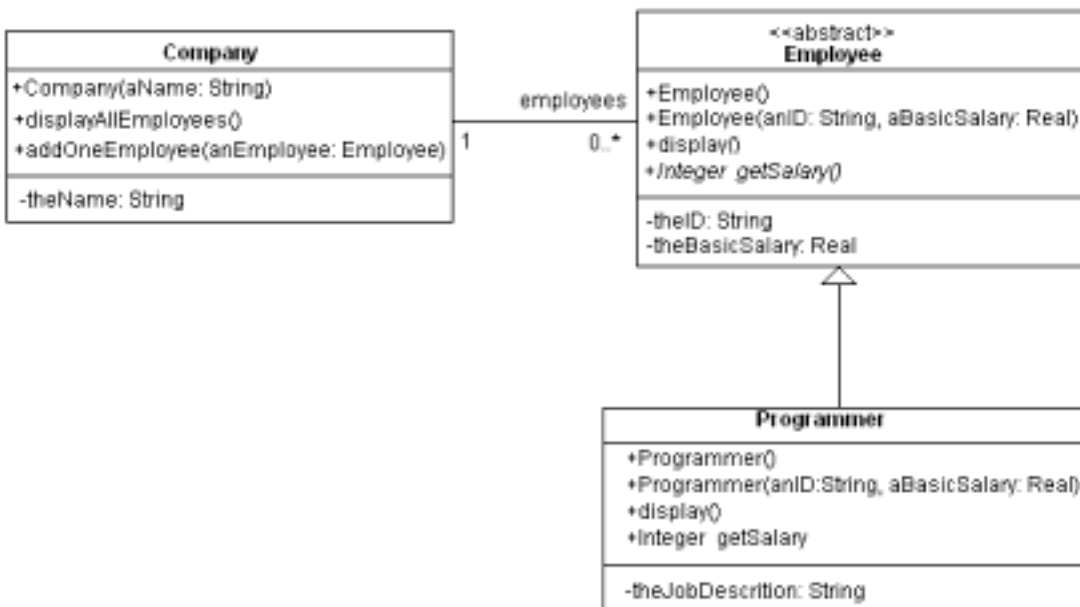
*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1. Operations and attributes of a class are given the following visibility: public, protected and private.

a) Explain the meaning of these three terms.

(6 marks)

b) Describe the information documented by the following class diagram.



(14 marks)

c) What constructs of an object oriented programming language would you expect to use in order to implement the class diagram shown in b)?

(5 marks)

Turn over]

2. a) A class is required to hold the basic details of bank accounts. The proposed `Account` class has the following instance variables:

number: Integer
name: String
balance: Integer

A class variable called `numberOfAccounts` is also required. It is incremented each time an `Account` 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 `Account` class. **(4 marks)**
- ii) Declare TWO constructors. The first should be a default constructor with no parameters that sets instance variables to either “not known” for the `Strings` or 0 for `Integers`. The second constructor should take three parameters, one for each of the instance variables. Both constructors should increment the class variable accordingly. **(7 marks)**
- iii) Show how both constructors given in ii) could be used to instantiate an object of the class `Account`. **(2 marks)**
- iv) Show the declaration of a getter method and setter method for one of the instance variables of the class `Account`. **(2 marks)**
- b) Giving your reasons, state which development style is most appropriate for the construction of a software system when using object technology. **(10 marks)**
3. a) Describe what is meant by the term *Design Pattern*. **(2 marks)**
- b) Give an example of ONE specific design pattern. Your answer should include a justification for its existence, and a description of it in use supported by appropriate UML diagrams. **(15 marks)**
- c) Using an object oriented programming language with which you are familiar, give an outline implementation of the design pattern in b). Your answer should focus on those elements that pertain to the design pattern. **(8 marks)**

4. In the following class diagram a **University** is shown as an aggregation of many **Students**. The diagram reveals that objects of the **Student** class can be sent the messages **getName** and **getAge**.



- a) Construct a collaboration diagram, showing the **University** and three students, to illustrate how the **University** would produce a list of the names of those students that are over the age of 21. Give a detailed explanation for the construction of this diagram. **(9 marks)**
- b) Show a sequence diagram for the same scenario as described in part a) of this question. Give a detailed explanation for the construction of this diagram. **(9 marks)**
- c) Describe what is shown by these two types of diagram. Identify the individual strengths of collaboration and sequence diagrams. **(7 marks)**
5. A lending library holds a large number of publications that may be books or journals. Both books and journals have a title and a unique library reference number. Each book also has an author and an international standard book number (ISBN). Journals have a date of publication and the name of the editor.
- a) Construct a class diagram for this scenario giving a detailed explanation for the resulting architecture. For each class in the diagram show the attributes that have been assigned to each. **(8 marks)**
- b) Identify the operations required by each class for the library to produce a list of publications that are currently on loan to the library's borrowers. **(8 marks)**
- c) In part a) of this question you are required to display the details of each publication. Identify within the class diagram how such a display operation might be implemented. Your answer should reveal what object oriented features are being exploited. **(9 marks)**
6. a) Explain what is meant by the following terms:
- i) Class
 - ii) Object instance
 - iii) Specialisation
 - iv) Operation overloading
 - v) Operation redefinition
- (15 marks)**
- b) Give a detailed account of the substitution principle used in object oriented systems. Your answer should include an example of how this is used. **(10 marks)**