

**THE BCS PROFESSIONAL EXAMINATION  
Diploma**

**April 2000**

**EXAMINERS' REPORT  
Object Oriented programming**

**Question 1**

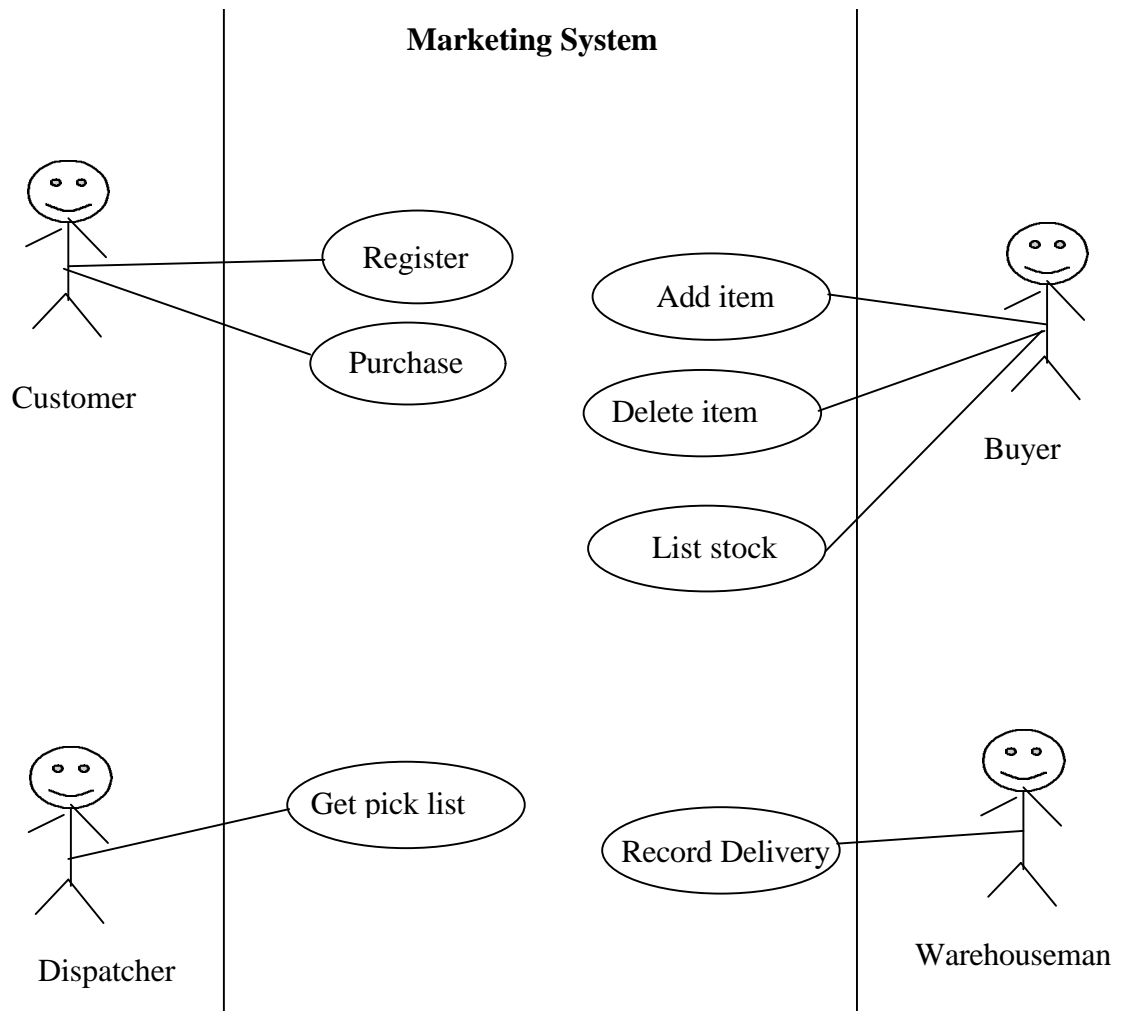
**Answer Pointers**

*An online retail company wishes to implement a Web-based marketing system with facilities to aid their purchasing and stock control. The outline requirements for the system are as follows:*

*All customers must be registered with the system. There should be a screen that allows them to do this on a fill-in-the-form basis. If they fill in all the details required and a valid email address they will be issued with a customer registration number. Registered customers may purchase online. Typically they will browse through details of the goods available and select one or more items. If an item is out of stock it will not be displayed whilst a customer is browsing. When they have selected all the items they require they can then move to a screen which enables them to enter their customer number and complete the purchase. Once ordered goods are sent to a customer by a dispatcher. Every morning the dispatcher requests a list of goods are to be sent out. The list contains the names and addresses of all the customers who have made an order on the previous day and the items they have ordered. A buyer determines the range of items that are for sale. A buyer can add new items to the online catalogue and discontinue the sale of existing items. Each morning the buyer requests a list of those items for which the quantity in stock is lower than their re-order level. Items on this list are re-ordered. When new stocks arrive they are received by a warehouseman who records the new stock levels on the computer system.*

*a) Draw a use case diagram for this system.*

*(10 marks)*



b) *Develop a use case description of the way a customer orders goods. Your answer should a normal sequence and also list some alternate sequences.*

*(15 marks)*

The normal sequence is when a customer connects to the web site, browses the catalogue, selects some items, moves to the purchase screen, enters customer number, the customer number is accepted (perhaps with password) and the order is confirmed.

Alternate sequences could be the situation where a customer orders a quantity of goods greater than the items in stock or when the customer number given is invalid.

**Examiner’s Guidance Notes:**

In part (a) candidates were expected to extract the essential details from the short case study and draw a use case diagram which represented them. Sensible alternative notations were given credit.

In part (b), on the whole candidates were able to identify a normal sequence but had difficulty imagining any alternate sequences.

## **Question 2**

### **Answer Pointers**

*You have just taken over the job as Test Team Leader for a project which is just completing the requirements phase. The development will be undertaken by three teams of six people. The project is using object-oriented techniques. There will be five increments of two months each, followed by a three month integration and system test period.*

*a) Provide a brief description of the testing approach you would use.*

*(5 marks)*

The testing approach could be the hierarchical one as described in the recommended reading or something similar.

*b) Develop an outline test plan and test schedule.*

*(15 marks)*

Candidates would be expected to develop a plan which tests the increment goals for each increment based on the use case scenarios which each increment would implement in the development plan. Test case script development should be done in a timely manner to allow review and refinement prior to the increment test period which would be the last 1-2 weeks of the increment in this case.

*c) Describe what inputs you would expect to use to develop the plan.*

*(5 marks)*

The test scripts should be based on the use cases and scenarios.

### **Examiner's Guidance Notes:**

This question was on testing. A few students made passable attempts and a small number gave model answers.

a) Most students made a reasonable attempt at describing a testing approach, though few made any reference to the recommended text on testing.

b) The student were asked to develop an outline plan and schedule. Most people restated the testing strategy. The question in fact gave some of the answer by describing the development schedule of five two month increments and a three month integration and test period. What was required was to fill this out with the test related

work items like test planning, developing test cases, test scripts and the running tests. The project was just completing the requirements phase so the test planning should start in the initial design phase. The test case development should lead the development increments so that the tests for a particular increment are ready for testing at the end of the increment.

c) The main inputs to developing the test plan are the development schedule, the requirements, such as use cases and scenarios, the design and the increment goals.

### Question 3

#### Answer Pointers

*Methods and attributes of a class have the following visibility scopes: private, protected and public.*

a) *Explain the meaning of each term.*  
(9 marks)

a)	Attribute	Method
private	Attributes can only be directly accessed by methods of the defining class.	Implementation function accessible only by the defining class.
protected	Provides access to attributes for the defining class and its subclasses.	Implementation function which is accessible by the defining class and its subclasses.
public	Anyone can access.	Anyone can access.
b)	Attribute	Method
private	The scope to use which provides greatest encapsulation, and hence the recommendation for best programming practice.	Implementation function which is special to the class and is hidden from all users.
protected	Provides encapsulation within the subclass hierarchy Gives slightly faster access than method access.	Implementation function which is provided for the benefit of subclasses. This will generally represent some abstract behaviour of the class.
public	Not normally recommended since the encapsulation is broken.	Default scope for methods providing the behaviour of the class.

Basically methods and attributes are only visible to the class in which they are defined for private; for protected they are visible in the class in which they are defined and subclasses of the defining class; and are visible anywhere for public. Additionally language specific features like friend in C++ and package visibility in Java could have been mentioned.

- b) Describe how to use each visibility scope for both an attribute and a method to meet the rules of good programming practice. (12 marks)***

Good practice is to encapsulate data, hide implementation and reduce coupling and cohesion. To achieve this, attributes and internal implementation methods would be made private and methods which support the responsibilities of a class, public. Good practice also dictates reuse and efficient designs. So trade-offs have to be made. Attributes and internal methods might be made protected so they are available to subclasses so they can be reused, this still preserves some of the encapsulation. Attributes might be made public for performance reasons or where these are standard implementations and the nature of the attribute is fixed and will not change.

- c) State what the effects of your answers, to the previous part of this question, are on maintainability and run-time performance. (4 marks)***

Using private and protected increases maintainability through encapsulation but will adversely effect runtime performance because attributes have to be accessed via method calls.

#### **Examiner's Guidance Notes:**

This question was on the visibility scope which is one the basic features of an OO language. Very few students showed a complete understanding this basic concept of OO languages.

#### **Question 4**

##### **Answer Pointers**

- a) Explain what is meant by the term 'pattern' in the context of object-oriented development.***

***(5 marks)***

A pattern is a named problem/solution pair that can be applied in new contexts with advice on how to apply it in novel solutions. Basically general principles and idioms codified in a structured format.

- b) Describe FOUR patterns with which you are familiar stating the problem they address and the basis of the solution they offer.***

***(20 marks)***

Candidates may list any four patterns they know. Here are five so called GRASP patterns as found in Larman, candidates might also produce patterns from Gamma (on the reading list) or any other text on design patterns.

Expert. Assign a responsibility to the class that has all the information necessary to fulfil the responsibility. Solves the problem of what is the basic principle for assigning responsibilities.

Creator. Assign class B the responsibility for creating instances of class A if, B aggregates B object, B contains A objects, B records instances of A object, B closely uses A objects, B has initialising data that will be passed to an A object when it is created. This is a solution to the problem of which class should be responsible for creating instances of another class.

Low coupling. Assign responsibility to classes so that coupling remains low. Solution to the problem of increasing reuse but maintaining low coupling.

High cohesion. Assign responsibility so that cohesion remains high. Solves the problem of keeping complexity manageable.

Controller. Assign the responsibility for handling a system event message to a class representing one of the following choices: represents the overall system, represents the overall business or organisation, represents something in the real world that might be involved in the task, represents an artificial handler for all system events of a use case. Solves the problem of which class should handle a system event.

### **Examiner's Guidance Notes:**

This question was not popular and where it was attempted the answers were very poor. The term 'pattern' is in the syllabus and the book by Gamma et al that appears in the reading list is the standard work on design patterns. Despite this the majority of candidates had clearly never encountered the term. As a consequence the marks awarded for this question were very low.

### **Question 5**

#### **Answer Pointers**

*Describe, the following features of an object-oriented language. Illustrate each with an example code fragment or diagram.*

a) *single inheritance* (5 marks)

Single inheritance is the ability to specify behaviour and attributes of a class as an extension of another class, the new class is called a subclass. The

relationship between the subclass and its parent ( known as a superclass ) is called an is-a relationship.

*b) multiple inheritance* (5 marks)

Multiple inheritance is the case where a class has multiple superclasses.

*c) polymorphism* (5 marks)

Candidates are expected to refer to 'polymorphic methods' or 'polymorphic interfaces', i.e., the ability of an object to respond to a message with its own implementation, and to the close relationship between polymorphism and inheritance when inherited method implementations are overridden by a subclass.

*d) abstraction* (5 marks)

Candidates are expected to define abstraction as the generalisation of the behaviour of a set of classes. Modelling an application domain's abstractions is essential for building reusable classes and components. Abstractions being encapsulated higher up the class hierarchy towards the root.

*e) specialisation* (5 marks)

Candidates are expected to refer to specialisation as the opposite of abstraction. Specializations will be towards the leaves of the hierarchy.

### **Examiner's Guidance Notes:**

This question was on the inheritance which is another basic feature of an OO language. Again very few students showed a comprehensive understanding of the basic concepts associated with inheritance.

Most people thought multiple inheritance was the case where a class has grandparents.

**Question 6**  
**Answer Pointers**

(a) *Explain the process of ‘iterative and incremental development’?*

*(8 marks)*

Candidates are expected to describe a process similar to prototyping where an application is developed in small chunks. A component of the system is quickly developed (perhaps only partially) and then tested. The component may then be revised or enlarged. Some candidates may remark that this approach is similar to Boehm’s spiral model of development.

(b) *How does incremental development help contain the risks inherent in system development?*

*(7 marks)*

The issue here is that only small parts of the system are built at any one time. In a ‘big bang’ approach success or failure cannot be assessed until the project is complete. By then an enormous amount of money may have been spent in developing the product. Incremental development reduces risk by introducing a number of points at which the success of the project and whether it is fulfilling requirements can be assessed.

(c) *Discuss the suitability of the use of object technology in an iterative development process.*

*(10 Marks)*

Object-oriented technology, by its very nature splits an application into manageable units. These are the classes which go together to make the final product. Object technology results in software with clean interfaces that can be tested in isolation. In addition once an interface has been constructed it is not necessary to produce all the code for a class at once.

**Examiner’s Guidance Notes:**

Part (a) of this question was well answered.

Part (b) – some answers were a little confused, but in general candidates understood the gains of developing systems in this way.

The majority of the candidates found the final part of the question very difficult and seemed to be unable to relate the design strategy to the tools and techniques.