

**THE BCS PROFESSIONAL EXAMINATION
Certificate**

October 2002

EXAMINERS' REPORT

Information Systems

Question 1

1. A small distribution warehouse which services all its dealers from one central warehouse needs to update its systems, with particular reference to E-commerce and E-business. These need to include on-line order processing, invoicing and payments. Six regional warehouses will be linked on-line to the central computer.

You have the responsibility of planning the analysis, design and implementation of the above system. Describe the stages and issues you would need to consider, using either a typical structured methodology, rapid application development or an object oriented approach. (30 marks)

This was an open-ended question allowing candidates a wide scope to include their experiences. It was answered reasonably well, although the candidates tended to present either the waterfall method which is well tried, but archaic, or SSADM.

Answer Pointers

Typical of all would be the setting up of steering/planning committees, implementation planning, hardware/software requirements, training and education, service/maintenance support, changeover, documentation, recovery/back-up, contingency plans, security, clerical processes, review. The appropriate stages would also need to be described briefly.

Question 2

2. a) Briefly describe and compare the main functions of the following, giving examples with which you are familiar:
- i) Spreadsheet Applications and Database Management Systems. (5 marks)
 - ii) Internet Service Providers and Multimedia Software (5 marks)
 - iii) Network Administrator and Database Administrator (5 marks)
- b) All the above need to deal with security of information. Provide a report detailing what measures you would take to ensure complete security of all aspects to do with information processing within an organisation. (15 marks)

Answer Pointers

- a) i) Spreadsheets deal mainly with the calculation and manipulation of figures, production of graphical images and are often used in the financial area of a business. Database management systems deal with manipulation of data including textual as well as numerical aspects. They also provide manipulation languages, data control and security as well as development tools.
- ii) Internet service providers provide the software appropriate for access to the world wide web (WWW) including sophisticated search engines. Multimedia software deals in text, sound, picture, video and other forms of media that can be designed and manipulated.
- iii) The network administrator is responsible for technical aspects of the network whilst the DBA supports the database. Both deal with security, control, performance etc
- b) All aspects need to be included for both hardware and software, the environment etc. Typical areas - usernames, passwords, roles, user views, encryption, pin numbers, firewalls, locks, computer room security, back-up, fire proof safes, contingency plans, disaster recovery, modern approaches such as retina scans, palm/finger print/voice recognition.

Question 3

3. a) **A Computer Shop that sells hardware and software applications is to set up a Help Desk on its web site for customers with problems or complaints. Information received is to be stored on a database for subsequent solution and analysis.**
- i) Draft the website screen(s) where the customer can record the details of the query/complaint. (5 marks)**
- ii) Describe the techniques you would suggest to make sure the screen is easy to use. (10 marks)**
- b) **Fact finding techniques such as interviews and questionnaires would be required to enable you to design the above system.**
- i) Draft a memo to your manager describing the benefits and drawbacks of using these techniques. (12 marks)**
- ii) Give an example of an 'open' question and a 'closed' question which could be used in your questionnaire. (3 marks)**

Answer Pointers

- a) i) Simple, well designed screens are expected, with appropriate field headings, help facilities, navigation aids etc.
- ii) Ease of use is assisted by colour, clarity, consistency, simplicity, continuity, commonality, good help facilities, navigation aids. Screens should be designed using familiar terminology working from top to bottom and left to right.

- b) i) Advantages of interviews : Can be structured, personal, good for obtaining ideas, problems
Disadvantages: Reactive, can be off putting, demotivating, time consuming etc

Advantages of questionnaires: Good for obtaining detail, can be used for many sources, geographical

Disadvantages: difficult to design, response is poor

ii) An open question is one, which allows opinions, and full answers e.g. What are the problems with the system?

A closed question is one that expects a simple answer e.g. How many customers do you have?

Question 4

4. a) **Data modelling techniques are used in data driven methodologies to build a stable data model.**
- i) Describe the elements of a logical data model (entity-relationship model). (6 marks)**
 - ii) Describe the three stages of normalisation. (9 marks)**
- b) **The following is a list of data items describing projects and personnel linked to those projects. Each project may have more than one person allocated to it. The date-joined refers to the date the person joined the project. The allocated-time indicates the length of time a person is allocated to a project. Each person is on a single job grade. One salary scale may apply to a number of grades, but a given grade will only apply to one salary scale.**

**Project code
Project type
Project description
Personnel no
Name
Grade
Salary-scale
Date-joined
Allocated-time**

- i) Produce a logical data model (entity-relationship model) depicting the above scenario. (6 marks)**
- ii) Describe the three stages of normalisation (9 marks)**

Answer Pointers

- a) i) An entity is something about which the system needs to know and record. Attributes are individual atomic descriptions which describe the entity. Relationships are linkages between different entities or an entity and itself. The degrees of relationship are 1:1 (one to one), 1:M (one to many) or M:N (many to many), they can also be optional or mandatory (also known as contingency). Many to many relationships cannot be physically supported and therefore have to be resolved using an intersection entity. Examples are entity customer and order. Customer number, name and address are examples of the customer entity. The relationship

between customer and order would be one to many, a customer places more than one order and an order can only be placed by one customer.

ii) The three stages of normalisation are : 1NF - a relation is in 1NF if it contains atomic values and all repeating groups are repeated. 2NF - a relation is in 2NF if it is in 1NF and every non-key attribute is fully dependant upon the primary key. 3NF - a relation is in 3NF if it is in 2NF and every non-key attribute is non-transitively dependant on the primary key.

- b) The model should contain : Project, Person, Allocation (person to project), Grade. The latter may be undiscovered, often found in normalisation.

The normalised relations. 1NF - Project code, Project code/personnel no. 2NF - Project code, Project code/personnel no, Personnel no. 3NF - (Project) Project code, (Allocation) Project code/personnel no, (Person) Personnel no, (Grade) Grade

SECTION B

Answer FIVE questions out of EIGHT. All questions carry equal marks.

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

- 5. Explain the differences between the following terms that are used to describe the characteristics of a column in a database table:**

**Data Type,
Primary Key,
Domain Constraints,
Null Values.**

(4 x 3 marks)

Generally satisfactory answers with some noticeable weakness in understanding of check constraints and why they may be implemented. Given that the other constraints were understood it should have been reasonable to assume what a check constraint was used for.

Answer Pointers

Columns in database tables have data types similar to variables in a programming language; e.g. as integer or string. However the declarations pertain to a common domain used to define many columns in a table similar to an abstract data type.

Primary Key defines the identifier of a row, ensuring its values are unique - the entity integrity constraint.

Check or Domain Constraints are used to validate/check ranges of values within a column. This constraint is not obligatory but is useful for validating input data.

Null Values are data values that are not defined (they are NOT zero or null strings). Most of the time NULL values are allowed (by default) otherwise they are specified as a constraint (NOT NULL) and applied to values in a column. Again this is a useful

constraint that can be used for validating input data. Columns which act as Keys cannot have Null values.

Question 6

6. **With reference to a software package with which you are familiar, describe briefly THREE built-in software tools that could be used to support the software development life cycle of an information system.**

Explain how the different software tools integrate together during development.

(12 marks)

A varied set of answers many of which missed the point of the question. Some candidates thought that 'utility' packages such as MS Word and Powerpoint were development tools. These are not the best examples and would not score high marks. At the other extreme some candidates only mentioned techniques but did not reference anything about the practical use of a package. Candidates should consider development tools they would use to build robust information systems.

Very few candidates could explain how their chosen software tools could be integrated during the development process.

Answer Pointers

The most important and obvious being:

Middleware: Typically a programming model that provides a separate layer of processing independent of the user interface and persistent data organisation. Used in both single and multi-user processing and provides the tools to link a user interface (client software) and to a database.

Report and Code Generators: This is a software tool supported by most IS packages that provides the automatic code generation facilities specific to presentation of hard copy reports. This is an essential tool that originated in now quite old mainframe packages such as RPG.

CASE tool: Computer Aided Software Engineering, a tool which supports the analyst in the management and development of a system design including graphical tools to support drawing of models to support DFD/ER models. Most CASE tools support such things as Schema generation and code templates.

Integration is a key part of the question and candidates were expected to be aware of how middleware can act as the main coordinating and connecting software packages to make the development tools work together. Thus in a Microsoft Office environment, software such as OLE, ActiveX act as middleware.

Question 7

7. **Describe THREE different project management techniques and state the advantages and disadvantages of each.**

(12 marks)

A few candidates misunderstood the question with an explanation of management techniques with no software/IS element context. Also questionnaires, observation - subjective, personal record keeping, etc with no IS context.

Answer Pointers

Three possible project management techniques are:

Network Analysis/Diagrams

Pert Diagrams

Gantt Charts.

Diagrams illustrating these techniques would be expected to reduce unnecessary writing.

Advantages and disadvantages are determined largely by the application area and this should be stated.

Question 8

8. With the aid of examples outline the main differences in modelling/describing an information system provided by each of the following design techniques:

- a) A High Level Data Flow Diagram versus a UML Use Case Diagram.**
- b) An Entity Relationship Diagram versus an Object Oriented Class Diagram.**

(2 x 6 marks)

Generally satisfactory though there was an over reliance on diagrams. There should be comments to support illustrations. Illustrations always need some comment to indicate what the illustration is trying to convey.

Answer Pointers

- a) DFD-> Process flow with emphasis on data sources and providers/consumers (processes) of that data. Associated with structured methods such as SSADM. Diagrams should emphasise the contrasts in these techniques.

UML-> Emphasis more on users as participants of an IS and consequently processes are seen as scenarios with step-wise dialogue with users. Emphasis on OO methods such as UML.

Both provide context models and different views of the process model.

- b) OOA is a more subjective and conceptual approach with a top-down approach of discovery/trial/error.

OOA is complete enough to produce the same design objectives as the more formal approach of ERA and both are used interchangeably. The benefits of both methods of design are that they use similar concepts in data modeling terms, though the ERA is a more database oriented design approach, but both techniques are ultimately limited by the role of Functional Dependencies as applied to data normalisation. Thus Entity Type = Class; Tuple = Object etc.

Question 9

9. Figure 1 (below) is an extract of a Table stored in a Relational Database. This Table is used in a Library and is intended to show the status of books; i.e. they can either be Reserved, On Loan or available for loan/reservation. A loan is indicated by an entry for the Borrower number and Borrower Name. The ISBN is a simplified representation of the international standard book number uniquely identifying all published material.

Outline how you would re-structure this information in order to solve the following problems:

- i) It is unclear how many copies of the same Book there are in the library.
- ii) It is difficult to add more than 2 co-authors for a book.
- iii) There is redundant duplication of data.
- iv) Information about the status of loans/reservations is missing and/or inconsistent.

(4 x 3 marks)

Author 1	Author 2	Book Title	ISBN	Borrower Number	Borrower Name	Return Date	Classification
K.Chan	D.Yeo	Visual Basic	233-7	RESERVE D	S.King		602.758
K.Chan		Java Basics	233-9				621.7
K.Chan	J.Hope	Begin .NET	296-8	1090	P.Hill	1-9-02	611.490
D.Yeo		Visual Basic	253-9	1192	S.King	2-9-02	602.758
D.Yeo		Visual Basic	253-8				602.758
D.Yeo		Visual Basic	303-3	RESERVE D	P.Hill		602.758

Figure 1. Library Loans/Reservations

Very poor answers in general. The question was not about normalisation per se but organising data that satisfies the basic rules of the relational logical model. This is reflected in ensuring:

atomicity, primary key and foreign key constraints, non-redundant data duplication.

This type of question has appeared before and similar comments were made then. Candidates need to read the question carefully to work out what is being asked rather than try to produce a stock answer.

Answer Pointers

- i) Need another Table listing the copies linked via the ISBN, record the CopyNumber and the loan status there. Note the number of copies is not required as each record entry is identified by a CopyNumber.

- ii) Adding another row would violate PK constraint thus add another table specifically holding co-authors.
- iii) Remove redundancy by using another Table to ensure identifiers identify corresponding attributes
- iv) Need separate loan and reservation tables indicating at the same time what is on loan and what is reserved and by whom.

Question 10

- 10. Describe briefly THREE different ways in which the integrity of data in a computer system could be compromised when the same item of data is held simultaneously in different computers located at different places within the organisation. State the techniques that are used to preserve data integrity. (4 x 3 marks)**

A number of candidates misunderstood the question thinking that integrity meant the very narrow view of relational database integrity. It was surprising to see this misreading of the question, therefore if there are no specialised requirements/features in the question always answer in the most general terms.

Answer Pointers

1. Replication Anomalies
When data values are replicated, possibly at different sites, from data in the same table then there is a possibility of inconsistency. More often than not the redundancy can be removed by applying a replication strategy and latency of publishing updates etc.
2. Transactional Consistency (ACID) no longer applies
3. Breach of security during transfer/transmission

Question 11

- 11. Explain using diagrams, how the following indexing techniques accommodate the insertion of records to a file:**
- a) B-tree indexed file
 - b) Indexed Sequential file
 - c) Inverted file
 - d) Random or Hashed file

(4 x 3 marks)

Diagrams are essential to convey the structure and processing techniques. Most noticeable was the lack of knowledge of B-trees. Inverted files are more associated with bibliographic databases and again candidates seemed to be unfamiliar with these important 'background' processing mechanisms.

Answer Pointers

B-tree is a type of dynamically balanced tree that is set up in which the index reference to the file store is held in each node (leaf). This enables a minimum search path and associated access of related strings of records. Thus when a new record is added it is ordered sequentially with the nodes re-balanced.

Indexed sequential index structures combine random and sequential access but this structure can become very inefficient when inserting is frequent as overflow blocks are required which affect efficiency for retrieval/update.

Inverted utilises secondary indexes to form an access path to an index determined by associating similar terms/values as the one added, used in document retrieval by keyword search.

Random would involve looking up corresponding indexes and associating the index with a value on the primary key using a hashing algorithm. This technique can be extended for cellular multi-lists.

Question 12

12. Suppose you were required to build a User Interface that allows a student to access a university library using the world wide web (WWW). Your user interface should support a user who wants to search for a book and then reserve a book which is held in the library catalogue. Assume the student has already logged in and has been authenticated as a member of the university library.

Sketch out an appropriate user interface and show how each of the following GUI controls would be used in your user interface:

- a) Check box**
- b) Command Button**
- c) Drop down list**
- d) Radio or Option Buttons**

(4 x 3 marks)

In general candidates had thought out the design. The best answers included a couple of screens to give an idea of the functionality and processing states. These screens could be :

- a data capture screen*
- a result (post of data from web server) of sending the requested data.*

Answer Pointers

A range of screens showing the dialogue with the use of prompts, text boxes, drop down menus etc. Varieties of screen dialogues should be presented for things such as messages, choosing selection of objects, clicking a mouse, pausing execution etc.

Thus appropriate use of the following controls was looked for across many possible answers:

- a) Check box - multiple selections possible depicted as a cross when enabled, blank otherwise
- b) Command button - on clicking this button some action is performed; used to switch control or perform regular operation
- c) Drop-down – selection from a list of options useful for validation and an alternative to using input fields
- d) Label/trim – uses a screen editor to allow text to be associated with a control such as a field. The text can be turned off or changed depending on context of the interaction