

BCS The Chartered Institute for IT

THE BCS PROFESSIONAL EXAMINATIONS

BCS Level 6 Professional Graduate Diploma in IT

ADVANCED DATABASE MANAGEMENT SYSTEMS

Tuesday 20th April 2010- Morning

Answer **any** THREE questions out of FIVE. All questions carry equal marks.

Time: THREE hours

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

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

Calculators are NOT allowed in this examination.

Section A

Answer Section A questions in Answer Book A

A1.

Refer to the discourse in Appendix A

a) Explain, aided by example SQL code, how each of the following programming constructs could be used to provide data integrity in the application supplied in Appendix A:

- Check Constraints
- Triggers

Justify your answer.

(15 marks)

b) One of the contestants complains they should have won at least a share of a prize because when they checked their answers they were correct for a particular competition. Having investigated the matter the complaint is found to be genuine. Indeed someone reported a similar problem occurred before. It is suspected there are faults in the database software as other possible causes such as human error and a breach of security have been discounted.

You are the leader of an external database investigative technical team charged with identifying possible causes of this breakdown of database integrity.

Write an account of the procedure you would follow to identify the cause of this breakdown of database integrity. Suggest possible policies and procedures that the company should follow in order to avoid breakdown of database integrity arising in the first place.

(10 marks)

A2.

a) Describe two different strategies, one efficient, one inefficient that a query processor could use to compute the following relational operation:-

$R \bowtie S$ (where R and S are relations)

(8 marks)

b) Apart from Relational Join describe FOUR other relational algebra operations. For each relational algebra operation you list, illustrate the result of applying it to the following set of relations using your own data samples.

r (A, B, C)

s (C, E)

(10 marks)

c) Although it is theoretically possible to query a relational database using relational algebra, in practice the vast majority of users use a language based on relational calculus. Describe the main features of relational calculus and its relationship to relational algebra.

(7 marks)

A3.

a) With reference to the discourse given in appendix A describe the characteristics of the infrastructure for mobile computing, and explain how database systems could operate within it.

(10 marks)

b) Discuss some of the areas of difficulty in providing mobile database services and how these may be overcome with particular reference to the discourse. State any assumptions you make.

(15 marks)

Section B

Answer Section B questions in Answer Book B

B4.

W3C working group has published specifications of XML encryption and XML signature in the area of XML security.

a) Explain the purpose of each of these specifications.

(10 marks)

b) Indicate which specification is used in the following XML code listings (Listing#1 and Listing #2) and explain the main functions provided by the code.

(15 Marks)

Listing #1: XML code examples in XML security

```
<?xml version= '1.0'?>
<EncryptedData xmlns='http://www.w3.org/2001/04/xmlenc#'
MimeType='text/xml'>
  <CipherData>
    <CipherValue>A23B45C56</CipherValue>
  </CipherData>
</EncryptedData>
```

Listing #2: XML code examples in XML security

```
<Signature ID?>
<SignedInfo>
  <CanonicalizationMethod/>
  <SignatureMethod/>
  (<Reference URI? >
    (<Transforms>)?
    <DigestMethod>
    <DigestValue>
    </Reference>)+
  </SignedInfo>
  <SignatureValue>
  (<KeyInfo>)?
  (<Object ID?>)*
</Signature>
```

B5.

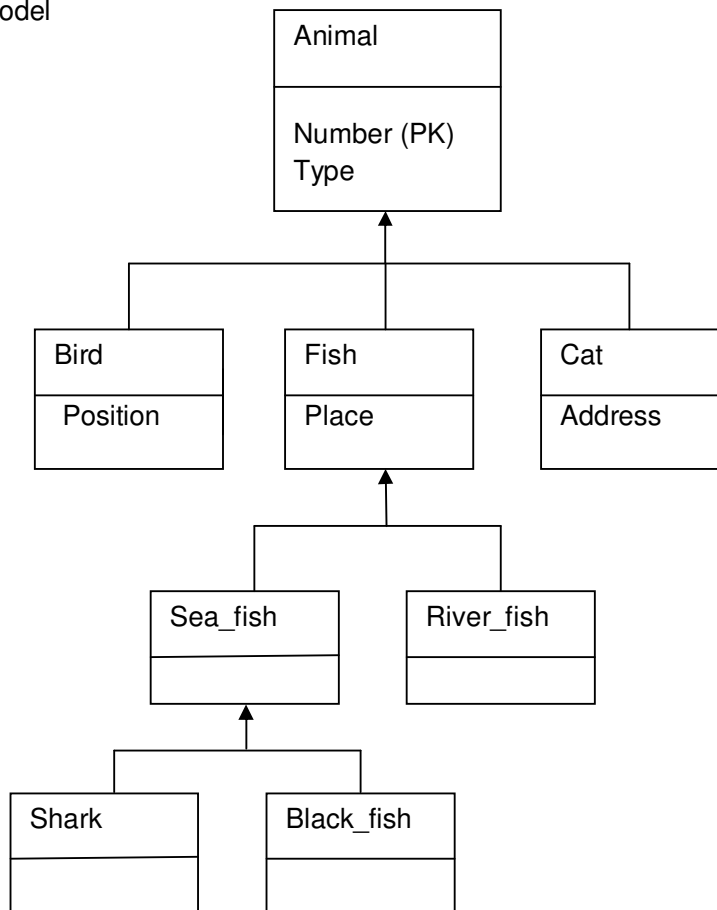
a) Specialisation and generalisation are concepts used in enhanced entity relationship – EER model. Explain the why these concepts are important in EER modelling.

(5 marks)

b) In the following data model (figure 4.1), specify which entity plays a role in specialisation and which entity plays a role in generalisation.

(10 marks)

Figure 4.1 Data Model



c) Using EER concepts write a program (using pseudo-code) that will define the structure of the above data model.

[10 Marks]

Appendix A: Discourse

A database application is required for a company that runs on-line competitions on the WWW. A central database stores past, present and future data on the following-

- *Competitions, Quizzes, Games and Puzzles.*
- *Quiz rounds, questions and answers/solutions.*
- *Contestants including their name and their contact details.*
- *Prize winners and the prizes they have won and their value.*
- *Fee income and the profit made for each competition.*

A contestant with a mobile device (such as an iphone, PDA) enters a competition with the goal of winning a prize. Contestants pay a fee to enter each competition during the time the competition is open (a competition is open for 10 days). After logging/registering with the competition web site a contestant chooses from a list of puzzles and quizzes which they must complete and answer correctly in order to win or share a prize. Each competition consists of:

- *a quiz consisting of 5 rounds with 6 questions in each round. Each round is on a different topic selected from sport , politics, music, geography, literature, history and science.*
- *a collection of 6 puzzles. For example there may be 2 crosswords (word puzzles) , 4 Sudoku puzzles (numeric puzzles).*

There are answers/solutions corresponding to each quiz and puzzle. For example every question has an answer and every puzzle has a solution. Every quiz and puzzle is unique and is never used again in any other competition. A prize is awarded to the successful contestant(s), or the value of the prize shared if there are multiple winners for each competition.

The same type of prize may be awarded in different competitions e.g. a car may be awarded in a different competition; but a particular car will only be won once. Occasionally there may not be a prize winner for a particular competition in which case the prize is rolled over to the next competition.

Contestants may enter the same competition or other competitions as many times as they like.

The company has revenue from competitor fees that when totalled up normally exceed overheads including the cost of prizes. They can offset the cost of some prizes by advertising or receiving sponsorship from companies that supply prizes.