

BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 6 Professional Graduate Diploma in IT

ADVANCED DATABASE MANAGEMENT SYSTEMS

Monday 23rd September 2013 – Afternoon

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

- a) In your own words, describe what is meant by the terms '*two-phase locking*' and '*serializability*' before elaborating on how the former ensures the latter. You should supply any suitable examples and/or diagrams that you deem appropriate to support your answer (hint: discuss the two distinct phases of two-phase locking and the role of serial and interleaved schedules).

(10 Marks)

- b) Using your own simple examples and/or diagrams, describe the potential problems that may occur in a multi-user database if concurrency control techniques are not fully implemented (hint: how data may be damaged or lost, supported by a time-line diagram of two transactions accessing the same database).

(10 Marks)

- c) For each of the following transaction management terms, write a single sentence explaining the key idea. You are not expected to supply any examples or diagrams. Each is worth one mark (hint: only write a *very brief* description for each – no need for extended responses, examples or diagrams).

- Schedule
- Cascaded rollback
- Optimistic locking
- Pessimistic locking
- Checkpoint

(5 Marks)

Turn Over]

A2

- a) Describe the different methods & tools that an end-user may use to interact with a data warehouse, briefly highlighting the primary purpose of each (hint: how different *categories* – not specific products - of tools are used for different data extraction purposes).
(5 Marks)
- b) A data warehouse may be implemented using a traditional RDBMS. However, due to the specific needs of a data warehouse and the large amount of data involved, the RDBMS must support a range of advanced features over and above the standard OLTP database requirements. Discuss these features (hint: focus on how a data warehouse is used differently to view data and how that data is stored).
(10 Marks)
- c) Using a simple example of your own choosing, explain and demonstrate the similarities and differences between the entity-relationship model used to build an OLTP database and the star schema model used to design a data warehouse. You should particularly address the roles of primary and foreign keys, normalized & de-normalized data and conclude by explaining what a snowflake schema is. Good diagrams are essential (hint: think how primary and foreign keys are used, the relative size of the different tables in a star schema, how aggregation relates to these tables and how dimensions can have dimensions).
(10 Marks)

A3

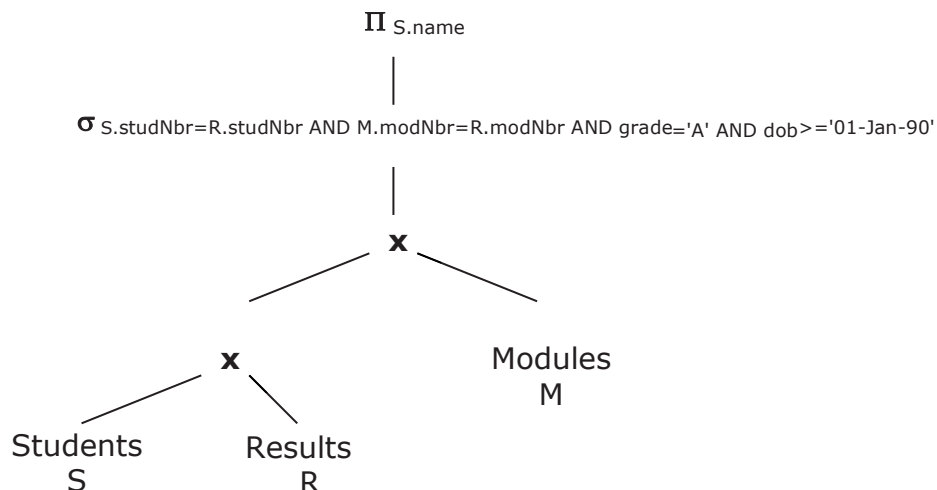
- a) Consider the following three linked relations:

Students (studNbr, name, dob)
Modules (modNbr, title)
Results (studNbr*, modNbr*, grade)

Suppose we have the following query:

```
SELECT S.name
FROM Students S, Modules M, Results R
WHERE S.studNbr = R.studNbr
AND M.modNbr = R.modNbr
AND R.grade = 'A'
AND S.dob >= '01-Jan-90';
```

Also suppose that an initial parse tree for that query is as shown below:



Turn Over]

Apply a series of transformations to this parse tree to make it more efficient.

Note: \times = Cartesian product, Π = projection, and σ = selection

(13 marks)

- b) In the context of database security, explain the concepts of “Authentication” and “Authorisation”.

(4 marks)

- c) Building indexes is one way of tuning the performance of a database. In the literature, we sometimes find guidelines on when to build such indexes. Give a brief explanation of each of the following guidelines:

i) Avoid indexing small tables

(2 marks)

ii) Build an index for a foreign key

(2 marks)

iii) Avoid indexing a column that is frequently updated

(2 marks)

iv) Build an index for a column that appears in the ORDER BY clause of a query

(2 marks)

Section B

Answer Section B questions in Answer Book B

B4

- a) Describe the reasons for the emergence and increasing use of SOA (Service Oriented Architecture) to support a database application with which you are familiar.

(7 marks)

- b) Discuss the role that databases play in this architecture.

(6 marks)

- c) "XML can be generated in code from a database without any installed XML software."
Explain how the above statement could be realised using either sample code of your own or the following code sample that has been provided.

(12 marks)

CODE SAMPLE

```
<%  
response.ContentType = "text/xml"  
set conn=Server.CreateObject("ADODB.Connection")  
conn.provider="Microsoft.Jet.OLEDB.4.0;"  
conn.open server.mappath("/db/database.mdb")  
  
sql="select fname,lname from tblGuestBook"  
set rs=Conn.Execute(sql)  
  
response.write("<?xml version='1.0' encoding='ISO-8859-1'?>")  
response.write("<guestbook>")  
while (not rs.EOF)  
response.write("<guest>")  
response.write("<fname>" & rs("fname") & "</fname>")  
response.write("<lname>" & rs("lname") & "</lname>")  
response.write("</guest>")  
rs.MoveNext()  
wend  
  
rs.close()  
conn.close()  
response.write("</guestbook>")  
%>  
<guestbook><guest><fname>Terje</fname><lname>Beck</lname></guest>
```

Turn Over]

B5

Given the UML Class Diagram in fig A1 below.

- Identify and describe each of the **THREE** types of relationship expressed in this diagram
(6 marks)
- Explain using an example the differences between aggregation and composition.
(4 marks)
- Treatment of a patient often follows a diagnosis of a patient's illness. How you would add this to the diagram/model
(4 marks)
- With reference to Figure A1, derive a set of relational database tables, showing only the primary and foreign keys
(6 marks)
- Explain how you reconciled the differences between the Relations and Classes.
(5 marks)

Fig A1 UML Class Diagram

