

**BCS THE CHARTERED INSTITUTE FOR IT**

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

**ADVANCED DATABASE MANAGEMENT SYSTEMS**

Monday 28<sup>th</sup> September 2015 - 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.

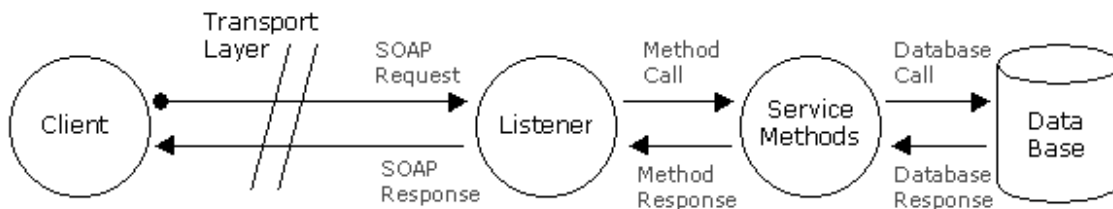
**Section A**

**Answer Section A questions in Answer Book A**

**A1**

Consider the following diagram (Fig A1) then answer the question parts a) and b) that follow.

Fig A1 Service Oriented architecture (SOA) supporting a client server database application



- Briefly describe a database application that would benefit from using the above system architecture. **(5 marks)**
- Describe the function and purpose of the above schematic diagram explaining how the various components support the database application that you have described in your answer to part (a). Include example code related to your application. **(10 marks)**
- Discuss the main challenges that a service oriented architecture has on a database management system. **(10 marks)**

## A2

Assume a journal library database holds the following Tables (with sample data) at a central site on a database server called (CTR)

### JOURNAL

JournalID	JournalName
3215	Database Weekly
3216	Database Journal
3217	Oracle News
3218	ACM TODS

### ARTICLE

ArticleID	ArticleTitle	AuthorID	JournalID
3215	ObjectOriented Analysis	23	3216
2409	Oracle indexing	18	3217
1398	DBA performance tools	23	3216
1289	Pioneers of Databases	23	3215
2554	Query optimisation	67	3216
1678	Daplex	18	3218

### AUTHOR

AuthorID	AuthorFName	AuthorSname
23	Norman	Gray
18	Carlos	Santos
67	Modrich	Neuman

### LOAN

ArticleID	BorrowerID	LoanDate	ReturnDate
2409	43	3/1/15	4/2/15
1398	43	3/1/15	24/1/15
1289	17	6/2/15	8/2/15
2554	26	1/2/15	12/2/15
2409	43	14/2/15	
2554	52	14/2/15	

### BORROWER

BorrowerID	BorrowerFname	BorrowerLname	BorrowerTelNo
A52	Jane	Green	0156387562
43	Fred	Briggs	01985-86722
17	Henry	Dhura	01582-74238
26	Jonas	Smith	01933-632001

The above tables are currently held on a database at the single site called CTR.

Following reorganisation it is intended to distribute the journals held at the central database across 3 new branch libraries located at remote sites called GTR; UTC and TWE. The central library becomes the HQ (an administrative centre) meaning that it no longer keeps or loans out any journals itself. Instead journals are made available for loan to borrowers registered at any of the 3 new sites.

- a) Briefly Describe in general terms THREE different approaches of achieving database distribution. **(6 marks)**
- b) Describe in detail THREE different proposals for data distribution of the central database (CTR).  
Hint: Show the distribution/replication of table fragments/partitions and explain any trade-off and pros/cons you think are relevant. **(12 marks)**
- c) Describe the criteria you would use to assess the effectiveness of your approach. **(7 marks)**

### A3

- a) Given the following three linked tables:

```
Customers (custID, name, address)
Products (prodID, price)
Orders (orderID, custID*, prodID*, date)
```

And the following query:

```
SELECT Customers.name
FROM Customers, Orders, Products
WHERE Customers.custID = Orders.custID
AND Orders.prodID = Products.prodID
AND Orders.date = '15-Jan-14'
AND Products.price > 100;
```

Draw a query tree that corresponds to the most efficient way of processing this query. **(11 marks)**

- b) Database security aims to minimise the loss of:

- Data Confidentiality
- Data Integrity
- Data Availability

- (i) Describe each of the above concepts **(6 marks)**
- (ii) Explain how each of the following mechanisms contribute to providing security for a database:  
  - Authorisation
  - Views
  - Backup and Recovery
  - Encryption**(8 marks)**

## Section B

### Answer Section B questions in Answer Book B

#### B4

- a) Using your own simple examples and/or diagrams, describe the potential data integrity and consistency problems that may occur in a *multi-user* database if *concurrency control* techniques are not fully implemented. You should comment specifically on:
- (i) Transaction scheduling techniques between parallel database operations **(5 marks)**
  - (ii) The use of time-line diagrams to model two or more transactions accessing the same database **(5 marks)**
  - (iii) The distinction between, and issues caused by, accessing committed and uncommitted data **(5 marks)**
- b) In your own words, describe what is meant by the following terms:
- (i) Two-Phase Locking **(3 marks)**
  - (ii) Serializability **(3 marks)**
- You should elaborate on how the former ensures the latter. You should supply any suitable examples and/or diagrams that you deem appropriate to support your answer.
- c) *Briefly* describe the various locking options available to a DBMS as part of the concurrency control function, paying particular attention to the granularity of the locking, the nature of the locks and the allowable operations and what happens when deadlock occurs. You should supply any examples or diagrams as you deem suitable (hint: think about the performance issues of different lock types too). **(4 marks)**

#### B5

- a) Explain, using your own simple examples where appropriate, what each letter ('E', 'T' and 'L') of the term 'ETL' means with respect to data warehouses, taking care to highlight common problems or issues in each stage. **Two marks per letter. (6 marks)**
- b) Describe *at least three* different methods or 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). **Two marks each. (6 marks)**
- c) Briefly describe the following data warehouse features:
- (i) Summary Management **(3 marks)**
  - (ii) Analytical Functions **(3 marks)**
- d) Using simple examples and/or diagrams of your own choosing, explain and demonstrate the similarities and differences between:
- Entity-Relationship Models
  - Star Schemas
  - Snowflake Schemas
- You should particularly address the roles of primary and foreign keys plus the role of normalized and de-normalized data on determining the number of dimensions in a given model. **(7 marks)**