

BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

DATABASE SYSTEMS

Monday 8th April 2013 - Morning

Answer FOUR questions out of SIX. All questions carry equal marks

Time: TWO 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) A dentist uses forms, such as the ones shown below, to keep a record of treatments given to patients. Each patient has a number, name, and a category (for example, adult, child, pregnant...). A patient can receive many treatments on the same day, but we will assume that the same treatment is not administered twice on the same day. For example, a patient cannot have two extractions on the same day.

Dentist Appointment Form		
Patient Number: P102 Patient Name: John Smith		
Patient Category Number: 1		
Patient Category Description: Adult		
Appointment Date	Treatment ID	Treatment Description
13-Aug-2011	T05	Root canal
13-Aug-2011	T03	Extraction
22-Nov-2011	T03	Extraction

Turn over]

Dentist Appointment Form		
Patient Number: P104 Patient Name: Ashok Kumar Patient Category Number: 2 Patient Category Description: Child		
Appointment Date	Treatment ID	Treatment Description
13-Aug-2011	T05	Root canal
27-Oct-2011	T03	Extraction

- (i) Identify any repeating groups in the above representation and describe how they can be removed to produce a table in first normal form (1NF). Show the obtained 1NF table filled with the data shown above. Identify the key attributes of this relation.

(6 marks)

- (ii) If left un-normalised, the table obtained in (i) could lead to some inconsistencies (anomalies). Give an example of inconsistencies that may occur in this table as a result of:

- Update operation
- Delete operation

(4 marks)

- (iii) Normalise the relation obtained in (i), showing functional dependencies and how you progress from 1NF through 2NF to a set of 3NF relations.

At each stage show the primary key and any foreign keys of each relation and state assumptions that you make about any of the relationships between the columns of data.

(10 marks)

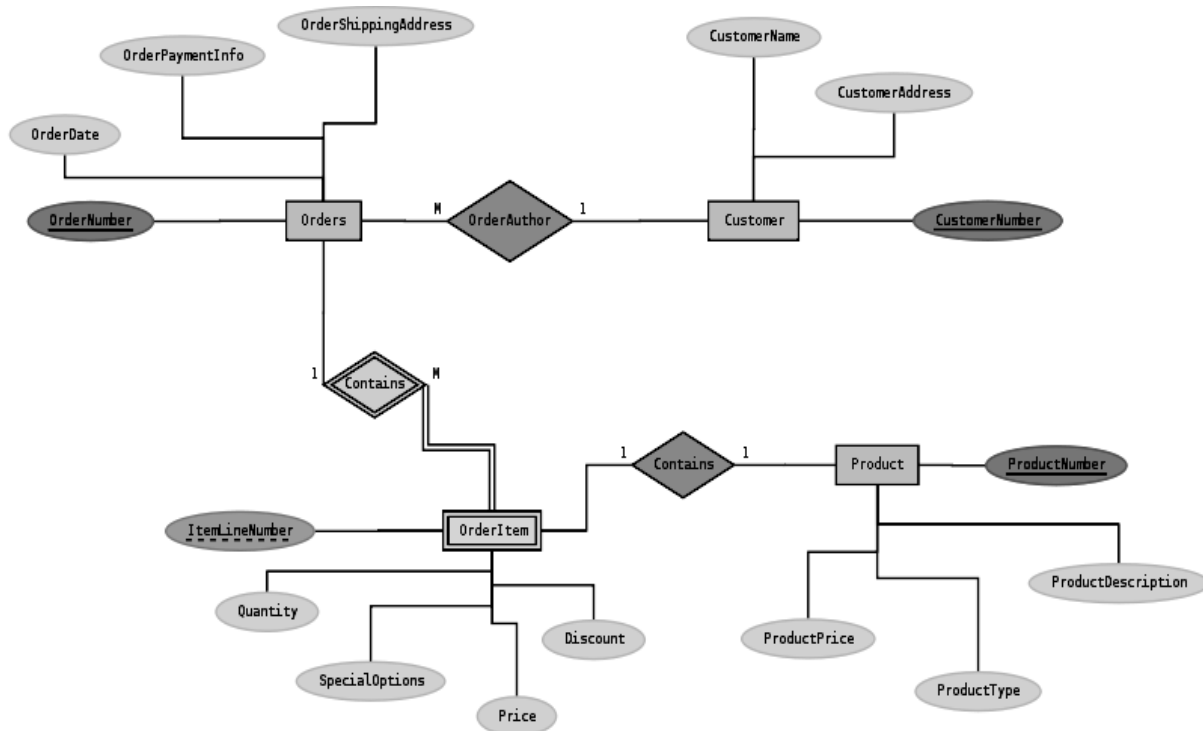
- (b) Describe the approach taken to the handling of data in the early file-based systems. Discuss the disadvantages of this approach.

(5 marks)

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A2

Refer to the following ER model which represents an order processing application.



(a) Using the ER model above give an example of EACH of the following modelling concepts:

- i) Entity Type
- ii) Entity occurrence
- iii) Key Attribute
- iv) Relationship
- v) Cardinality

(5 marks)
1 mark per example

(b) Using a defined ER modelling notation, explain how you would extend the ER model to represent :-

- i) An optional participation constraint in a relationship.
- ii) A mandatory participation constraint in a relationship.

(6 marks)

(c) Using examples derived from the ER model explain the difference between :-

- i) Strong and Weak Entity Types
- ii) Binary and Ternary Relationship

(6 marks)

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- (d) Discuss the validity of the restrictions imposed by the relationship between Orders and Products if this model was applied in a practical order processing application. Provide example data to assist in your answer.

(3 marks)

- (e) Why is it good practice to resolve M:N relationships in an ER model? Give an example from the ER model above where a M:N relationship has been resolved.

(5 marks)

A3

The following tables define the relationship between STREETS and JUNCTIONS at which STREETS intersect.

STREETS	
Street	name

S1	Grange Road
S2	High Rise
S3	Morton Ave
S4	Muston Lane
S5	Borrowby Court
S6	Fell Road

JUNCTIONS		
junctionID	loc1	loc2

1	S1	S3
2	S1	S4
3	S2	S3
4	S1	S5
5	S2	S5

- (a) Show with the aid of a sketch the intersection of streets at junctions.

(5 marks)

- (b) Show your working, determine what output is produced by each of the following SQL queries.

(6 marks)

Query1:

```
SELECT DISTINCT Name
FROM Streets x, Junctions y
WHERE x.street = y.loc2
```

Query2:

```
SELECT Name FROM Streets x
WHERE x.street NOT IN
(SELECT y.loc2 FROM Junctions y)
```

- (c) Explain the overall function of each query.

(6 marks)

- (d) Using the above sample data, give an example of an SQL query that would utilise the GROUP BY and HAVING operators.

(8 marks)

Section B

Answer Section B questions in Answer Book B

B4

- (a) *With reference to a sample relation of your own choosing*, explain and discuss the following relational model terminology, including its function and any related concepts as well as supplying the 'everyday' term for each formal term. A good illustrative diagram is strongly suggested.

- Tuple
- Attribute
- Domain
- Degree
- Cardinality
- Primary Key
- Foreign Key

Each item is equally weighted.

(15 Marks)

- (b) *Using your own simple data sets and Venn diagrams*, explain how the UNION, INTERSECT and MINUS (DIFFERENCE) operations work. What limitations does the concept of UNION COMPATIBILITY place upon the sets being processed? Explain what UNION COMPATIBILITY means. Suitable diagrams will gain bonus marks.

(10 Marks)

B5

- (a) Describe the various interfaces, tools and techniques that a developer and DBA may employ when interacting with a database.

(10 Marks)

- (b) Explain what the term *data validation* means (in the sense of checking the quality and accuracy of inputted data). *Using your own examples*, describe the various data validation techniques that may be embedded into a forms-based interface to a database – for example, ensuring that the correct type and range of data values are entered.

(10 Marks)

- (c) Describe the *form components* (such as drop-down lists and other items that appear on the screen when entering data into a form) that may be used to implement these data validation techniques.

(5 Marks)

Turn over]

B6

- (a) Explain what is meant by a transaction and why it is an important unit of operation in a DBMS?

(4 marks)

- (b) The consistency and reliability aspects of transactions are due to their “ACID” properties. Discuss each of these properties and how they relate to the concurrency control and recovery mechanisms in a database.

(12 marks)

- (c) Describe, using an example, one type of problem that can occur in a multi-user environment when concurrent access to the database is allowed.

(5 marks)

- (d) Suppose we have a table called employees that, initially, has 120 records. How many rows will be in the table after executing the following commands? **Justify** your answer. Hint: the answer is one of the following: 123, 124, 0, or 1.

(4 marks)

```
INSERT INTO employees (employee_id) VALUES (140);  
SAVEPOINT emp140;  
INSERT INTO employees (employee_id) VALUES (141);  
SAVEPOINT emp141;  
INSERT INTO employees (employee_id) VALUES (142);  
SAVEPOINT emp142;  
TRUNCATE TABLE employees;  
INSERT INTO employees (employee_id) VALUES (143);  
ROLLBACK;
```