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**THE BRITISH COMPUTER SOCIETY**

**THE BCS PROFESSIONAL EXAMINATION  
Diploma**

**DATABASE SYSTEMS**

26<sup>th</sup> April 2000 - 2:30p.m. - 4:30p.m.

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

Time: TWO hours.

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

1.
  - a) With respect to the relational data model, define the concept of a foreign key. What are foreign keys used for? Illustrate your answer with an example. **(6 marks)**
  - b) With respect to the relational data model, discuss the entity integrity and referential integrity constraints. Why is each considered important? **(10 marks)**
  - c) Discuss the implications of these integrity constraints for update operations. **(9 marks)**
  
2.
  - a) Describe the three-schema architecture of a database management system. **(6 marks)**
  - b) Explain what is meant by the term “data independence”. Distinguish between physical and logical data independence. Illustrate your answer with examples. **(12 marks)**
  - c) Outline briefly how physical and logical data independence are achieved by a database management system. **(7 marks)**
  
3. Refer to the database Table definitions given in Appendix A (on the back page).
  - a) Write SQL code to perform the following operations. Show the contents of each Table after running the SQL code.
    - i) Populate the following Tables according to the following requirements:  
Table ORDERS: - add 2 rows with orderno = 4, 5  
Table ITEMS: - add 2 rows with itemid = 1,2  
                  qty\_in\_stock = 1, 10 respectively  
Table ITEMS\_ORDERED:  
                  - add 2 rows for orderno = 4,  
                  - add 1 row for orderno = 5,  
                  - itemid = 2 is duplicated in both orders  
  
Other columns - add further data of your own **(6 marks)**
    - ii) Increase the unitprice of itemid = 2 by 17.5%. **(4 marks)**
    - iii) Remove itemid = 2 associated with orderno = 4. **(6 marks)**
  - b) Identify a column that stores derivable data. Write a query to compute a value for this column. Give one advantage and one disadvantage of storing derivable data in a Table. **(9 marks)**

**[Turn over**

4. Consider the following database requirements specification.

A database used in an order-entry system is to contain information about customers, products, and orders. The following information is to be included:

- For each customer: a unique customer number, one or more shipping addresses, an account balance, a credit limit, and a discount rate.
- For each product: a unique product number, a product description, the names of manufacturing sites making this product (there may be several), the current stock level at each manufacturing site, the stock danger level for each manufacturing site.
- For each order: a customer number, a (single) shipping address, and the date of the order.
- For each detail line on an order: the product number, and the quantity being ordered. There may be several detail lines per order.

A quantity outstanding value is also associated with each detail line on an order. This value is initially set equal to the quantity of the product ordered and is (progressively) reduced to zero as (partial) shipments are made.

a) Draw an Entity-Relationship (ER) diagram that models the information in the above scenario. Your ER diagram should include:

- The attributes of each entity type.
- The degree of each relationship (that is, 1:1, 1:N, or M:N).
- Whether participation in a relationship is optional or obligatory.

State any assumptions that you make. State and explain the symbol notation that you use. **(12 marks)**

b) Design a set of relational database tables that could be used to implement the ER diagram that you developed above. **(8 marks)**

c) Are there any drawbacks in your database design, if only a very small number of customers had more than one shipping address? **(5 marks)**

5. "TERATOY" is a retail company that sells children's toys. The IT manager at TERATOY has created a series of web pages containing information advertising its product range over the WWW. The Chief Executive of TERATOY, though quite happy with the existing web site, wants to know whether incorporating the following improvements are technically feasible:

- i) The development of on-line ordering of products over the WWW by customers.
- ii) The ability to keep the web pages up to date, in particular the details of products and availability must be consistent with the company stock control database.

Suppose you are the IT manager, write a report detailing the technical requirements of implementing these improvements. **(25 marks)**

6. The BCNF (Boyce Codd Normal Form) rule informally states:  
 “Every Determinant MUST be a Candidate Identifier”.

a) Define precisely the following terms referred to above:

- i) Determinant
- ii) Candidate Identifier

(7 marks)

b) Give examples from Figure 1 below of a Determinant and a Candidate Identifier.

(5 marks)

c) Apply the BCNF rule to the Table given in Figure 1 below and thus derive BCNF Tables. Show all your working.

(7 marks)

d) The following row is to be added to Figure 1 below:

CB	BENIDORM	SC	AL HAMBRA	14	OCTOBER	299
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What effect does this have on:

- i) the enterprise rules defined below Figure 1.
- ii) the BCNF Tables you derived in c), again show your working.

(6 marks)

AREA	RESORT NAME	ACCOM	HOTEL	NIGHTS	MONTH	PRICE
CB	BENIDORM	SC	FLAMINGO	7	JUNE	265
MJ	PALMA NOVA	SC	JARDIN DEL SOL	7	JULY	315
CB	BENIDORM	HB	BALI HAI	7	MAY	355
CB	SANTA POSA	HB	HAWAII	7	MAY	365
LZ	PLAYA BLANCA	SC	SUN PARK	14	JULY	425
CB	BENIDORM	SC	AL HAMBRA	14	AUGUST	499
MJ	PALMA NOVA	FB	SUN PARK	14	AUGUST	609
CB	SANTA POSA	FB	RIVERSIDE	14	JUNE	625
CB	BENIDORM	FB	TROPICANA	14	JULY	719
CB	BENIDORM	HB	HELIOS	28	AUGUST	1129
LZ	PLAYA BLANCA	HB	ATLANTIC PARK	28	MAY	1171
CB	SANTA POSA	HB	ROSE DEL BOY	28	MAY	1205

FIGURE 1: Table of Holiday Vacancies

Assume the following **enterprise rules** can be deduced from the sample data set:

- An Area contains one or more Resorts.
- A Resort contains one or more Hotels with those listed as having accommodation which is available for a particular number of nights, during a particular month, at a fixed price.
- Hotels are uniquely named within an Area.

**APPENDIX A Orders Database Structure** (for use with Question 3)

*CUSTOMER TABLE*

<b>Column Name</b>	<b>Type</b>	<b>Length</b>	<b>Nulls</b>
custid	integer	4	no
cname	varchar	15	yes
custaddr	varchar	20	yes
custtown	varchar	15	yes
custarea	varchar	12	yes
custpc	char	8	yes

*ITEMS TABLE*

<b>Column Name</b>	<b>Type</b>	<b>Length</b>	<b>Nulls</b>
itemid	integer	2	no
descr	varchar	25	no
reorder qty	integer	4	yes
qty_in_stock	integer	4	yes
unitprice	money		yes
total_qty sold	integer	4	yes

*ORDERS TABLE*

<b>Column Name</b>	<b>Type</b>	<b>Length</b>	<b>Nulls</b>
orderno	integer	4	no
custid	integer	4	no
orderdate	date		no
promisedate	date		yes

*ITEMS\_ORDERED TABLE*

<b>Column Name</b>	<b>Type</b>	<b>Length</b>	<b>Nulls</b>
itemordered	integer	2	no
orderno	integer	4	no
qtyordered	integer	4	no