Databases

December 2015

Sample Exam Marking Scheme

This marking scheme has been prepared as a **guide only** to markers. This is not a set of model answers, or the exclusive answers to the questions, and there will frequently be alternative responses which will provide a valid answer. Markers are advised that, unless a question specifies that an answer be provided in a particular form, then an answer that is correct (factually or in practical terms) **must** be given the available marks.

If there is doubt as to the correctness of an answer, the relevant NCC Education materials should be the first authority.

Throughout the marking, please credit any valid alternative point.

Where markers award half marks in any part of a question, they should ensure that the total mark recorded for the question is rounded up to a whole mark.

Answer ALL questions

Marks

Question 1

a) Identify FIVE (5) ways in which a large educational institution such as a university might use data. **5**

Examples could include:

- ***Student records***
- ***Course attendance records***
- ***Course results***
- ***Course materials***
- ***Financial records such as fee payments***
- ***Staff records***

Accept any relevant examples. 1 mark for each example.

b) Explain what *metadata* means **and** provide THREE (3) examples of metadata from the systems you identified in part (a). **5**

Metadata is data about other data (1 mark). The structure of a relational database is kept within the database itself in structures such as a system catalogue or metadata tables (1 mark). Up to 3 more marks for examples of metadata from chosen systems. Examples from a university could be the structure of tables for Students, Courses and Staff etc. The relevant attributes and data-types should be specified for top marks.

Total: 10 Marks

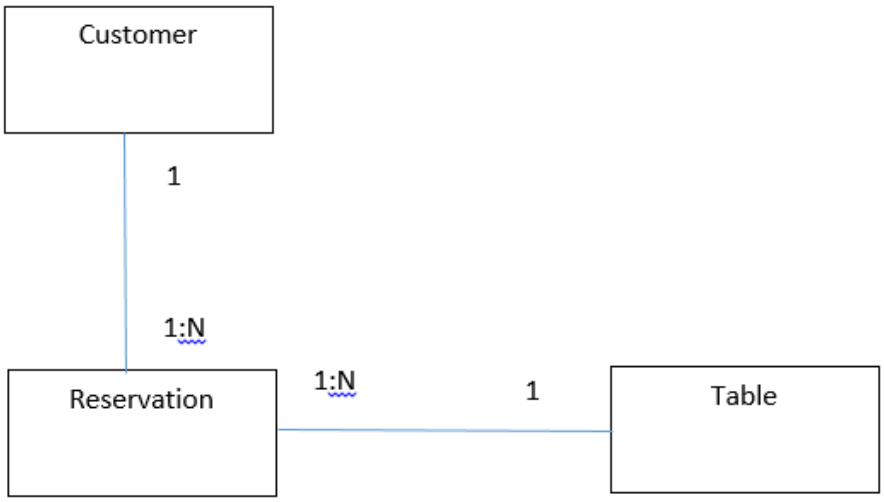
Marks

Question 2

An online restaurant booking system allows customers to make a reservation for a table. A table might be reserved by many customers over a period of time.

a) Draw an entity-relationship (ER) diagram for this scenario. **5**

1 mark for each correct entity, 3 marks total.
1 mark for each correct relationship, 2 marks total



b) Identify attributes, including primary and foreign keys, for this ER model. **5**

Customer
CustomerID (PK)
CustomerName

Table
TableID(PK)
NoOfSeats

Reservation
CustomerID(PK) (FK)
TableID(PK)(FK)
Date
Time

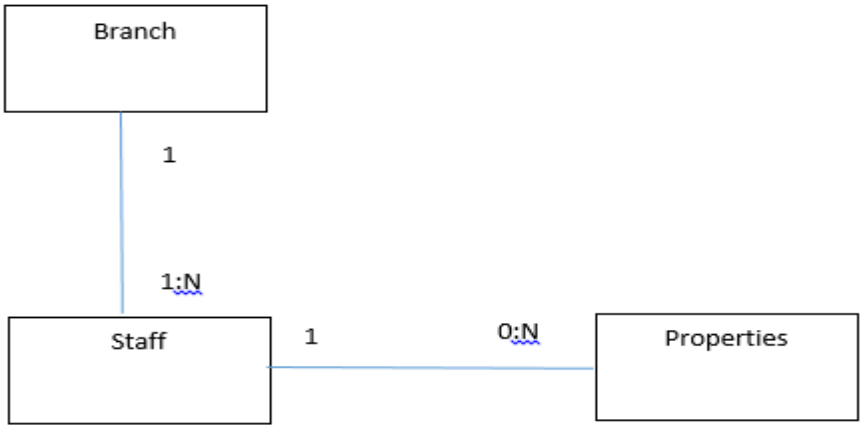
Award 1 mark for each (PK) in Customer and Table, 2 marks total.
Award 1 mark for (PK) (FK) pair in Reservation
Award 1 mark for sensible attributes on Customer and Table
Award 1 mark for specifying that Reservation needs Date and Time

Total: 10 Marks

Marks

Question 3

Consider the following relational model. In a property management company a branch has many staff members who manage properties, but not every property must be managed by someone.



a) This model is an example of a *chasm trap*. Explain what a chasm trap is. **3**

These occur where there are relationships between entities but one of the relationships is non-mandatory, i.e. there does not <u>have</u> to be an instance of this relationship (1 mark). This is shown in the example: here a Branch has many Staff members who manage Properties, but not every Property must be managed by someone (1 mark). Therefore there could be properties for which we do not know what branch they are managed by (1 mark).

b) How might this problem be resolved in the scenario shown? **2**

Creating a direct relationship between properties and branches (1 mark). This would mean that even properties not managed by a staff member can be shown as belonging to a particular branch (1 mark)

c) Define the term *tuple*. **1**

A tuple is equivalent to a row in a table.

d) Explain what is meant by *cardinality* in the relational model **and** give THREE (3) examples. **4**

The way in which data in one relation (or table) relates to data in another relation (or table) (1 mark). (It might also be defined as the number of tuples in a relation.)

1 mark for each example:

- ***one:one***
- ***one:many***
- ***many:many***

Total of 3 marks for examples.

Total: 10 Marks

Marks

Question 4

a) Explain the term *relation*. **5**

The logical structure of the database is perceived as a series of tables with rows and columns. These are known as relations. (1 mark) It is worth noting that this has no implication for how the database is stored physically (1 mark). Relations can be thought of as tables with certain properties (1 mark). Plus 1 mark each for any of these properties to a total of 2 marks:

- ***It has a name which is unique within the relational schema***
- ***Each cell of a relation contains exactly one value***
- ***Each attribute has a name***
- ***Each tuple is unique***
- ***The order of the attributes is insignificant***
- ***The order of tuples is insignificant***

Alternative answers which give this set of criteria for a relation are acceptable, 1 mark for each criteria to a total of 5 marks.

Maximum of 5 marks.

b) What is meant by the term *data independence* in the context of relational databases? **5**

Data independence means that access to data moves from being the realm of the programmer to that of, ideally, the end user (1 mark). The internal storage structure of the data does not need to concern someone who wants to access the data (1 mark). All they need to know about is the structure of the relations (or tables) and the attributes (or columns) (1 mark). This can be achieved through metadata (1 mark) because the structure of the relational database is self-describing. (1 mark)

Total: 10 Marks

Marks

Question 5

a) List FOUR (4) data manipulation commands in SQL. **4**

DML commands could include retrieve (or select), insert, update and delete data. 1 mark for each command.

b) In what ways can SQL be used to enforce domains? **2**

Data types enforce general domains, such as whether a column takes a character or number (1 mark). For more specific domains, such as 'Male' or 'Female', then SQL uses something called constraints (1 mark).

c) What issue with the CHAR data type does the use of the VARCHAR data type overcome? **2**

This overcomes the problem of having the field padded out with blank characters as with a Char data type (1 mark) Only the actual characters are stored (1 mark).

d) Explain how SQL does not support the full relational model. **2**

Referential integrity is not supported (1 mark) in the sense that while we can define primary keys and foreign keys, it is possible to create tables without a primary key (so allowing the insert of duplicate tuples) and to have non-enforced foreign keys (1 mark).

Total: 10 Marks

Marks

Question 6

The table below is associated with customers and the products they have purchased. **10**

Customer ID	Customer Name	Products Purchased	Product Type Code	Product Type Description
C1	Danny Whybrow	Lawnmower Rake Microwave Oven	G G K	Gardening Gardening Kitchen
C2	Anderson Smith	Saucepan Set	K	Kitchen
C3	Tommy West	Chrome Book	T	Technology
C6	Charun Singh	Lawnmower	G	Gardening

Split the table into FOUR (4) third normal form (3NF) relations. You do not have to show data or the steps that you took to normalise the table.
There should be four relations:
Customer(CustomerID (PK), CustomerName)
Purchase (CustomerID(PK)(FK), ProductName(PK)(FK))
Product (ProductName(PK), ProductType(FK))
ProductType(ProductType(PK), ProductTypeDescription)

Award 2 marks each for Customer and ProductType.
Award 3 marks each for Purchase and Product with correct FKs (award partial marks if not all keys are identified).

Total: 10 Marks

Marks

Question 7

a) Explain the role that prototyping can play in systems development. **4**

Prototype – a first or original example of something from which others have or will have developed (1 mark).

Prototyping – the process whereby a model is built of part of the envisaged system (1 mark). Enhancements or amendments are discussed with the user which can then be incorporated in the finished product (1 mark). This can form part of an iterative cycle of development with further enhancements being shown to users for feedback (1 mark).

b) Identify SIX (6) activities that could be involved in physical database design. **6**

Could include:

- ***The move from entities to tables (designing the base relations).***
- ***Indexing.***
- ***De-normalisation.***
- ***View creation.***
- ***Query design.***
- ***Query tuning.***

1 mark for each activity, maximum of 6 marks.

Total 10 Marks

Marks

Question 8

a) What activities need to be carried out during database design to understand how transactions will interact with the database? **6**

Trace all transactions to the relations that they use or affect (1 mark). This will mean thinking about what tables are written to, read from etc. (1 mark) Determine if some relations are frequently used by many transactions (1 mark). Cross-reference transactions with each other so that frequently used relations can be identified (1 mark).

Analyse how the data is used by a given transaction (1 mark). This will utilise something like a CRUD matrix (1 mark).

b) What is meant by the term *performance* with regard to data manipulation statements? **2**

The term 'performance' is generally used by database professionals to refer to the way in which a query or other data manipulation statement behaves when run against a database (1 mark). Usually this is measured in the amount of time it takes to perform the operation (1 mark).

c) Suggest TWO (2) ways in which a database developer might increase the performance of database transactions. **2**

- ***Use of indexes***
- ***Tuning of queries in general***
- ***Specific points about tuning such as minimising number of joins***
- ***Denormalisation***

1 mark each for any of these points, maximum of 2 marks.

Total 10 Marks

Marks

Question 9

Consider the following tables for a vehicle hire company that operates largely online and needs to keep a record of its customers and rentals.

Customer ID	Customer Name	Address
232	Donald Smith	55 Treetop Avenue, London, N1
345	Mandy Jackson	101 Tops Road, London, SE15
123	Tamara O'Toole	99 Ustinov Road, London, N1

CUSTOMERS

Vehicle ID	Name
1	Ford Transit Van
2	VW Utility Van
3	VW Camper

VEHICLES

Customer ID	Vehicle ID	Rental Start Date	Rental End Date
232	1	01/01/2015	06/01/2015
232	1	09/06/2015	10/06/2015
123	3	01/01/2015	30/01/2015

RENTALS

Question 9 continues on next page

a) Write the SQL statements to create the above tables. **5**

Create table Customers
(Customer ID varchar 10 not null, (Datatype could be numeric such as integer)
CustomerName varchar30
Primary Key CustomerID);

Create table Vehicles
(VehicleID integer 6 not null,
Name varchar 30,
Primary Key VehicleID);

Create table Rentals
(CustomerID varchar10 not null,
VehicleID integer 6 not null,
RentalStartDate Date,
RentalEndDate Date,
Primary Key (CustomerID, VehicleID, RentalStartDate),
Foreign Key (CustomerID) reference Customers,
Foreign Key (VehicleID) references Vehicles);

1 mark for correct syntax of Create statements
1 mark for specifying primary keys for Customers and Vehicles
1 mark for correctly identifying and specifying key for Rentals
1 mark for specifying foreign keys
1 mark for correct overall solution
Please allow for variation, for example in data types and field lengths.

b) Write an SQL statement to change the name of the vehicle 'VW Camper' to 'VW Luxury Camper'. **3**

Update tools (1 mark for this syntax)
Set toolname = 'VW Camper' (1 mark)
Where toolname = 'VW Luxury Camper' (1 mark);

Note that answer could use ID of Vehicle in Where clause.

c) Write an SQL statement to delete Donald Smith as a customer. **2**

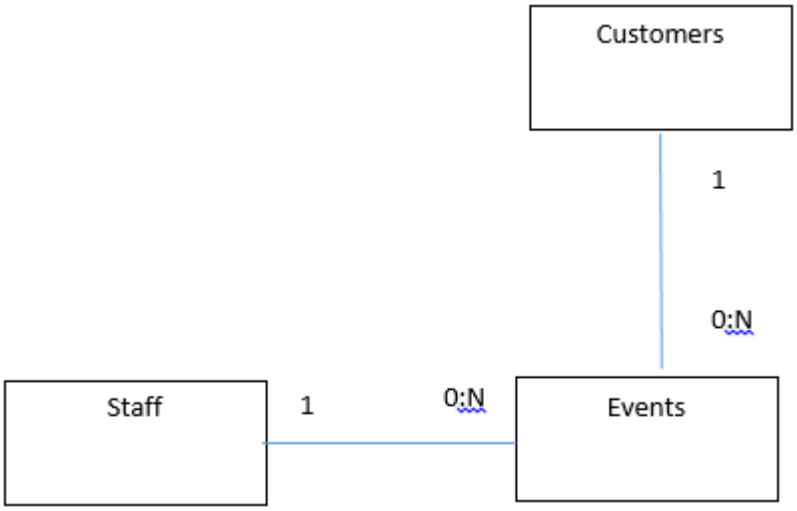
Delete from Customers (1 mark)
Where CustomerName = 'Donald Smith' (1 mark)
Note that candidate could use CustomerID.

Total 10 Marks

Marks

Question 10

Consider the entity-relationship (ER) diagram shown below for an events management company.



a) Create a CRUD matrix to show the following transactions: **4**

Transaction 1 – add a new event
Transaction 2 – delete a customer
Transaction 3 – record an event
Transaction 4 – show a list of events and the staff and customers they are for

Answer:

Transaction	***Customers***	***Events***	***Staff***
T1		***C***	
T2	***D***		***D***
T3		***C***	
T4	***R***	***R***	***R***

1 mark for each correct row in a table similar to the one shown above, maximum of 4 marks.

b) Identify and explain the FOUR (4) basic properties of a transaction. **4**

Atomicity: this is the property that defines a transaction as an indivisible unit in the sense that the whole transaction must occur or no part of it must occur. (1 mark)
Consistency: a transaction must not leave the database in an inconsistent state. (1 mark)
Isolation: transactions should not interfere with other transactions. (1 mark)
Durability: when a transaction has taken place then its effects must be lasting and not vulnerable to being lost because of a subsequent system failure. (1 mark)

Question 10 continues on next page

c) What are the concerns of the concept of *authorisation* with regard to transactions in a relational database? **2**

Security must be enforceable (1 mark). This means being able to allocate different roles and levels of access to users with associated user names, passwords and privileges that give access to some, but not all, areas of the database and some, but not necessarily all, CRUD operations (1 mark for some discussion of roles and privileges which covers some of these points).

Total 10 Marks

End of Examination Paper

Learning Outcomes matrix

Question	Learning Outcomes assessed	Marker can differentiate between varying levels of achievement
1	1	Yes
2	1, 4	Yes
3	1, 2	Yes
4	2	Yes
5	5	Yes
6	2	Yes
7	3	Yes
8	3	Yes
9	5	Yes
10	1	Yes

Grade descriptors

Learning Outcome	Pass	Merit	Distinction
Understand the concepts associated with database systems	Demonstrate adequate level of understanding	Demonstrate robust level of understanding	Demonstrate highly comprehensive level of understanding
Understand the concepts associated with the relational model	Demonstrate adequate level of understanding	Demonstrate robust level of understanding	Demonstrate highly comprehensive level of understanding
Understand how to design and develop a database system	Demonstrate adequate level of understanding	Demonstrate robust level of understanding	Demonstrate highly comprehensive level of understanding
Be able to develop a logical database design	Show adequate development	Show sound and appropriate development	Show innovative and highly appropriate development
Be able to develop a database system using SQL	Show adequate development	Show sound and appropriate development	Show innovative and highly appropriate development