# Database

## Question 1

A driving school teaches people how to drive cars. The school has a relational database, DRIVING_SCHOOL, to store information about instructors, students, lessons and the cars used by instructors.

INSTRUCTOR(InstructorID, FirstName, LastName, DateOfBirth, Level)

CAR(Registration, Make, Model, EngineSize)

INSTRUCTOR_CAR(InstructorID, Registration)

STUDENT(StudentID, FirstName, LastName, DateOfBirth, Address1)

LESSON(LessonID, StudentID, InstructorID, LessonDate, LessonTime)

(a) Give **two** benefits to the **driving school** of using a relational database instead of a flat file.

1 ................................................................................................................................................

...............................................................................................................................................

2 ................................................................................................................................................

........................................................................................................................... [2]

(b) Complete the entity-relationship diagram for the database DRIVING_SCHOOL.

| INSTRUCTOR | | INSTRUCTOR_CAR |
|---|---|---|

| LESSON | | CAR |
|---|---|---|

| STUDENT |
|---|

[4
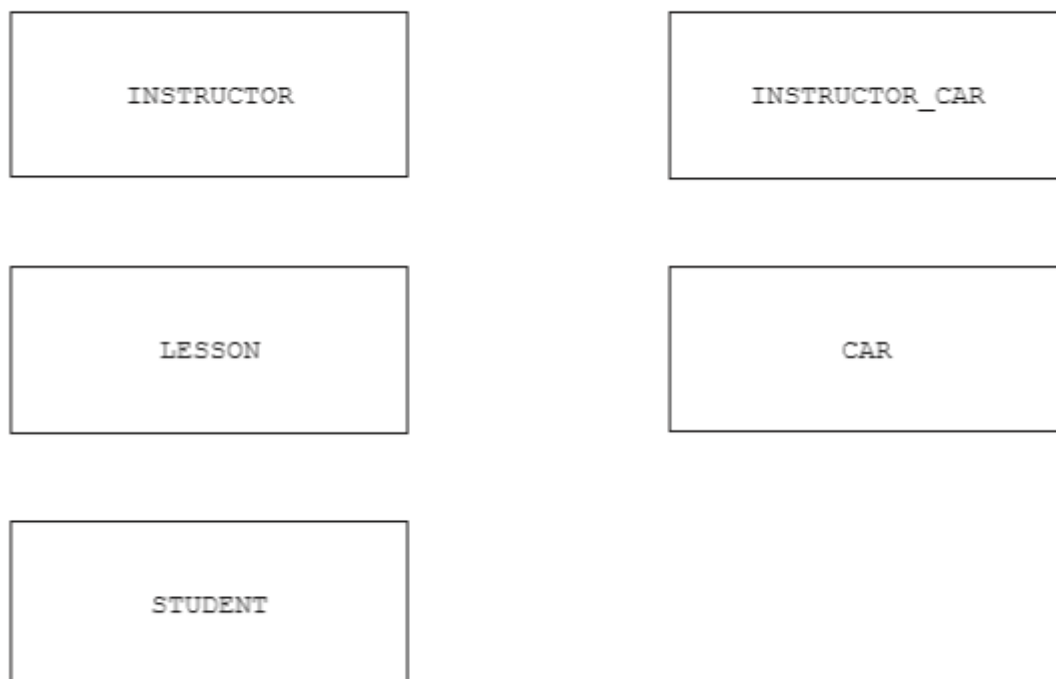
**(c)** The table shows some sample data for the table INSTRUCTOR.

| InstructorID | FirstName | LastName | DateOfBirth | Level |
|---|---|---|---|---|
| Ins01 | Jayden | Han | 05/06/1974 | 1 |
| Ins02 | Freda | Choi | 06/02/1978 | 2 |
| Ins03 | Kelly | Kim | 01/12/1966 | 1 |
| Ins04 | Santana | Thompson | 09/09/1985 | 3 |

Complete the Data Definition Language (DDL) statement to create the table INSTRUCTOR.

```
_____ TABLE INSTRUCTOR(

    InstructorID VARCHAR(5),

    FirstName VARCHAR(15),

    LastName VARCHAR(15),

    DateOfBirth DATE,

    Level _____ ,

    _____ (InstructorID)

);
```

[3]

**(d)** The table STUDENT needs an additional field to store the student's telephone number, for example 012-3456.

Write a Data Definition Language (DDL) statement to add the new field to the table STUDENT.

...........................................................................................................................................................

...........................................................................................................................................................

...........................................................................................................................................................

........................................................................................................................................... [2]

(e) Write a Data Manipulation Language (DML) statement to return the date and time of all future

lessons booked with the instructor whose InstructorID is Ins01.

...........................................................................................................................................................

...........................................................................................................................................................

...........................................................................................................................................................

...........................................................................................................................................................

...........................................................................................................................................................

...........................................................................................................................................................

...........................................................................................................[4]

## Question 2

A software development company has a relational database, SOFTWARE_MANAGEMENT. The database stores details of the customers who have purchased software, as well as the software and licences that customers have purchased.

The SOFTWARE_MANAGEMENT database has the following tables:

CUSTOMER_DETAILS(CustomerID, CompanyName, Address1, Address2, City)

SOFTWARE_PURCHASED(SoftwareName, SoftwareDescription, CustomerID,
                   LicenceType, LicenceCost, RenewalDate)

(a) Explain why this database is **not** in Third Normal Form (3NF). Refer to the tables in your answer.

Do **not** attempt to normalise the tables.

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

................................................................................................................................... [2]

(b) Give an example from the database SOFTWARE_MANAGEMENT for each of the following database terms.

| Term | Example |
|---|---|
| Entity | |
| Foreign key | |
| Attribute | |

[3]

(c) The company also develops computer games. They extend the relational database SOFTWARE_MANAGEMENT by adding a new table. The new table, GAME_DEVELOPMENT, stores details about the games and the software development teams creating them.

The table shows example data in GAME_DEVELOPMENT.

| GameName | Genre | TeamNumber | DevelopmentStage | ManagerID |
|---|---|---|---|---|
| Bunny Hop | Platform | 4 | Analysis | 23KP |
| Fried Eggs | Retro | 2 | Programming stage 1 | 9RTU |
| Create-a-game | Action | 1 | Acceptance testing | 11TF |

(i) Complete the Data Definition Language (DDL) statement to create the table GAME_DEVELOPMENT.

CREATE ............................ ............................ (

  GameName VarChar,

  Genre VarChar,

  ............................ ............................ ,

  DevelopmentStage VarChar,

  ManagerID VarChar,

  ............................ (GameName)

);

[5]

(ii) Another table, PRODUCT_MANAGER, is created.

PRODUCT_MANAGER(ManagerID, FirstName, LastName)

Complete the Data Manipulation Language (DML) statement to return the game name, genre and team number of all games managed by the product manager with the first name 'James' and the last name 'Fitz'.

.................................... GameName, Genre, TeamNumber

FROM GAME_DEVELOPMENT, PRODUCT_MANAGER

WHERE PRODUCT_MANAGER.FirstName = "James"

AND PRODUCT_MANAGER.LastName = "Fitz"

AND ....................................

  = .................................... ;

[3]

## Question 3

6    Sheila creates a relational database for her hotel using a Database Management System (DBMS).

(a)    Draw **one** line from each database term to its most appropriate description.

**Database Term**

| Primary key |

| Attribute |

| Foreign key |

| Entity |

**Description**

A field in one table that links to a primary key in another table

A collection of records and fields

The type of data that is being stored

A unique identifier for each tuple

A data item, represented as a field within a table

The concept or object in the system that we want to model and store information about

[4]

(b) Identify three tasks that Sheila can perform using the DBMS developer interface.

1 ....................................................................................................................................................

2 ....................................................................................................................................................

3 ....................................................................................................................................................

(c) Sheila creates the database HOTEL with the following table structure:

ROOM(RoomNumber, RoomType)

BOOKING(BookingID, RoomNumber, CustomerID, StartDate)

CUSTOMER(CustomerID, FirstName, LastName, Address, Tel_Num)

(i) The following table shows some sample data for the table ROOM.

| RoomNumber | RoomType |
|------------|-----------|
| 1 | Standard |
| 2 | Double |
| 3 | Executive |
| 4 | Standard |

Complete the Data Definition Language (DDL) statement to create the table ROOM.

.................................................. TABLE ROOM(

   RoomNumber Integer,

   RoomType ................................................,

   .................................................. (RoomNumber)

);

[3]

(ii) Room number **5** is a **Double** room.

Complete the Data Manipulation Language (DML) statement to add the details for room number 5 to the table ROOM.

INSERT .................................................. ROOM

VALUES (..............................................................................................);

[2]

(iii) The table BOOKING needs an additional field to store the number of nights (for example, 3) a customer is staying.

Write a Data Definition Language (DDL) statement to add the new field to the table BOOKING.

.................................................................................................................................................................

.................................................................................................................................................................

.................................................................................................................................................................

.................................................................................................................................................................

................................................................................................................................................. [2]

## Question 4

(b) The software company stores information about customers and the software licences they have purchased. The company considers a file-based approach for the storage and retrieval of data.

(i) Give three limitations of a file-based approach to store the data.

1 ...........................................................................................................................................

...........................................................................................................................................

2 ...........................................................................................................................................

...........................................................................................................................................

3 ...........................................................................................................................................

.......................................................................................................................... [3

(ii) The software company decides to use a database to overcome the limitations of a file-based system. Some of these limitations are addressed through the logical schema. Name and describe two levels of the schema of a database.

Name 1 ...............................................................................................................................

Description ...............................................................................................................................

...........................................................................................................................................

Name 2 ...............................................................................................................................

Description ...............................................................................................................................

.......................................................................................................................... [4]

(c) The database has the following tables:

CUSTOMER(CustomerID, CompanyName)

SOFTWARE(SoftwareID, SoftwareName, OperatingSystem, Description)

LICENCE(LicenceID, CustomerID, SoftwareID, DateOfPurchase,
        LicenceType, Cost, ExpiryDate)

(i) Identify the type of relationship that exists between the tables CUSTOMER and LICENCE.

...........................................................................................................................

.......................................................................................................... [1]

(ii) Describe how the relationship is created between the tables CUSTOMER and LICENCE.

.................................................................................................................................................

.. ...............................................................................................................................................

.................................................................................................................................................

................................................................................................................................... [2

**(iii)** The company needs a list of all software licences that have an expiry date on or before 31/12/2019.

Write an SQL query to return the fields CustomerID, SoftwareID, LicenceType, Cost and ExpiryDate for all licences that expire on, or before 31/12/2019. Group the output by CustomerID, and in ascending order of cost.

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

................................................................................................................................... [5]

## Question 5

A company uses a relational database, EMPLOYEES, to store data about its employees and departments. (a) The company uses a Database Management System (DBMS).

(i) The DBMS has a data dictionary.   Describe what the data dictionary stores.

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

................................................................................................................................... [2]

(ii) The DBMS has a query processor.   Describe the purpose of a query processor.

.................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

................................................................................................................................... [2]

(b) Relationships are created between tables using primary and foreign keys. Describe the role of a primary and a foreign key in database relationships.

..............................................................................................................................................

..............................................................................................................................................

..............................................................................................................................................

.......................................................................................................................................... [2]

(c) In the company:

- An employee can be a manager.
- A department can have several managers and several employees.
- An employee can only belong to one department.

The EMPLOYEES database has three tables:

EMPLOYEE_DATA(EmployeeID, FirstName, LastName, DateOfBirth, Gender, DepartmentNumber)

DEPARTMENT(DepartmentNumber, DepartmentName)

DEPARTMENT_MANAGER(DepartmentNumber, EmployeeID, role)

Complete the entity-relationship (E-R) diagram for the EMPLOYEES database.

```
┌─────────────────────┐
│                     │
│   EMPLOYEE_DATA     │
│                     │
└─────────────────────┘
```

```
┌─────────────────────┐          ┌─────────────────────┐
│                     │          │                     │
│ DEPARTMENT_MANAGER  │          │     DEPARTMENT      │
│                     │          │                     │
└─────────────────────┘          └─────────────────────┘
```

[3]

(d) Give **three** reasons why the EMPLOYEES database is fully normalised.

1 ..........................................................................................................................................

..............................................................................................................................................

2 ..........................................................................................................................................

..............................................................................................................................................

3 ..........................................................................................................................................

.......................................................................................................................................... [3]

(e) Part of the EMPLOYEE_DATA table is shown.

| EmployeeID | FirstName | LastName | DateOfBirth | Gender | DepartmentNumber |
|---|---|---|---|---|---|
| 156FJEK | Harvey | Kim | 12/05/1984 | Male | S1 |
| 558RRKL | Catriona | Moore | 03/03/1978 | Female | F2 |
| 388LMDV | Oscar | Ciao | 01/01/1987 | Male | F2 |

(i) Write a Data Definition Language (DDL) statement to create the EMPLOYEES database.

............................................................................................................................................

..................................................................................................................... [1]

(ii) Write a DDL statement to define the table EMPLOYEE_DATA, and declare EmployeeID as the primary key.

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................ [5]

(iii) Write a Data Manipulation Language (DML) statement to return the first name and last name of all female employees in the department named Finance.

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................ [5]

## Question 6

Moheem is creating a relational database to store data about his customers.

(a) Moheem has been told a relational database addresses some of the limitations of a file-based approach by reducing data redundancy.

(i) State what is meant by the term data redundancy.

......................................................................................................................................................
............................................................................................................................................ [1]

(ii) Explain how a relational database can help to reduce data redundancy.

……………………………………………………………………………………………………………………………………………
......................................................................................................................................................
......................................................................................................................................................
.. ...................................................................................................................................................
......................................................................................................................................................
............................................................................................................................................ [3]

(b) Moheem uses a Database Management System (DBMS) to ensure the security and integrity of the data.

(i) Explain the difference between security and integrity.

......................................................................................................................................................
......................................................................................................................................................
. ....................................................................................................................................................
............................................................................................................................................ [2]

(ii) Name and describe two security features provided by a DBMS.

Feature 1 ........................................................................................................................................
......................................................................................................................................................
......................................................................................................................................................
......................................................................................................................................................

Feature 2 .......................................................................................................................................
......................................................................................................................................................
......................................................................................................................................................
.........................................................................................................................................[4]

(iii) The DBMS provides software tools for the database developer.

Fill in the names of the missing software tools in the following statements.

A .................................................................... allows a developer to extract data from a database.

A ................................................................ enables a developer to create user-friendly forms and

reports.

## Question 7

(d) The bank uses a relational database, ACCOUNTS, to store the information about customers and their accounts.

The database stores the customer's first name, last name and date of birth.

The bank has several different types of account. Each account type has a unique ID number, name (for example, regular or saving) and bonus (for example, $5.00, $10.00 or $15.00).

A customer can have more than one account.

Each customer's account has its own ID number and stores the amount of money the customer has in that account.

The bank creates a normalised, relational database to store the required information. There are three tables:

- CUSTOMER
- ACCOUNT_TYPE
- CUSTOMER_ACCOUNT

(i) Write the attributes for each table to complete the database design for the bank.

CUSTOMER ( ...........................................................................................................................

.............................................................................................................................................

....................................................................................................................................)

ACCOUNT_TYPE ( .................................................................................................................

.............................................................................................................................................

....................................................................................................................................)

CUSTOMER_ACCOUNT ( .......................................................................................................

.............................................................................................................................................

....................................................................................................................) [3]

(ii) Identify the primary key for each table that you designed in part (d)(i).

CUSTOMER ....................................................................................................................

ACCOUNT_TYPE  ......................................................................................................................................

CUSTOMER_ACCOUNT  ......................................................................................................... [2]

(iii) Identify one foreign key in one of the tables that you designed in part (d)(i).

Table name  .................................................................................................................................

Foreign key  ........................................................................................................................ [1]

**(iv)** The following table has definitions of database terms.

Write the correct database term in the table for each definition.

| Definition | Term |
|---|---|
| All the data about one entity | |
| The data in one row of a table | |
| A column or field in a table | |

[3]

## Question 8

Anushka needs to store information about bookings at a sports club.

(a) Anushka has a file-based storage system. She wants a relational database.

(i) Describe the features of a relational database that address the limitations of Anushka's file-based

system. .........................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

... .................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

.................................................................................................................................... [4]

(ii) The relational database design needs to be normalised. The following statements describe the

three stages of database normalisation.

Complete the statements by filling in the missing words.

  For a database to be in First Normal Form (1NF) there must be no ................................    groups

of attributes.   For a database to be in Second Normal Form (2NF), it must be in 1NF, and contain no

..................................... key dependencies.   For a database to be in Third Normal Form (3NF), it must

be in 2NF, and all attributes    must be fully dependent on the .....................................

..................................... . [4]

**(b)** The **normalised** relational database, SPORTS_CLUB, has the following table design.

MEMBER(<u>MemberID</u>, FirstName, LastName, MembershipType)

SESSION(<u>SessionID</u>, Description, SessionDate, SessionTime, NumberMembers)

TRAINER(<u>TrainerID</u>, TrainerFirstName, TrainerLastName)

MEMBER_SESSION(<u>MemberID</u>, <u>SessionID</u>)

SESSION_TRAINER(<u>SessionID</u>, <u>TrainerID</u>)

**(i)** Anushka has designed an entity-relationship (E-R) diagram for SPORTS_CLUB.

Complete the entity-relationship (E-R) diagram.



[2]

(ii) Anushka first needs to create the database that she has designed.   Write a Data Definition

Language (DDL) statement to create the SPORTS_CLUB database.

....................................................................................................................................................

.................................................................................................................................... [1

**(iii)**   The table shows some sample data for the table SESSION.

| SessionID | Description | SessionDate | SessionTime | NumberMembers |
|-----------|-------------|-------------|-------------|---------------|
| 21PL | Pilates junior | 04/04/2020 | 18:00 | 15 |
| 13AE | Aerobics senior | 04/04/2020 | 19:00 | 20 |
| 33WG | Weightlifting advanced | 04/04/2020 | 10:00 | 10 |

Write a DDL script to create the table SESSION.

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

...................................................................................................................................................

................................................................................................................................... [5]

(iv) Write a Data Manipulation Language (DML) script to return the first name and last name of all members who have Peak membership type.

.................................................................................................................................................

................................................................................................................................................

................................................................................................................................................

................................................................................................................................................

................................................................................................................................... [3

## Question 9

A hotel needs to record information about customers and their bookings.

(a) The hotel has two types of room: double and family. Each room has a unique room number.  The hotel stores information about the customers including their name, address and contact details. When a customer books a room, they give the start date and the number of nights they want to stay. If a customer wants more than one room, each room must have a separate booking. Each booking has an ID number.

The hotel creates a normalised, relational database to store the required information. There are three tables:

• CUSTOMER

• ROOM

• BOOKING

(i) Complete the database design for the hotel by writing the attributes for each table.

467

CUSTOMER ( ..................................................................................................................................

........................................................................................................................................................

....................................................................................................................................)

ROOM( .......................................................................................................................................

........................................................................................................................................................

................................................................................................................................ )

BOOKING( ................................................................................................................................

........................................................................................................................................................

.......................................................................................................................... ) [3

(ii) Identify the primary key for each table that you designed in part (a)(i).

CUSTOMER ...........................................................................................................................

ROOM ..................................................................................................................................

BOOKING ...................................................................................................................... [2]

(iii) Identify one foreign key in the tables that you designed in part (a)(i).

Table name ..........................................................................................................................

Foreign key ................................................................................................................. [1]

(b) The hotel wants to use a Database Management System (DBMS) to set up and manage the database.  Describe, using examples, how the hotel can use the following DBMS tools:

Developer interface .............................................................................................................

........................................................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

Query processor ...................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

.............................................................................................................................. [5

(c) The following table has four SQL scripts.

Tick (✓) **one** box in each row to identify whether the script is an example of a Data Definition Language (DDL) statement or a Data Manipulation Language (DML) statement.

| Script | DDL | DML |
|---|---|---|
| CREATE TABLE FILMS | | |
| SELECT FilmID FROM FILMS | | |
| ALTER TABLE FILMS ADD PRIMARY KEY (FilmID) | | |
| CREATE DATABASE MYDATA | | |

[2]

## Question 10

7   A social media website has a relational database, WEBDATA, that stores the site's information.

The database has three tables to store users' details, and details of the images and text that they post.

```
USER(UserName, FirstName, SecondName, DateOfBirth)
PHOTO(PhotoID, UserName, Comment, UploadDate)
TEXTPOST(PostID, UserName, DateOfPost, TheText)
```

(a)  (i) Explain how the relationship between the tables USER and PHOTO has been implemented.

...............................................................................................................................................
.. ...........................................................................................................................................
...............................................................................................................................................
.........................................................................................................................................[2]

(ii) Draw the entity-relationship (E-R) diagram to show the relationships between the three tables.

[2]

(b) A database administrator decides to enforce referential integrity. Use an example from the database WEBDATA to explain what is meant by referential integrity.

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

..............................................................................................................................................[3]

(c) The database has been normalised to Third Normal Form (3NF). Define the three stages of database normalisation.

1NF ..............................................................................................................................................

...................................................................................................................................................

2NF ..............................................................................................................................................

...................................................................................................................................................

3NF ..............................................................................................................................................

.............................................................................................................................................. [3

**(d)** The following shows sample data from the USER table.

| UserName | FirstName | SecondName | DateOfBirth |
|----------|-----------|------------|-------------|
| gem123 | John | Smith | 01/01/1995 |
| purpleSky | Muhammed | Ali | 23/02/1956 |
| OpenWindow | Sunny | Amir | 03/03/1997 |
| bluebird127 | Raziya | Bello | 04/03/1982 |

(i)     Write an SQL script to create the USER table.

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

..............................................................................................................................

.......................................................................................................... [5]

(ii) The database administrator needs to alter the USER table. A new field, Country, needs

to be added.

Write an SQL script to add the field Country to the USER table.

.............................................................................................................................

.. .........................................................................................................................

.............................................................................................................................

..............................................................................................................[2]

## Question 11

A company writes applications (apps) for smartphones. The company has a relational database, PURPLEGAME, which stores the information for one of its online game apps.

The database has three tables to store player's details, dates when they have logged into the app and in-app purchase details.

LOGIN(LoginID, PlayerID, Date)

PURCHASE(PurchaseID, PlayerID, PurchaseDate, Cost)

PLAYER(PlayerID, PlayerName, SkillLevel)

(a) Draw the entity-relationship (E-R) diagram to show the relationships between the three tables.

[2]

(b) The database manager is concerned about data integrity.

State what is meant by data integrity. Give an example of how the manager can ensure data integrity in the PURPLEGAME database.

.............................................................................................................................

.............................................................................................................................

.............................................................................................................................

..............................................................................................................[2]

**(c)** The database designer states that the `PURPLEGAME` database is in Third Normal Form (3NF).

Tick (✓) **one** box to indicate whether this statement is true or false.

| True | False |
|------|-------|
|      |       |

Justify your choice.

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

...................................................................................................................................[3]

**(d) (i)** The following table shows some sample data for the `PLAYER` table.

| PlayerID | PlayerName | SkillLevel |
|----------|------------|------------|
| fly918 | Kylie | 3 |
| elephant11 | Mehrdad | 9 |
| candy22 | Suzi | 15 |
| greenGrass | Jason | 22 |

Write an SQL script to create the PLAYER table.

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

.......................................................................................................................... [5]

(ii) The table, PLAYER, needs to be altered. A new field, DateOfBirth, needs to be added.

Write an SQL script to add the DateOfBirth field to the PLAYER table.

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..........................................................................................................................................[2]

## Question 12

A movie theatre has a relational database that stores the movie schedule, and information about the movies. The theatre has several screens that play movies at the same time.

The database has three tables to store information about the movies, the screens and the movie schedule.

```
MOVIE(MovieID, Title, Length, Rating)

SCREEN(ScreenNumber, NumberSeats)

MOVIESCHEDULE(ScheduleID, MovieID, ScreenNumber, Time)
```

**(a)** Complete the entity-relationship (E-R) diagram to show the relationships between these tables.

```
┌──────────────┐          ┌──────────────┐
│    MOVIE     │          │    SCREEN    │
└──────────────┘          └──────────────┘


        ┌──────────────────┐
        │  MOVIESCHEDULE   │
        └──────────────────┘
```
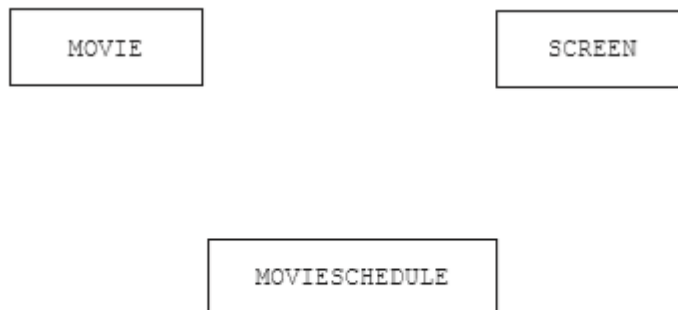
[2]

(b) Explain how primary and foreign keys are used to link the tables in the movie theatre database.

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

................................................................................................................................................

..........................................................................................................................................[4]

(c) The database needs to store the name of the company that produced each movie, for example, Rocking Movies. Write an SQL script to add the attribute Production Company to the MOVIE table.

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

.................................................................................................................................................

...........................................................................................................................................[2]

(d) Write an SQL script to display the title and rating of all movies scheduled to play on screen number 3.

..................................................................................................................................................

..................................................................................................................................................

.................................................................................................................................................

.................................................................................................................................................

................................................................................................................................................

.................................................................................................................................................

..................................................................................................................................................

.................................................................................................................................................

................................................................................................................................................

...........................................................................................................................................[4]

## Question 13

1    A hospital is divided into two areas, Area A and Area B. Each area has several wards. All the ward names are different.

A number of nurses are based in Area A. These nurses always work on the same ward. Each nurse has a unique Nurse ID of STRING data type.



(a) Describe the relationship shown above.

..................................................................................................................................................

...........................................................................................................................................[1]

(b) A relational database is created to store the ward and nurse data. The two table designs for Area A are:

A-WARD(WardName, NumberOfBeds)

A-NURSE(NurseID, FirstName, FamilyName, ..........................................................)

(i) Complete the design for the A-NURSE table. [1]

(ii) Explain how the relationship in part (a) is implemented.

.................................................................................................................................................................

.................................................................................................................................................................

.................................................................................................................................................................

.............................................................................................................................................................[2]

(c) In Area B of the hospital, there are a number of wards and a number of nurses.

Each Area B ward has a specialism.

Each Area B nurse has a specialism.

A nurse can be asked to work in any of the Area B wards where their specialism matches with the ward specialism.

The relationship for Area B of the hospital is:



(i) Explain what the degree of relationship is between the entities B-NURSE and B-WARD.

.................................................................................................................................................................

.............................................................................................................................................................[1]

ii) The design for the Area B data is as follows:

B-NURSE(NurseID, FirstName, FamilyName, Specialism)

B-WARD(WardName, NumberOfBeds, Specialism)

B-WARD-NURSE( ...........................................................................................................)

Complete the attributes for the third table. Underline its primary key. [2]

**(iii)** Draw the relationships on the entity-relationship (E-R) diagram.

| B-NURSE | | B-WARD |
|---|---|---|

| B-WARD-NURSE |
|---|
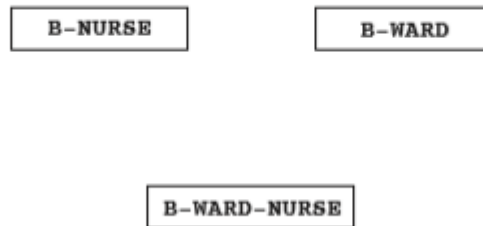
[2]

(d) Use the table designs in part (c)(ii).

(i) Write an SQL query to display the Nurse ID and family name for all Area B nurses with a specialism of 'THEATRE'. ......................................................................................................................................
...............................................................................................................................................................
...............................................................................................................................[3]

(ii) Fatima Woo is an Area B nurse with the nurse ID of 076. She has recently married, and her new family name is Chi.   Write an SQL command to update her record.

UPDATE ....................................................................................................................................

SET ..........................................................................................................................................

WHERE ...............................................................................................................................  [3

## Question 14

1    Some shops belong to the Rainbow Retail buying group. They buy their goods from one or more suppliers.

Each shop has:

- a unique shop ID
- a single retail specialism (for example, food, electrical, garden).

Each supplier has:

- a unique supplier ID
- a similar single specialism recorded.

Rainbow Retail creates a relational database to record data about the shops and their suppliers.

The entity-relationship (E-R) diagram for the relationship between the SHOP and SUPPLIER tables is shown.

| SHOP | | SUPPLIER |
|---|---|---|

(a) Explain what the degree of relationship is between the entities SHOP and SUPPLIER.

...................................................................................................................................................

.........................................................................................................................................[1]

The database design is as follows:

SHOP(ShopID, ShopName, Location, RetailSpecialism)

SUPPLIER(SupplierID, SupplierName, ContactPerson, RetailSpecialism)

SHOP-SUPPLIER(ShopID, SupplierID)

The SHOP–SUPPLIER table stores the suppliers that each shop has previously used. Primary keys are not shown.

b) (i) Label the entities and draw the relationships to complete the revised E-R diagram
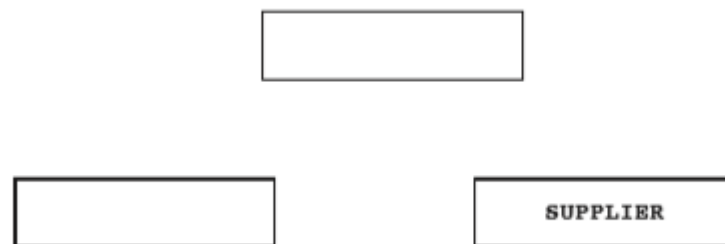
```
        ┌─────────────────┐
        │                 │
        └─────────────────┘



┌─────────────────┐              ┌─────────────────┐
│                 │              │    SUPPLIER     │
└─────────────────┘              └─────────────────┘
```
[3]

(ii) Complete the following table to show for each database table:

- the primary key
- the foreign key(s) (if any):
    o Each table may contain none, one or more foreign key(s).
    o For a table with no foreign key, write 'None'.
- an explanation for the use of any foreign key.

| Table | Primary key | Foreign key(s) (if any) | Explanation |
|---|---|---|---|
| SHOP | | | |
| SUPPLIER | | | |
| SHOP–SUPPLIER | | | |

[5]

(iii) The database designer has implemented SUPPLIER.ContactPerson as a secondary key.

Describe the reason for this.

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

.............................................................................................................................................[2]

(c) (i) Write an SQL query to display the shop ID and location of all shops with a 'GROCERY' specialism.

...................................................................................................................................................

...................................................................................................................................................

.............................................................................................................................................[3]

(ii) The existing shop with ID 8765 has just used the existing supplier SUP89 for the first time.

Write an SQL script to add this data to the database.

...................................................................................................................................................

...................................................................................................................................................

.............................................................................................................................................[3]

## Question 15

7   A clinic is staffed by several doctors. The clinic serves thousands of patients. Each day and at any one time, there is only one doctor in the clinic available for appointments.

The clinic stores patient, doctor and appointment data in a relational database.

**(a)  (i)**   Underline the primary key for each table in the following suggested table designs.
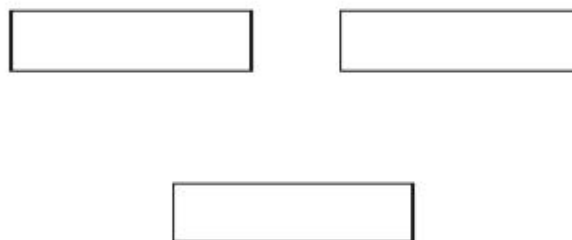
PATIENT(PatientID, PatientName, Address, Gender)

DOCTOR(DoctorID, Gender, Qualification)

APPOINTMENT(AppointmentDate, AppointmentTime, DoctorID, PatientID)

[2]

**(ii)**   Complete the following entity-relationship (E-R) diagram for this design.

[2]

478

b) The doctors are concerned that many patients make appointments but do not attend them.

Describe the changes to the table designs that could be made to store this information.

........................................................................................................................................................

..............................................................................................................................................[2]

(c) The doctors are about to set up a new clinic in the neighbouring village, SITE-B.

The original location is identified as SITE-A.

A new table is designed to store the ID of the doctor who is able to work at each site.

DOCTOR-AVAILABILITY(DoctorID, Site)

Five entries stored in the table are:

| DoctorID | Site |
|----------|--------|
| 098 | SITE-A |
| 074 | SITE-A |
| 117 | SITE-B |
| 098 | SITE-B |
| 033 | SITE-B |

(i) State what this data shows about the availability of the doctor with the ID of 098.

........................................................................................................................................................

.............................................................................................................................................[1]

(ii) Opening a new clinic in the neighbouring village will not require any additional table for storing appointments. It will need a change to the existing appointment table design.   Show the revised APPOINTMENT table.

 APPOINTMENT(  ......................................................................................................................

........................................................................................................................... ) [1]

(d) The doctor with the ID of 117 has recently been allocated a new DoctorID of 017.

(i) Write an SQL script to update this doctor's record in the database.

UPDATE  ......................................................................................................................

SET .........................................................................................................................

WHERE  ................................................................................................. [3]

(ii) Describe why this update could cause problems with the existing data stored.

…………………………………………………………………………………………………………………………………………………

…………………………………………………………………………………………………………………………………………………

……………………………………………………………………………………………………………………………………..[2]

(e) Write an SQL script to display the date and time of all appointments made by the patient with the PatientID of 556.

…………………………………………………………………………………………………………………………………………………

…………………………………………………………………………………………………………………………………………………

…………………………………………………………………………………………………………………………………………..[3

## Question 16

A company takes customer service for its clients very seriously. The client • The client names are unique.

A visit

• The company arranges a date for a visit to gather feedback from a client.

• A visit to a client never takes more than one day.

• Over time, the client receives many visits. Staff (Interviewers)

• One or more staff attend the visit.

• If there is more than one staff member visiting, each performs a separate interview. Interviews

• Each interview is classified as either 'general' or by some specialism, for example, marketing, customer service or sales.

• A report is produced for each interview, InterviewText.

• Each interview is conducted by a single staff member. The client, visit, staff and interview data will be stored in a relational database.

    a)   (i) Underline the primary key for each table in the following suggested table designs.

        STAFF(StaffID, StaffName, Department)

        CLIENT(ClientName, Address, Town)

        VISIT(ClientName, VisitDate)

        INTERVIEW(ClientName, VisitDate, StaffID, SpecialistFocus, InterviewText)

                                                          [3]

**(ii)** For each of the pairs of entities, A, B and C, draw the relationship between the two entities.

A  CLIENT                    VISIT

B  VISIT                     INTERVIEW

C  INTERVIEW                 STAFF

[3]

(b) The company decides to produce a visit report, VisitReportText, for each visit made. This text will be produced from the one or more interview texts obtained at the visit. State how one or more of the given table designs can be changed to add this attribute.

....................................................................................................................................................

.............................................................................................................................................[1]

(c) Client ABC Holdings are now trading under the name of Albright Holdings.

(i) Write an SQL script to update this client's record in the database.

UPDATE  ..........................................................................................................................

SET ...................................................................................................................................

WHERE  ...................................................................................................... [3]

(ii) Describe why this update could cause problems with the existing data stored.

....................................................................................................................................................

...................................................................................................................................................

.............................................................................................................................................[2]

(d) Write an SQL script to display the Staff ID of each member of staff who performed an interview when they visited New Age Toys on 13/10/2016.

..........................................................................................................................................

.........................................................................................................................................

.....................................................................................................................................[3]

(e) At present, all interviews are performed in the UK. Many clients now operate in other countries in Europe. The company wants to perform interviews with the client's staff in other countries. Not all interview staff are willing to travel outside of the UK. State how one or more of the table designs should be revised to store this information.

..........................................................................................................................................

.....................................................................................................................................[1]

## Question 17

A school stores a large amount of data. This includes student attendance, qualification, and contact details. The school's software uses a file-based approach to store this data.

(a) The school is considering changing to a DBMS.

(i) State what DBMS stands for.

..................................................................................................................................................[1]

(ii) Describe two ways in which the Database Administrator (DBA) could use the DBMS software to ensure the security of the student data.

1 ....................................................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

2 ....................................................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

..................................................................................................................................................[4]

(iii) A feature of the DBMS software is a query processor.

Describe how the school secretary could use this software.

........................................................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

..................................................................................................................................................[2]

(iv) The DBMS has replaced software that used a file-based approach with a relational database.

Describe how using a relational database has overcome the previous problems associated with a file-based approach.

........................................................................................................................................................

........................................................................................................................................................

........................................................................................................................................................

..................................................................................................................................................[3]

(b) The database design has three tables to store the classes that students attend.

STUDENT(StudentID, FirstName, LastName, Year, TutorGroup)

CLASS(ClassID, Subject)

CLASS-GROUP(StudentID, ClassID)

Primary keys are not shown. There is a one-to-many relationship between CLASS and CLASS–GROUP.

(i) Describe how this relationship is implemented.

..................................................................................................................................................

..................................................................................................................................................

.........................................................................................................................................[2]

(ii) Describe the relationship between CLASS-GROUP and STUDENT.

.........................................................................................................................................[1]

(iii) Write an SQL script to display the StudentID and FirstName of all students who are in the tutor group 10B. Display the list in alphabetical order of LastName.

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

.........................................................................................................................................[4]

(iv) Write an SQL script to display the LastName of all students who attend the class whose ClassID is CS1.

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

.........................................................................................................................................[4]

## Question 18

(c) The database design has three tables to store the qualifications and grades each student has attained. The following is a sample of the data from each table.

STUDENT

| StudentID | FirstName | LastName | Tutor |
|---|---|---|---|
| 001AT | Ahmad | Tan | 11A |
| 003JL | Jane | LI | 11B |
| 011HJ | Heather | Jones | 10A |

QUALIFICATION

| QualCode | Level | Subject |
|---|---|---|
| CS1 | IGCSE | Computer Science |
| MT9 | IGCSE | Maths |
| SC12 | IGCSE | Science |

STUDENT-QUALIFICATION

| QualCode | StudentID | Grade | DateOfAward |
|---|---|---|---|
| SC12 | 011HJ | A | 31/8/2014 |
| SC12 | 003JL | C | 31/8/2014 |
| CS1 | 003JL | B | 31/8/2014 |

(i) Draw an Entity-Relationship (E-R) diagram to show the relationships between these three tables.

—[2]

(ii) State the type of relationship that exists between STUDENT and STUDENT-QUALIFICATION.

....................................................................................................................................[1]

(iii) Describe how the relationship between QUALIFICATION and    STUDENT-QUALIFICATION is implemented.

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

..........................................................................................................................[2]

(d) (i) The database will store each student's date of birth.

  Write an SQL script to add a date of birth attribute to the appropriate table.

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

..........................................................................................................................[2]

 (ii) Write an SQL script to display the StudentID, Grade and DateOfAward for the QualCode value of SC12. ...................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

..........................................................................................................................[3]

 (iii) Write an SQL script to display the FirstName and LastName and QualCode for all STUDENT-QUALIFICATIONs for which the Grade value is A.

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

.......................................................................................................................................

..........................................................................................................................[4]

## Question 19

(a) Five descriptions and seven relational database terms are shown below.

Draw a line to link each description to its correct database term.

**Description**                                      **Database term**

| Any object, person or thing about which it is possible to store data |

|                                                     Secondary key |

|                                                     Candidate key |

| Dataset organised in rows and columns; the columns form the structure and the rows form the content |

|                                                     Entity |

| Any attribute or combination of attributes that can act as a unique key |

|                                                     Foreign key |

|                                                     Primary key |

| Attribute(s) in a table that link to the primary key in another table to form a relationship |

|                                                     Table |

|                                                     Tuple |

| Attribute or combination of attributes that is used to uniquely identify a record |

[5]

(b) Explain what is meant by referential integrity.

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..................................................................................................................................................

..........................................................................................................................................[3]

## Question 20

A health club offers classes to its members. A member needs to book into each class in advance.

(a) The health club employs a programmer to update the class booking system. The programmer has to decide how to store the records. The choice is between using a relational database or a file-based approach.

Give three reasons why the programmer should use a relational database.

1 ....................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

2 ....................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

3 ....................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

.....................................................................................................................................[6]
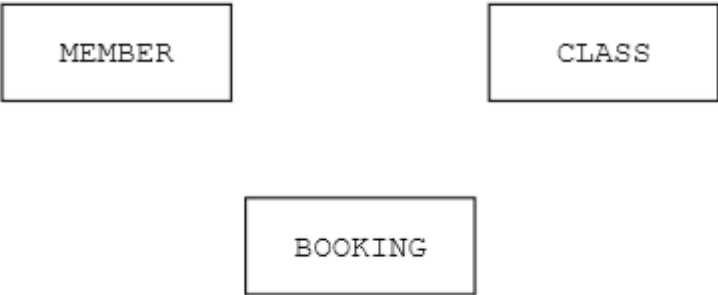
(b) The programmer decides to use three tables: MEMBER, BOOKING and CLASS.

Complete the Entity-Relationship (E-R) diagram to show the relationships between these tables.

```
┌─────────────┐            ┌─────────────┐
│   MEMBER    │            │   CLASS     │
└─────────────┘            └─────────────┘

          ┌─────────────┐
          │   BOOKING   │
          └─────────────┘
```

[2]

(c) The CLASS table has primary key ClassID and stores the following data:

| ClassID | Description | StartDate | ClassTime | NoOfSessions | AdultsOnly |
|---------|-------------|-----------|-----------|--------------|------------|
| DAY01 | Yoga beginners | 12/01/2016 | 11:00 | 5 | TRUE |
| EVE02 | Yoga beginners | 12/01/2016 | 19:00 | 5 | FALSE |
| | | | | | |
| DAY16 | Circuits | 30/06/2016 | 10:30 | 4 | FALSE |

Write an SQL script to create the CLASS table.

.......................................................................................................................................................

.......................................................................................................................................................

......................................................................................................................................................

.......................................................................................................................................................

.....................................................................................................................................................

......................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

......................................................................................................................................................

......................................................................................................................................................

.................................................................................................................................................[6

## Question 21

**9** A database has been designed to store data about salespersons and the products they have sold.

The following facts help to define the structure of the database:

- each salesperson works in a particular shop
- each salesperson has a unique first name
- each shop has one or more salespersons
- each product which is sold is manufactured by one company only
- each salesperson can sell any of the products
- the number of products that each salesperson has sold is recorded

The table `ShopSales` was the first attempt at designing the database.

| FirstName | Shop | ProductName | NoOfProducts | Manufacturer |
|---|---|---|---|---|
| Nick | TX | television set<br>refrigerator<br>digital camera | 3<br>2<br>6 | SKC<br>WP<br>HKC |
| Sean | BH | hair dryer<br>electric shaver | 1<br>8 | WG<br>BG |
| John | TX | television set<br>mobile phone<br>digital camera<br>toaster | 2<br>8<br>4<br>3 | SKC<br>ARC<br>HKC<br>GK |

**(a)** State why the table is **not** in First Normal Form (1NF).

........................................................................................................................................................................

....................................................................................................................................................................[1]

**(b)** The database design is changed to:

`SalesPerson (FirstName, Shop)`

`SalesProducts (FirstName, ProductName, NoOfProducts, Manufacturer)`

Using the data given in the first attempt table (`ShopSales`), show how these data are now stored in the revised table designs.

Table: `SalesPerson`

| FirstName | Shop |
|---|---|
|  |  |
|  |  |
|  |  |

Table: SalesProducts

| FirstName | ProductName | NoOfProducts | Manufacturer |
|-----------|-------------|--------------|--------------|
|           |             |              |              |
|           |             |              |              |
|           |             |              |              |
|           |             |              |              |
|           |             |              |              |
|           |             |              |              |
|           |             |              |              |
|           |             |              |              |
|           |             |              |              |

[3]

(c) (i) A relationship between the two tables has been implemented.

Explain how this has been done.

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...........................................................................................................................................[2]

(ii) Explain why the SalesProducts table is not in Third Normal Form (3NF).

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...........................................................................................................................................[2]

(iii) Write the table definitions to give the database in 3NF.

.......................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

.......................................................................................................................................................

...........................................................................................................................................[2]