



10.1 Conceptual data entity relationship

Name: _____

Class: _____

Date: _____

Time: **483 minutes**

Marks: **335 marks**

Comments:

Q1.

Athletes, who are members of teams, compete in running events, which are held at fixtures throughout the year.

For example, athlete 15 might compete in the Girls' 1500m Under 18 race in the fixture at Marsten on 12 September 2018.

A relational database is used to store the details of which athletes enter each event at each fixture. The relations used in the database are shown in **Figure 1**.

Figure 1

Athlete(AthleteID, Surname, Forename, DateOfBirth, Gender, TeamName)

EventType(EventTypeID, Gender, Distance, AgeGroup)

Fixture(FixtureID, FixtureDate, LocationName)

EventAtFixture(FixtureID, EventTypeID)

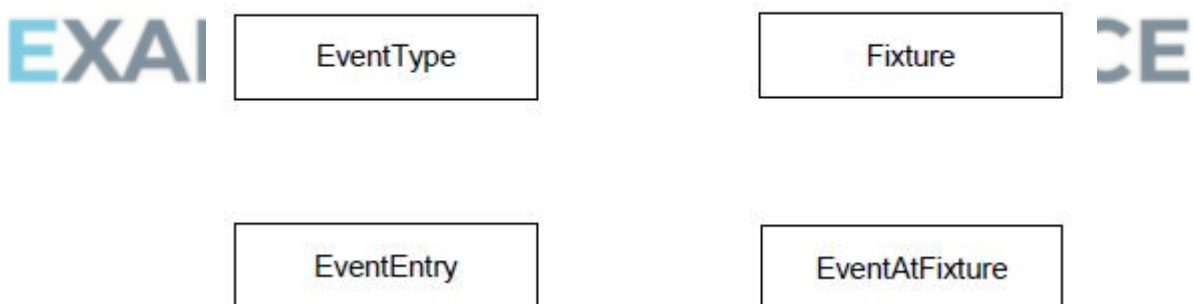
EventEntry(FixtureID, EventTypeID, AthleteID)

- Each Athlete, EventType and Fixture is identified by a unique identity number, for example AthleteID for athletes.
- An EventType is a type of event, such as Boys' 100m Under 15 race.
- If an athlete wants to take part in an event at a particular fixture, then an entry is created in the EventEntry relation to represent this.

- (a) **Figure 2** shows an incomplete entity-relationship diagram for part of the database.

Draw lines on **Figure 2** to show the degree of any **three** relationships that exist between the four entities shown.

Figure 2



(2)

- (b) **Figure 3** shows an SQL statement that is intended to make a table to represent the Athlete relation. The statement contains some errors.

Figure 3

```
CREATE TABLE Athlete (  
    PRIMARY KEY AthleteID,  
    VARCHAR(50) Surname,  
    VARCHAR(30) Forename,  
    DATE DateOfBirth,  
    VARCHAR(6) Gender,
```

```
        VARCHAR(30) TeamName
    )
```

You may assume that all of the data types used in **Figure 3** are valid and the field lengths are appropriate.

State **two** errors that have been made.

Error 1: _____

Error 2: _____

(2)

- (c) State **two** reasons why database designs, such as this one, are usually normalised.

Reason 1: _____

Reason 2: _____

(2)

Figure 1 is repeated below.

Figure 1 (repeated)

Athlete(AthleteID, Surname, Forename, DateOfBirth, Gender, TeamName)

EventType(EventTypeID, Gender, Distance, AgeGroup)

Fixture(FixtureID, FixtureDate, LocationName)

EventAtFixture(FixtureID, EventTypeID)

EventEntry(FixtureID, EventTypeID, AthleteID)

A list is to be produced of the names of all athletes who are competing in the fixture that is taking place on 17/09/18. The list must include the Surname, Forename and DateOfBirth of these athletes and no other details. The list should be presented in alphabetical order by Surname.

- (d) Write an SQL query to produce the list.

(5)
(Total 11 marks)

Q2.

A garage services and repairs cars. It uses a relational database to keep track of the jobs that customers have booked for it to carry out. The database includes jobs that have been completed and jobs that are waiting to be done.

The details of the jobs that the garage does, together with the parts that it stocks and uses are stored in the database using the four relations shown in **Figure 1**.

Figure 1

Job (JobID, CarRegNo, JobDate, InGarage, JobDuration)

Car (CarRegNo, Make, Model, OwnerName, OwnerEmail, OwnerTelNo)

Part (PartID, Description, Price, QuantityInStock)

PartUsedForJob (JobID, PartID, QuantityUsed)

- Each car has a unique CarRegNo.
- A type of car can be uniquely identified by the combination of its Make and Model. Different Makes may use the same Model name and a particular manufacturer (Make) will produce several different car Models.
- A booking made for a car on a particular date counts as one job, regardless of how many different tasks are completed upon it.
- A job might require the use of any number of parts, including zero.
- Some of the details are stored in the database as soon as a booking is made and others are only added when a job has been completed.

The attribute JobID is the Entity Identifier (Primary Key) of the Job relation.

- (a) If the JobID attribute were not included in the Job relation, which other attribute or attributes that are currently in the relation could probably be used as an Entity Identifier (Primary Key) instead?

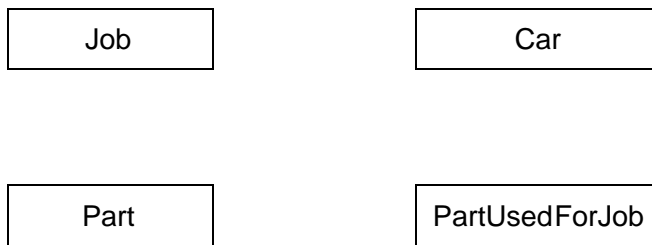
(1)

It has been suggested that the owner details (OwnerName, OwnerEmail, OwnerTelNo) should not be stored in the Car relation and that a new relation should be created to store owner details separately from car details.

- (b) Explain why storing the owner details separately would improve the design of the database.

(2)

- (c) On the incomplete Entity-Relationship diagram below show the degree of any **three** relationships that exist between the entities.



(2)

When an appointment is made for a job, this is represented in the Job relation. At the time of booking, the InGarage attribute is set to False and the JobDuration attribute is set to 0:00. When the car arrives at the garage the value of the InGarage attribute is changed to True. When the job is finished the value of the JobDuration attribute is updated to indicate how long the job took and details of the parts used are recorded in the database.

The Job with JobID 206 has been completed. The job took 1 hour 30 minutes (1:30) and used two of the parts with PartID 12.

- (d) Write the SQL commands that are required to record the amount of time that the job took in the database.

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(3)

- (e) Write the SQL commands that are required to record in the database the fact that two of the parts with PartID 12 were used.

Figure 1 is repeated below.

Job (JobID, CarRegNo, JobDate, InGarage, JobDuration)

Car (CarRegNo, Make, Model, OwnerName, OwnerEmail, OwnerTelNo)


Part (PartID, Description, Price, QuantityInStock)

PartUsedForJob (JobID, PartID, QuantityUsed)

A mechanic needs to produce a list of all of the parts used on the job with JobID 93 for a customer.

This list must include the PartID, Description, Price (each) and QuantityUsed of each part, and no other details. The parts in the list should be ordered by PartID with the parts with the lowest PartIDs nearest to the top of the list.

(f) Write an SQL query to produce the list.



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(5)

There are restrictions on which parts can be fitted to which cars. For example:

- The driver's door mirror with PartID 104 can only be fitted to one particular make and model of car.
- The ignition switch with PartID 27 can be fitted to any model of car for one particular make as the maker uses the same ignition switch in all models.
- The tyre with PartID 97 can be fitted to a wide range of cars of different makes and models as it is a standard size.

If the information about which parts could be fitted to which makes and models of cars were represented in the database, it could be used to help a mechanic identify the correct parts to use for a job.

- (g) Explain how the database design could be modified to represent which makes and models of car a part can be fitted to.

(3)

(Total 18 marks)

Q3.

A company is building an e-commerce website. The website will display details of the products that the company sells and allow customers to place orders. Customers must register on the website before they can place an order and each order can be for one or more different products.

The product, customer and order details will be stored in a relational database.

It was originally proposed that the following three relations were required:

Product(ProductNumber, ProductPrice, ProductDescription, QuantityInStock)

Order(OrderNumber, OrderDate, CustomerID, OrderingComputerIPAddress, ProductNumber, Quantity)

Customer(CustomerID, CustomerName, Address, Postcode, EmailAddress, PaymentCardNumber)

The computer programmer identified a problem with the Order relation and stated that it should be divided up into two separate relations:

Order(OrderNumber, OrderDate, CustomerID, OrderingComputerIPAddress)

OrderLine(OrderNumber, ProductNumber, Quantity)

- (a) Describe the problem that the programmer identified with the original Order relation and explain what the cause of this problem was.

(2)

- (b) Complete the Entity-Relationship diagram below to show the degree of any **three** relationships that exist between the entities in the improved database design.



(3)

A web page is required that will display a summary of the products that are on a particular order.

The summary must include only the ProductNumber, ProductDescription, ProductPrice and the Quantity of the product that has been ordered. These must be displayed in ascending order of ProductDescription.

- (c) Write an SQL query that will find the data needed to produce the order summary web page for order number 97.

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(5)

(Total 10 marks)

Q4.

A parcel delivery company uses a relational database to store information about the deliveries that it makes. These details include information about each customer who sends a parcel, the individual parcels being delivered and pricing details.

The company offers three different service speeds, which are "Express", "Standard" and "Economy". The price that is charged for delivering a parcel depends upon the service speed selected and the weight of the parcel (to the nearest gram). For each service speed, parcel prices are split into bands for a range of weights. For example, for the "Express" service, the price bands are as follows:

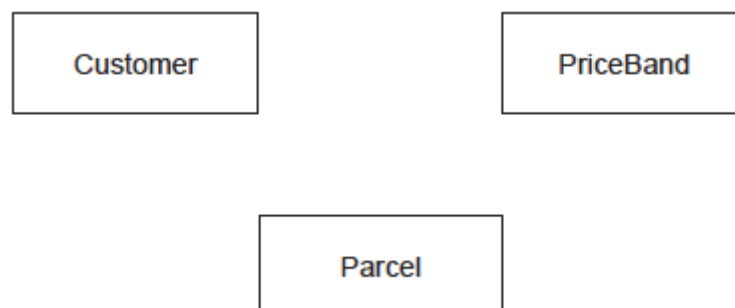
Minimum Weight (g)	Maximum Weight (g)	Price
0	249	£1.99
250	499	£2.99
500	999	£3.99
1000	4999	£4.99
5000	19999	£9.99

Similar price bands, but with different prices, exist for the "Standard" and "Economy" services.

The details are stored using the three relations in the figure.

Customer(<u>CustomerID</u> , Title, Forename, Surname)
PriceBand(<u>ServiceSpeed</u> , <u>MinWeight</u> , MaxWeight, Price)
Parcel(<u>ParcelID</u> , ServiceSpeed, Weight, DateSent, CustomerID, RecipientName, HouseNumber, Street, Town, County, Postcode)

- (a) On the incomplete Entity-Relationship diagram below, show the degree of the three relationships that exist between the entities.



(2)

- (b) The price that is charged for an "Express" delivery, weighing between 1000 and 4999 grams is to be increased to £5.99. Complete the SQL statements below to make this update.

UPDATE _____

SET _____

WHERE _____

(4)

- (c) Write a query that will list all of the parcels sent by the customer whose **CustomerID** is 109.

For each parcel, the list should include the **DateSent**, the **Postcode** that the parcel was sent to, the **ServiceSpeed** that was used and the **Price** charged, and no other details.

The list should be presented in order, with the parcel sent the longest time ago at the top of the list and the parcel sent most recently at the bottom.

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(6)

The figure is repeated below to help you answer part (d).

Customer(CustomerID, Title, Forename, Surname)

```
PriceBand(ServiceSpeed, MinWeight, MaxWeight, Price)
```

Parcel(ParcelID, ServiceSpeed, Weight, DateSent, CustomerID, RecipientName,
HouseNumber, Street, Town, County, Postcode)

- (d) The **Street, Town** and **County** parts of a recipient's address can all be identified from the **Postcode**.

This means that the Parcel relation is not normalised and contains redundant data.

Redesign the Parcel relation, and create any new relations that you think are necessary, to eliminate this redundancy from the database to produce a normalised design.

Use the same notation that has been used in the figure when answering this

question part. Make sure that you underline the attribute(s) that make up the primary key in each relation.

(3)

(Total 15 marks)

Q5.

David runs a beauty salon. He uses a database management system (DBMS) to store the information that he needs to manage his business. This information includes customer contact details, staff names, the treatments that the salon offers (for example, 'spray tan') and appointments that customers have made for treatments. A separate appointment must be made for each treatment.

The details are stored in a database using the following four relations:

Customer(CustomerID, Forename, Surname, TelephoneNumber, EmailAddress)

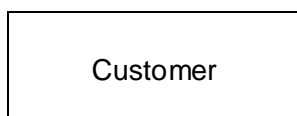
Staff(StaffID, Forename, Surname, IsQualified)

Treatment(TreatmentName, Price, TimeTaken, NeedsQualification)

Appointment(CustomerID, TreatmentName, ApDate, ApTime, StaffID)

- The IsQualified attribute for a member of staff stores one of the values True or False, to indicate if the member of staff is fully qualified or not.
- The NeedsQualification attribute for a treatment stores True or False, to indicate if the treatment can only be given by a qualified member of staff.
- The TimeTaken attribute for a treatment is the number of minutes (a whole number) that the treatment takes.

- (a) On the incomplete Entity-Relationship diagram below, show the degree of any **three** relationships that exist between the entities.



Treatment

Appointment

(2)

- (b) Complete the following Data Definition Language (DDL) statement to create the Treatment relation, including the key field.

CREATE TABLE Treatment

(

_____)

(3)

- (c) David wants to send e-mail advertisements to all his customers who had a 'Luxury Manicure' treatment in 2014.

To send the e-mail, the customers' e-mail addresses, forenames and surnames are needed.

Write an SQL query to retrieve the e-mail address, forename and surname of each customer to whom e-mails should be sent.

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(6)

(Total 11 marks)

Q6.

A government agency is responsible for storing information about vehicles and their owners. Each vehicle that is driven must be registered with this agency. Vehicles must be insured to be driven, so the agency also keeps a record of vehicle insurance policies.

Details of the vehicles, owners and insurance policies are stored in a relational database using the following three relations:

Vehicle(RegistrationNumber, OwnerID, Manufacturer, Model, Colour, EngineSize, DateRegistered)

Owner(OwnerID, Title, Forename, Surname, HouseNumber, Street, Town, Postcode)

Insurance(PolicyNumber, RegistrationNumber, DateStarted, PolicyType, ExcessAmount)

In this system, the following restrictions apply to some attributes:

- RegistrationNumber: a mixture of exactly 7 letters and numbers, eg MA11FXB
- EngineSize: a whole number value representing the capacity of the engine, eg 1597
- PolicyType: can be either 'Comprehensive' or 'Third Party' and nothing else
- ExcessAmount: a monetary value, eg 100

- (a) Complete the following Data Definition Language (DDL) statement to create the Insurance table, including the key field.

CREATE TABLE Insurance (

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_____)

(3)

- (b) The owner of the vehicle with registration number DF24JUT has had his car repainted so that its colour is now pink.

Complete this SQL statement to update the data in the Vehicle table to reflect this change.

UPDATE _____

SET _____

WHERE _____

(2)

- (c) A police officer is following a car with registration number AB72XHC. She wants to use the computerised system to check some details about the car and its owner.

Write an SQL query that could be used to retrieve the Model and Colour of the car and the Forename and Surname of the car's owner.

(4)

- (d) The police officer requests the information using a hand held terminal that connects to the Internet. She types the vehicle registration number into a form on a secure webpage and the details about the car and owner are then displayed in the web browser on the terminal.

A server-side script is used to search for the required information.

- (i) Explain what a server-side script is.

(2)

- (ii) The server-side script includes the statement:

```
RegNo = Request("RegistrationNumber")
```

Explain what this statement does when executed.

(2)

- (iii) The server-side script includes the statement:

```
Response.Write("Owner is " + Forename + " " + Surname)
```

Explain what this statement does when executed.

(2)

The definitions of the three relations in the database are repeated here.

Vehicle(RegistrationNumber, OwnerID, Manufacturer,
Model, Colour, EngineSize, DateRegistered)

Owner(OwnerID, Title, Forename, Surname, HouseNumber,
Street, Town, Postcode)

Insurance(PolicyNumber, RegistrationNumber,
DateStarted, PolicyType, ExcessAmount)

- (e) The database is to be extended to store information about vehicle safety certificates. Each year, a vehicle must be taken to a garage where it will be tested. If the vehicle passes the test, a certificate will be issued. Each certificate will have a unique Certificate Number. Certificates will last for 12 months so the date that a certificate is issued must be recorded, as must the name of the garage that issued the certificate.

The database must keep a record of all the certificates that have been issued for each vehicle. For a particular vehicle this will include the current certificate together with any certificates that have been issued in the past.

Explain how you would change the design of the database so that the information about safety certificates can be stored.

(3)

(Total 18 marks)

Q7.

A company sells furniture to customers of its store. The store does not keep the furniture in stock. Instead, a customer places an order at the store and the company then orders the furniture required from its suppliers. When the ordered furniture arrives at the store a

member of staff telephones or e-mails the customer to inform them that it is ready for collection. Customers often order more than one type of furniture on the same order, for example a sofa and two chairs.

Details of the furniture, customers and orders are to be stored in a relational database using the following four relations:

Furniture(FurnitureID, FurnitureName, Category, Price, SupplierName)

CustomerOrder(OrderID, CustomerID, Date)

CustomerOrderLine(OrderID, FurnitureID, Quantity)

Customer(CustomerID, CustomerName, EmailAddress, TelephoneNumber)

- (a) These relations are in Third Normal Form (3NF).

What does this mean and why is it important that the relations in a relational database are in Third Normal Form?

Meaning: _____

(2)

Why important: _____

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(2)

- (b) On the incomplete Entity-Relationship diagram below show the degree of any **three** relationships that exist between the entities.

Furniture

CustomerOrder

Customer

CustomerOrderLine

(3)

- (c) Complete the following Data Definition Language (DDL) statement to create the Furniture relation, including the key field.

CREATE TABLE Furniture (

)

(3)

- (d) A fault has been identified with the product that has FurnitureID number 10765. The manager needs a list of the names and telephone numbers of all of the customers who have purchased this item of furniture so that they can be contacted. This list should contain no additional details and must be presented in alphabetical order of the names of the customers.

Write an SQL query that will produce the list.

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(6)

- (e) The system requirements have changed. When an order is placed the system must now record the name of the sales person who took the order.

Place **one** tick next to the correct SQL command below that should be used to update the structure of the database so that this information can be recorded.

Command	Correct? (Tick one)
ALTER TABLE	
CREATE FIELD	

INSERT COLUMN	
---------------	--

(1)
(Total 17 marks)

Q8.

A library uses a database management system (DBMS) to store details of the books that it stocks, its members and the loans that it has made. These details are stored in a database using the following three relations:

Book(BookID, Title, Author, Publisher)

Member(MemberID, Surname, Forename, HouseNumber, StreetName, Town, County, Postcode, DateOfBirth, EmailAddress)

Loan(MemberID, BookID, LoanDate, DueBackDate, Returned)

The library does not stock more than one copy of the same book.

- (a) The key in the Loan relation is made up of three attributes.

What is the name given to a key that is made up of multiple attributes?

(1)

- (b) The relations in this database have been fully normalised.

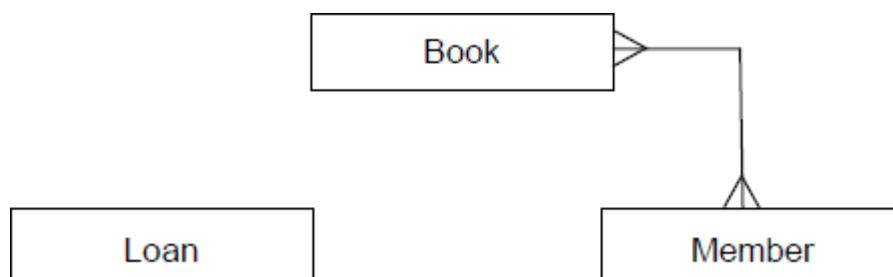
State **two** properties that the relations in a fully normalised database must have.

Property 1: _____

Property 2: _____

(2)

- (c) Complete the Entity-Relationship diagram below to show the degree of the **two** missing relationships between the entities.



(2)

- (d) The library is holding a 'meet the author' event at which members will be able to meet the author Lucas Bailey. The librarian wants to send e-mails to all of the library members who have read any of his books to invite them to the event.

Write an SQL query to retrieve the EmailAddress, Forename and Surname of the people to whom e-mails should be sent.

SELECT

FROM

WHERE

(5)

(e) A new book is to be added to the library stock. The book details are:

- BookID: 837023
- Author: Karen Matu
- Title: Kenyan Safari
- Publisher: African Travel Guides

Write the SQL commands that will add this book into the database.

INSERT INTO _____

VALUES _____

(2)

The definitions of the three relations in the database at the beginning of this question are repeated here so that you can answer Question (f) on this page without having to turn back.

Book(BookID, Title, Author, Publisher)

Member(MemberID, Surname, Forename, HouseNumber, StreetName, Town, County, Postcode, DateOfBirth, EmailAddress)

Loan(MemberID, BookID, LoanDate, DueBackDate, Returned)

(f) The system requirements have changed. The library now needs to be able to stock more than one copy of the same book. Two different copies of the same book will have the same BookID.

Explain how the database design could be modified to meet this new requirement, whilst ensuring that the database remains normalised.

(3)

(g) The DBMS organises the data in the database in files using hashing.

(i) Why is hashing used?

(1)

(ii) In the context of storing data in a file, explain what a *hash function* is.

(2)

(iii) Collisions can occur when hashing is used.

In this context, explain what a *collision* is and how one might be dealt with.

(2)

(Total 20 marks)

Q9.

A company is building an e-commerce website. The website will display details of the products that the company sells and allow customers to place orders. Customers must register on the website before they can place an order and each order can be for one or more different products.

The product, customer and order details will be stored in a relational database. It was originally proposed that the following three relations were required:

Product(ProductNumber, ProductPrice, ProductDescription, QuantityInStock)

Order(OrderNumber, OrderDate, CustomerID, OrderingComputerIPAddress, ProductNumber, Quantity)

Customer(CustomerID, CustomerName, Address, Postcode, EmailAddress, PaymentCardNumber)

The computer programmer identified a problem with the Order relation and stated that it should be divided up into two separate relations:

Order(OrderNumber, OrderDate, CustomerID, OrderingComputerIPAddress)

OrderLine(OrderNumber, ProductNumber, Quantity)

- (a) Describe the problem that the programmer identified with the original Order relation and explain what the cause of this problem was.

(2)

- (b) Complete the Entity-Relationship diagram below to show the degree of any **three** relationships that exist between the entities.

Customer

Product

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Order

OrderLine

(3)

- (c) Complete the following Data Definition Language (DDL) statement to create the Product relation, including the key field.

CREATE TABLE Product

(

(3)

- (d) The individual web pages that describe each product will be generated dynamically using server-side scripting.

Explain what a *server-side script* is.

(2)

- (e) The definitions of the four relations in the database are repeated here so that you can answer the questions on these pages without having to turn back in the question booklet.

Product(<u>ProductNumber</u> , ProductPrice, ProductDescription, QuantityInStock)
Order(<u>OrderNumber</u> , OrderDate, CustomerID, OrderingComputerIPAddress)
OrderLine(<u>OrderNumber</u> , <u>ProductNumber</u> , Quantity)
Customer(<u>CustomerID</u> , CustomerName, Address, Postcode, EmailAddress, PaymentCardNumber)

A customer can add a product to an order by loading the product's web page, typing the quantity of the product required into a text box and then pressing the order button on the page. The web browser then sends the ProductNumber and Quantity to the web server.

After the user has pressed the order button, the CGI script shown below is executed.

Line No

```
1.  ProdNum = Request("ProductNumber")
2.  SaleQuant = Request("Quantity")
3.  ProdDetails = ExecuteSQL("SELECT ProductPrice
                             FROM Product WHERE ProductNumber = " + ProdNum)
4.  ItemPrice = ProdDetails.GetField("ProductPrice")
5.  TotalPrice = ItemPrice * SaleQuant
6.  Response.Write ("Total Price is " + TotalPrice)
```

- (i) Explain the purpose of lines 1. and 2. of the CGI script:

```
ProdNum = Request("ProductNumber")
SaleQuant = Request("Quantity")
```

(2)

- (ii) Explain the purpose of line 3. of the CGI script:

```
ProdDetails = ExecuteSQL("SELECT ProductPrice  
FROM Product WHERE ProductNumber = " + ProdNum)
```

(2)

- (iii) Explain the purpose of line 6. of the CGI script:

```
Response.Write ("Total Price is " + TotalPrice)
```

(1)

- (f) A web page is required that will display a summary of the products that are on a particular order.

The summary must include only the ProductNumber, ProductDescription, ProductPrice and the Quantity of the product that has been ordered. These must be displayed in ascending order of ProductNumber.

Write an SQL query that will find the data needed to produce the order summary web page for order number 4013.

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(5)

(Total 20 marks)

Q10.

The council of a large city wants to reduce the number of cars owned by the city's residents. The council is planning to introduce a car share club. The club will own cars, which will be parked in designated parking areas across the city when not hired out. The club members will be able to hire a car via the Internet, by e-mail or by phone. Members can book a car for one or more hours, or one or more days, up to a maximum of three

weeks. Members pay a fixed monthly membership fee. They are also billed for the amount of time the car is hired plus a mileage charge. If a member returns a car late to the designated parking area, there will be a penalty charge for each additional hour. Each car has a built-in computer with mobile phone technology to provide a communication link to the booking centre. Each member will receive a membership card which contains an RFID (Radio Frequency Identification) tag and the member is issued with a PIN (Personal ID Number).

- (a) When a resident of the town wants to join the car share club, they are required to provide the following details:
- Credit card number
 - Full Name and Address (as registered against their credit card)
 - Driving Licence Number
 - E-mail address
 - Mobile telephone number

The monthly fee plus hire charges are automatically added to the member's credit card.

A statement of charges is available for the member to download from the Internet.

- (i) What other details are required to be stored about the member so that the member can only access their own statement of charges?

_____ (2)

The details held about each Parking Area are:

- A 3-character unique Location Code
- Name of Parking Area, such as "Station"
- Post Code of Parking Area

The details held about each car are:

- Car Registration Number
- Designated Parking Area

At the time of booking, the member will be asked to provide the following details:

- Member ID
- Pick-up point (from which parking area)
- Hire start date and time
- Hire end date and time

The booking centre allocates a car from the chosen parking area to the member and issues the member with a booking reference code.

Choosing suitable attribute identifiers, complete the relations making sure that the primary key attribute(s) are underlined.

- (ii) Member (_____)
 _____) (1)

- (iii) ParkingArea (_____)
 _____) (1)

(iv) Car (_____
_____)

(1)

(v) Booking (_____
_____)

(b) Complete the entity-relationship diagram for the entities below:



(3)

(c) Using SQL commands SELECT, FROM, WHERE, ORDER BY, write an SQL statement to query the database tables to produce a list of bookings for the month of December 2007. The results of the query are to be in member ID order.

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(4)

(Total 15 marks)

Q11.

Sam starts work at a small business selling garden tools and equipment by mail order. Four of the employees in the business have their own stand-alone computers.

- Mary takes the order and enters it into her computer. She records the customer's name and address, plus the item(s) ordered. She prints out a copy and gives it to Renie.
- Renie takes the items off the shelves and packs the order. She records, on her computer, the customer's name and address, and the items despatched. She notes any item that is out of stock; these will have to follow in a later despatch. She prints off a copy of these details to give to Hassan.
- Hassan produces the invoice. He records, on his computer, the customer's name and address and the items despatched with prices. He adds a handling charge and puts the invoice into an envelope ready for posting to the customer. He gives a copy

invoice to James.

- James is the accountant. He records, on his computer, the customer's name and address, the invoice amount and whether it has been paid or not.

(a) This system has disadvantages. Explain **two** of these.

1. _____

2. _____

(4)

(b) Sam suggests that if the computers were networked, they could share files. If the computers were networked, why is it unlikely that they could share files as they are set up currently?

(2)

(c) The company decide to start again and create a relational database. Sam starts talking about *attributes*, *primary keys* and *foreign keys*.

(i) Define an attribute.

(1)

(ii) Define a primary key.

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(1)

(iii) Define a foreign key.

(1)

(d) Initially Sam thinks that four tables are needed

1. Customer table
2. Stock table containing details of each item of stock
3. Order table containing general details of each order
4. OrderLine table containing details of each item ordered for a particular order

Table:	Customer		Stock		Order		OrderLine
To include these fields	Surname		PartNumber		OrderNumber		OrderNumber
	Firstname		Description		DateOfOrder		OrderLineNumber

	Address 1		UnitPrice		CustomerID		PartNumber
	Town		NumberInStock				Quantity
	PostCode						
	Telephone Number						
	CustomerID						

- (i) What would be the most suitable primary key for the table Customer?

_____ (1)

- (ii) What would be the most suitable primary key for the table OrderLine?

_____ (1)

- (iii) Name a foreign key in the table OrderLine.

_____ (1)

- (iv) Mr Jeremiah Smith telephoned Mary. He said that he had mislaid his copy of his latest order and asked her to remind him what he had ordered. Mary asked him if he could remember the date he made the order, and he told her it had been 23rd April 2006. If Mary were using a relational database, set up to include the tables as described above, she could run a query to list the items. Complete the QBE grid required to produce this list.

Field	Surname	FirstName	DateOfOrder		
Table					
Show					
Criteria					

(6)

(Total 18 marks)

Q12.

A computer technician in a school is asked to keep up-to-date details of the hardware equipment the school owns (known as an inventory). The school management require the following details to be stored for each item of hardware:

- description
- make
- model
- inventory reference number (20 alphanumeric characters)
- date of purchase
- purchase price

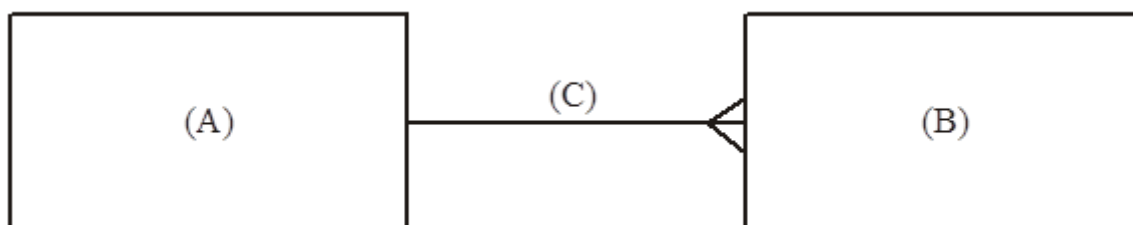
- room where item is kept.

If an item is loaned, the following details must be stored:

- location details of where the item will be located
- the initials of the person responsible for its return
- the dates of removal and return.

- (a) The **two** entities **HardwareItem** and **EquipmentLoan** have been identified.

- (i) Complete the diagram below.



B _____

C

(2)

- (ii) Name this type of diagram.

Age Group	Percentage
18-24	15%
25-34	25%
35-44	20%
45-54	18%
55-64	12%
65-74	8%
75-84	5%
85+	3%

(1)

- (b) Complete the following Data Definition Language (DDL) statements to create the fully normalised tables necessary to implement the database.

```
CREATE TABLE HardwareItem
```

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```
CREATE TABLE EquipmentLoan
```

(6)

- (c) Using the SQL commands SELECT, FROM, WHERE, ORDER BY and any others that you consider appropriate, write an SQL statement to query the database tables for the description, inventory reference number and date of removal of those items of equipment that have been loaned since a given date. The results of this query should be displayed in such a way as to make it easy to see how many times each item was loaned.

(6)

(Total 15 marks)

Q13.

A head of department in a school wishes to store data on her pupils' module results for AS and A-level Computing. The data requirements are defined as follows:

- each pupil has their forename(s) and surname recorded;
- each pupil is assigned a unique candidate number;
- each module is identified by a module code;
- each module has a given maximum number of marks available;
- each module is available each year at a winter and/or summer session;
- each pupil's module result is a number of marks between 0 and the maximum for that module;
- each pupil may resit a module several times, the best results being used to calculate the overall grade.

A single table, ResultsTable, was constructed initially in a relational database. **Figure 1** shows the structure of this table and a few entries.

Figure 1

Pupil Forenames	Pupil Surname	Candidate Number	Module Code	Exam Session	Module Mark	Level	Total Mark	Grade
Ali	Patel	1234	CPT1	W04	54	AS	187	C
			CPT1	S04	74	A	318	D
			CPT2	S04	63			

			CPT3	S04	50			
			CPT4	W05	43			
			CPT2	S05	60			
			CPT5	S05	43			
			CPT6	S05	45			
Marie Anne	Frost	1357	CPT1	W04	97	AS	255	A
			CPT2	S04	86	A	500	A
			CPT3	S04	72			
			CPT4	W05	50			
			CPT4	S05	72			
			CPT5	S05	75			
			CPT6	S05	98			
John Mark	Smith	2345	CPT1	W05	65	AS	169	D
			CPT1	S05	60			
			CPT2	S05	72			
			CPT3	S05	32			
Ali :	Patel :	7315 :	: :	: :	: :	: :	: :	: :

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(a) Which of the column heading(s) in ResultsTable would be suitable as a primary key?

_____ (1)

(b) What makes this table **not** in First Normal Form?

_____ (1)

(c) When the data in Figure 1 is stored in a fully-normalised relational database, **three** relations, **Pupil**, **ModuleResult** and **PupilGrade** are used. For each of these, complete the relations making sure the primary key attribute(s) are underlined.

(i) Pupil (_____) (2)

(ii) ModuleResult (_____)

_____)

(2)

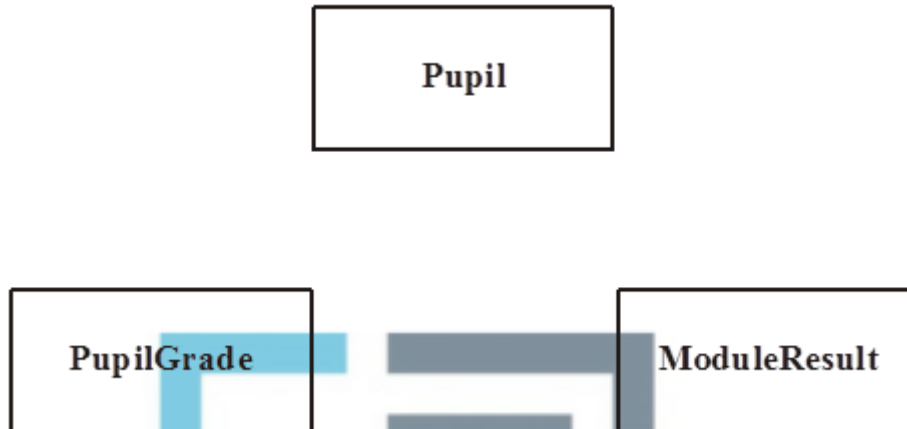
(iii) PupilGrade (_____)

_____)

(2)

- (d) Complete the partial Entity-Relationship diagram in **Figure 2** to show the degree of **two** relationships which exist between the given entities.

Figure 2



(2)

- (e) Using the SQL commands SELECT, FROM, WHERE, ORDER BY and any others that you consider appropriate, write an SQL statement to query the database tables for the pupil forenames, surname and A-level grades in descending order of total mark.

(5)

(Total 15 marks)

Q14.

An Examination Board records total entries by centre and subject for its examinations for June 2005 in an un-normalised relational database table as shown in the figure below. The data requirements specify that

- a subject offered for examination by the Examination Board has at most one Examination Board Subject Officer;
- an Examination Board Subject Officer may be a subject officer for more than one subject offered for examination by the Examination Board;
- Centre Number and SubjectID are unique.

CentreNo	Centre Name	Centre Address	SubjectID	Subject Name	ExamBoard SubjectOfficer Name	NumberOf Candidates Entered
2345	Broad Street Grammar School	Walton Road,Niver,Yorkshire	4400 5500 6600	Spanish AS Chemistry AS Physics AS	Miss Smith Mr Minns Dr Jowett	20 62 45
2346	Bash Street Comprehensive	French Lane,Therm,Oxfordshire	4400 7700 8800 9900	Spanish AS Maths AS Biology AS Computing AS	Miss Smith Mr Walton Mrs Brown Ms Jones	10 35 21 21
2347	St Trinians Girls School	Wallingbrook,Essex	3310 4410 5520	History A2 Spanish A2 Chemistry A2	Dr George Miss Smith Mr Minns	23 11 23
2348	GreyFriars	Bunter Road,Warton,Devon	8821 8855	Biology A2 French AS	Mrs Brown Miss Smith	18 18
.
9567	Kings College	The Lane, Witherton, Northumberland	2222 3320 5511	German AS Chinese AS Arabic AS	Ms Hilter Mrs Cheng Mr Abdulla	20 2 1

The relation for this table is as follows

ExamBoardEntryNumbers(CentreNo, CentreName, CentreAddress, SubjectID, SubjectName, ExamBoardSubjectOfficerName, NumberOfCandidatesEntered)

(a) What makes this table un-normalised?

EXAM PAPERS PRACTICE

(1)

(b) When the data in the figure above is stored in a fully-normalised relational database three relations Centre, **CentreEntryNumber** and **Subject** are used. For each of **these** complete the relations making sure that the primary key attribute(s) are underlined.

(i) Centre (_____)

(2)

(ii) CentreEntryNumber (_____)

(2)

(iii) Subject (_____)

(2)

(c) (i) Complete the entity-relationship diagram for the entities **Centre** and **CentreEntryNumber**.

Centre

CentreEntryNumber

(1)

- (ii) Complete the entity-relationship diagram for the entities **Centre** and **Subject**.

Centre

Subject

(1)

- (d) Problems with particular entries are also logged in the relational database. These problems are reported in e-mails sent to the Examination Board by the Examination Officer responsible for a centre's examination entries. The Examination Board may communicate a response via e-mail. The relational database includes two extra fully-normalised relations **ExaminationOfficer** and **Problem** for this purpose.

ExaminationOfficer(CentreNo, ExamOfficerSurname, Title, EMailAddress)

Problem(ProblemId, DateReported, ProblemDescription, CentreNo, ReplySent)

Using the SQL commands

SELECT, FROM, WHERE, ORDER BY

and any other commands which are considered appropriate, write an SQL statement to query the database tables for the surname and centre number of all Examination Officers who have reported a problem before 1st March 2005 and the corresponding description of the problem.

The result of the query is to be ordered in ascending order of CentreNo.

EXAM PAPERS PRACTICE

(5)

- (e) Name the type of package which would be most suitable to use with the database or on its own for creating a mail merge operation to send personalised letter attachments with each e-mail.

(1)

(Total 15 marks)

Q15.

A teacher of Advanced Level Computing uses a relational database to record details of

- Students
- Work done by students on their Advanced level project
- Marks awarded for the system life cycle phases of a student's project
- Description and maximum mark for each system life cycle.

The teacher assigns

- A unique student identifier to each student
- A unique identifier to each system life cycle phase.

Work done by a student on a project is carried out

- On more than one date
- On different system life cycle phases on different dates
- On no more than one system life cycle phase on any particular date
- In only one time period on any particular date.

Students submit their work for assessment after completing each phase of the system life cycle.

The relational database uses four tables:

Student(StudentID, FirstName, Surname, DateOfBirth)

WorkDone(Date, StudentID, StartTime, LifeCyclePhaseID, DescriptionOfWorkDone, TimeSpent)

MarkAwarded(StudentID, LifeCyclePhaseID, DateSubmitted, Mark, DateMarked, TeachersComments)

LifeCyclePhase(LifeCyclePhaseID, LifeCycleName, Maximum)

(a) Draw an Entity-Relationship (E-R) diagram for the tables:

(i) Student and WorkDone

(1)

(ii) Student and MarkAwarded

(1)

(iii) LifeCyclePhase and MarkAwarded

(1)

(b) Using the SQL commands SELECT, FROM, WHERE and any others considered appropriate, write an SQL statement to query the database tables for each of the following

(i) The first name and surname of every student;

(1)

(ii) The first name and surname of every student together with the mark awarded for the phase of the system life cycle with LifeCyclePhaseID = 1, presented in ascending order of student surname.

(5)

(Total 9 marks)

Q16.

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A swimming club organises swimming gala competitions.

A gala consists of

- more than one race
- races of different swimming strokes, e.g. breast stroke, front crawl
- races at more than one distance for a given stroke
- races with more than one swimmer.

A race has a

- specified swimming stroke
- set distance
- more than one swimmer.

A swimmer may

- swim in more than one race
- swim one swimming stroke in one race and a different stroke in another race
- swim in races of different distances.

A swimming club uses a relational database to record details of

- swimmers
- swimming galas
- swimmers entered for a race in a gala
- swimming strokes swum by swimmers.

The swimming club assigns a

- unique swimmer number to each swimmer
- unique number to each gala
- number to each race in a gala which is unique only within the particular gala, e.g. 100 metres breast stroke race is assigned the number 1
- unique number to each swimming stroke that swimmers may swim in a race, e.g. breast stroke is assigned the number 1.

The relational database uses five tables:

Swimmer(SwimmerNo, FirstName, Surname, DateOfBirth)

Gala(GalaNo, GalaDescription, DateOfGala, Venue)

GalaRace(GalaNo, RaceNo, StrokeNo, Distance, SwimmerNoOfWinner, WinningTime)

GalaRaceSwimmer(GalaNo, RaceNo, SwimmerNo, EntryFeePaid, TimeRecordedForRace)

Stroke(StrokeNo, StrokeDescription)

(a) Draw an Entity-Relationship diagram for the tables:

(i) Gala and GalaRace

(1)

(ii) GalaRace and GalaRaceSwimmer

(1)

(iii) Stroke and GalaRace

(1)

(iv) Gala and Swimmer

(1)

(b) Using the SQL commands SELECT, FROM, WHERE and any others considered appropriate, write an SQL statement to query the database tables for each of the following.

(i) The surname of the swimmer with SwimmerNo = 6.

(1)

(ii) The SwimmerNo for each swimmer in race with RaceNo = 5 and gala with GalaNo = 2, presented in ascending order of TimeRecordedForRace.

(3)

(iii) The surname of the winner of each race in gala with GalaNo = 4.

EXAM PAPERS PRACTICE

(3)

(Total 11 marks)

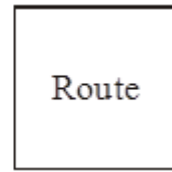
Q17.

A department of local government responsible for recreation and the environment has printed leaflets of scenic walking routes in its area. The table below shows details which are recorded in an un-normalised relational database table. The data requirements specify that

- A leaflet references one or more routes.
- A route is referenced in at most one leaflet.

(3)

- (c) Complete the entity-relationship diagram for the entities **Leaflet** and **Route**.



(1)

- (d) Problems with particular routes are logged in the relational database. These problems are reported in e-mails sent by people walking the routes for which leaflets are available. The relational database includes two extra fully-normalised relations **Person** and **Problem** for this purpose.

Person(PersonId, Surname, Title, EMailAddress)

Problem(ProblemId, DateReported, ProblemDescription, RouteId, PersonId, ReplySent)

Using the SQL commands

SELECT, FROM, WHERE, ORDER BY

and any others which are considered appropriate, write an SQL statement to query the database tables for all surnames and e-mail addresses of people who have reported a problem before 1st January 2004 and the corresponding RouteIds. The result of the query is to be ordered in ascending order of RouteId.

EXAM PAPERS PRACTICE

(6)

- (e) Name the **type** of package which would be most suitable to use with the database or on its own for creating:

- (i) a mail merge operation to send personalised letter attachments with each e-mail;

(1)

- (ii) the design of the leaflets in a printer-ready form;

(1)

- (iii) a simple accounting record of leaflet sales.

(1)
(Total 16 marks)

Q18.

A lending library uses a relational database to record details of books, book loans and borrowers.

- A unique International Standard Book Number (ISBN) is assigned to each book title such as “The Art of Passing Computing Examinations”.
- The library assigns a unique Accession Number to each copy of a book in the library.
- The library assigns a unique Borrower Number to each borrower.

The relational database uses four tables **Book**, **Book Copy**, **BookLoan** and **Borrower** with attributes (primary key is underlined) as follows:

Book(ISBN, AuthorName, Title, NumberOfCopies)

BookCopy(AccessionNumber, ISBN, DateAcquired, ReplacementCost)

BookLoan(AccessionNumber, BorrowerNumber, DateDueBack)

Borrower(BorrowerNumber, Surname, Initials, Address)

- (a) Draw an entity relationship diagram for the tables:

- (i) Borrower and BookLoan

(1)

- (ii) Book and Borrower

(1)

- (b) Using the SQL commands **SELECT**, **FROM**, **WHERE**, and any others considered

appropriate, write an SQL statement to query the database tables for each of the following:

- (i) The title of the book with ISBN "1-57820-082-2".

(2)

- (ii) The name of the author and ISBN of a book with the Accession Number 1234.

(4)

- (c) By linking the database with a word-processing package, overdue book reminder letters can be generated when copies of books on loan to borrowers are overdue. What is this process called?

(1)

(Total 9 marks)

EXAM PAPERS PRACTICE

Q19.

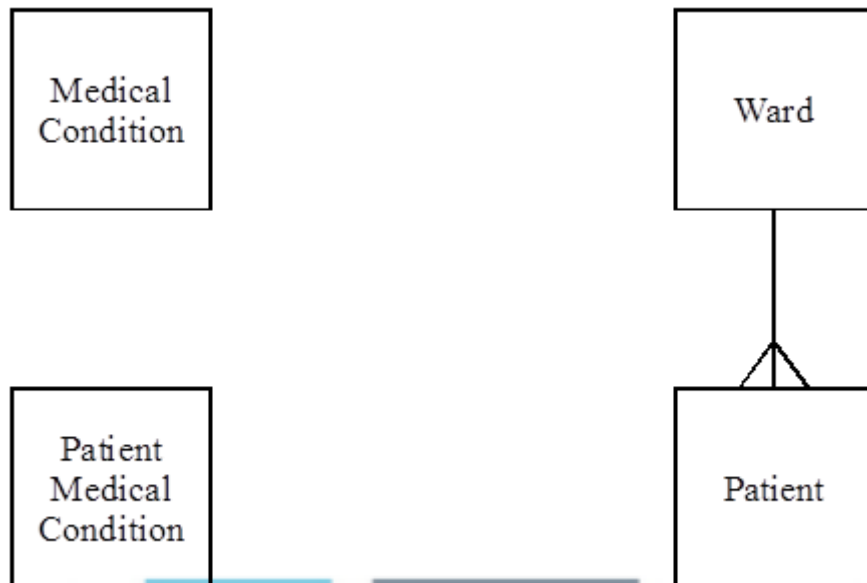
A hospital stores details of its wards, patients and their medical condition in a database in a way that will allow information about these details to be extracted. The data requirements are defined as follows.

- Each patient is assigned a patient number (unique), surname, forename, address, date of birth and gender.
- Each ward has a number of beds.
- Each ward is assigned a ward name (unique), name of the nurse in charge and the number of beds it possesses.
- Each medical condition that the hospital can treat is recorded.
- Each medical condition is assigned a medical condition number (unique), name and the recommended standard treatment.
- Each patient may suffer from one or more medical conditions.
- A particular medical condition may be attributed to more than one patient.
- The medical conditions of each patient are recorded.
- Each ward has zero or more patients.
- A patient can be assigned to only one ward at any one time.
- Each ward may have patients with different medical conditions.

Four entities for the hospital database are

Ward, Patient, MedicalCondition, PatientMedicalCondition

- (a) Using the partially complete entity relationship diagram shown in the figure below, as an aid, show the degree of **three** more relationships which exist between the given entities.



(3)

- (b) Using the following format

TableName(PrimaryKey, Non-keyAttribute1, Non-keyAttribute2, etc)

describe tables, stating all attributes, for the following entities underlining the primary key in each case.

- (i) Ward _____ (1)

- (ii) Patient _____ (2)

- (iii) MedicalCondition _____ (1)

- (iv) PatientMedicalCondition _____ (2)

- (c) Using the SQL commands **SELECT, FROM, WHERE**, write an SQL statement to query the database tables for the forename, surname and medical condition number of all patients in Victoria ward.

(3)
(Total 12 marks)

Q20.

Customers placing orders with ABC Ltd for ABC's products have their orders recorded by ABC in a database.

The data requirements for the database system are defined as follows:

- Each product is assigned a unique product code, ProductId and has a product description.
- The quantity in stock of a particular product is recorded.
- Each customer is assigned a unique customer code, CustomerId and has their name, address and telephone number recorded.
- An order placed by a customer will be for one or more products.
- ABC Ltd assigns a unique code to each customer order, ABCOrderNo.
- A customer placing an order must supply a code, CustomerorderNo, which the customer uses to identify the particular order.
- A customer may place one or more orders.
- Each new order from a particular customer will have a different customer order code but two different customers may use, independently, the same values of customer order code.
- Whether an order has been despatched or not will be recorded.
- A particular order will contain one or more lines.
- Each line is numbered, the first is one, the second is two, and so on.
- Each line will reference a specific product and specify the quantity ordered.
- A specific product reference will appear only once in any particular order placed with ABC Ltd.

After normalisation the database contains four tables based on the entities:

Customer, Product, Order, OrderLine

- (a) **Figure 1** below is a partially complete entity-relationship diagram. Show the degree of **three** more relationships which exist between the given entities.

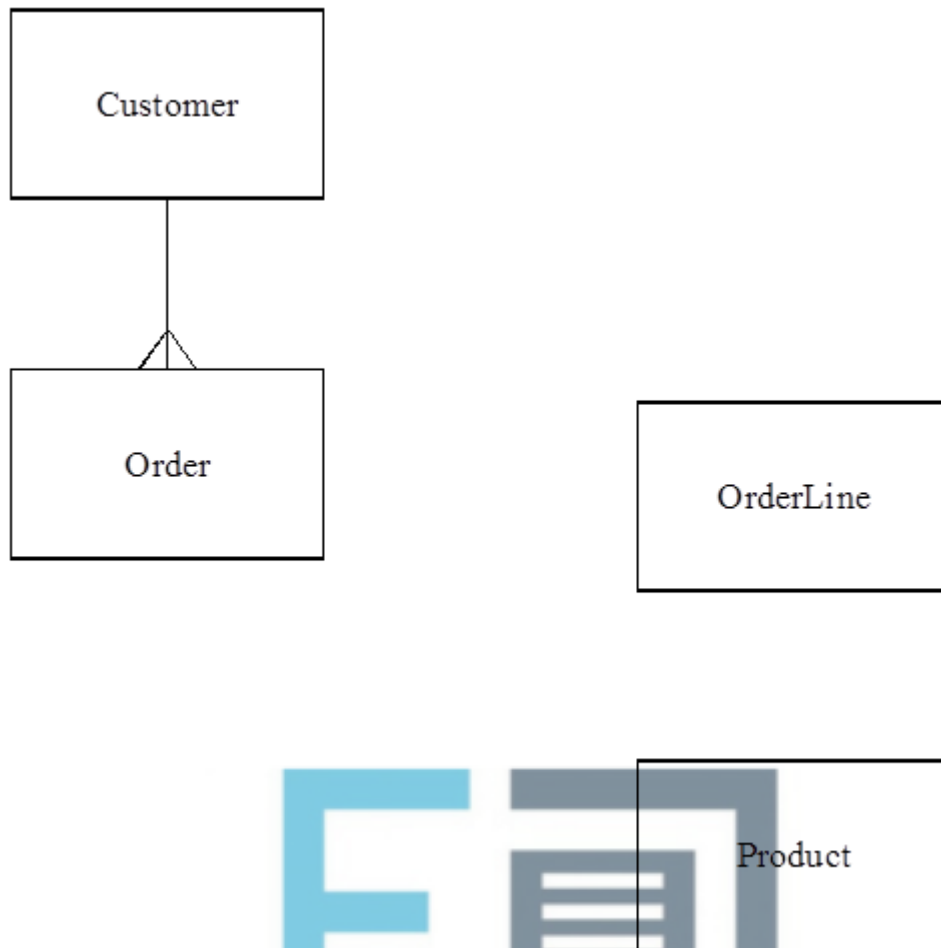


Figure 1

(3)

(b) Using the following format:

TableName(Primary Key, Non-key Attribute1, Non-key Attribute2, etc)

describe tables, stating all attributes, for the following entities underlining the primary key in each case.

(i) Product _____

(2)

(ii) Customer _____

(2)

(iii) Order _____

(3)

(iv) OrderLine _____

(4)

- (c) Using the SQL commands SELECT, FROM, WHERE, ORDER BY, write an SQL statement to query the database tables for all customer names where the orders have been despatched. The result of the query is to be ordered in ascending order of ABCOrderNo.

(6)

(Total 20 marks)

Q21.

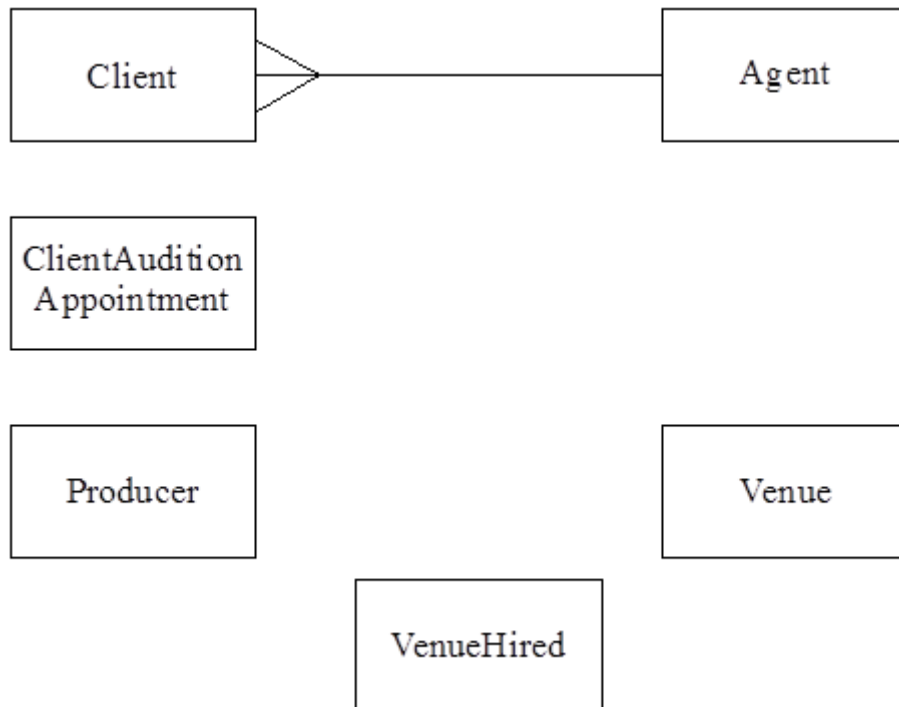
A theatrical agency finds theatrical work for its clients - actors and actresses - in theatre, television and film productions. The data requirements for a database for a theatrical agency are defined below.

- Each client is assigned to one agent
- An agent is responsible for many clients.
- Each agent within the agency is assigned an identification number and has their name recorded.
- Each client is assigned an identification number and has their name recorded.
- Audition appointments are arranged between clients and producers.
- Each producer is assigned an identification number and has their name recorded.
- Auditions take place at venues that are hired by producers around the country.
- A particular venue may be hired by more than one producer and a producer may hire more than one venue.
- Each venue is assigned an identification number and has its name and address recorded.
- A producer never holds more than one audition per day.
- A client never attends more than one audition per day.
- A venue may not be hired more than once per day.
- The date and the time of a client's appointment for an audition are recorded.

Six entities for the theatrical agency database are:

Client, Agent, Producer, Venue, ClientAuditionAppointment, VenueHired

- (a) Using the partially complete entity-relationship diagram as an aid, show the degree of **four** more relationships which exist between the given entities.



(4)

- (b) A relational database is to be used to record the data. The table corresponding to the entity **Agent** is

Agent(AgentId, AgentName)

Using the following format

TableName(PrimaryKey, Non-KeyAttribute1, Non-KeyAttribute2, etc)

describe tables, stating all attributes, for the following entities. Underline the primary key in each case.

- (i) Producer

(1)

- (ii) Venue

(1)

- (iii) Client

(2)

(iv) VenueHired

(3)

(v) ClientAuditionAppointment

(3)

- (c) The contents of a result table with the column structure shown below are to be produced.

ClientId	ClientName	AgentId	AgentName
---	---	---	---
---	---	---	---
---	---	---	---

Using a structured query language (SQL) of the type **Select ... From ... Where ...**, show how the relevant data may be extracted from the tables in part (b) to produce the contents of this result table.

Q22.

A club, AQA Wanderers, wishes to computerise the records of matches played by its first team so that it can generate statistics on its players. The data requirements are defined below.

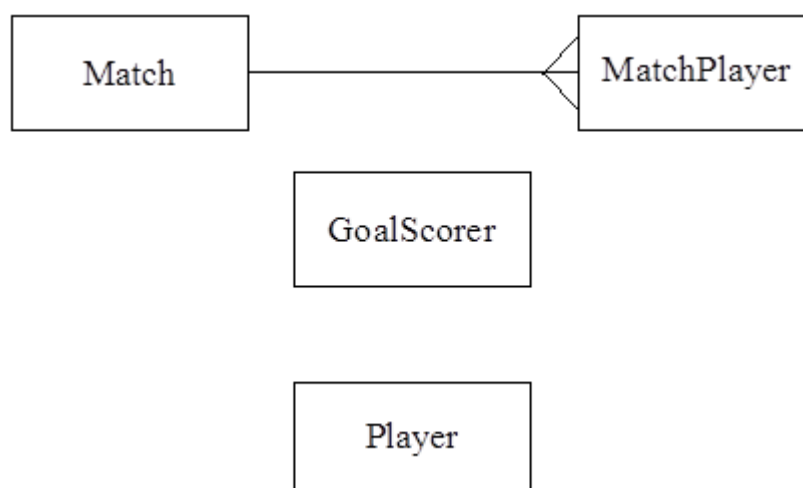
In a season, the club's first team plays against all opposition clubs' first teams from the same division of the league twice, once at home and once away from home. The date of each match, the start time, opposition team's name, whether home or away, goals for and goals against are recorded. Each AQA Wanderers' player has a player identification number and their surname, forenames, date of birth, contact telephone number are recorded.

For each match, fourteen players from a pool of twenty are selected as match players including three substitutes. The player identification numbers of the selected players are to be recorded for each match together with the identification number sewn on the shirt worn (range one to fourteen) so that a player's first team appearances may be analysed. The goal scorers of AQA Wanderers, if any, in each match must also be recorded together with the number of goals scored by each against the opposition. Players one to eleven start a match but may be substituted by players twelve to fourteen during the match. For any substitution of an AQA Wanderers' player by another during a match the player identification numbers of both are to be recorded.

Five entities for AQA Wanderers are

Player, MatchPlayer, Match, GoalScorer, Substitution

- (a) Using a copy of the partially complete entity relationship diagram shown below as an aid show the degree of **five** more relationships which exist between the given entities.



(5)

- (b) A relational database is to be used to record the data for one season so that statistics on individual players can be produced at the end of the season. Using the following format

TableName(PrimaryKey, Non-KeyAttribute1, Non-KeyAttribute2, etc)

describe tables, stating all attributes, for the following entities underlining the primary key in each case.

- (i) Player

(2)

- (ii) Match

(2)

- (iii) GoalScorer

_____ (4)

(iv) MatchPlayer

(3)

(v) Substitution

(4)

(Total 20 marks)



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