4.10.1 Relational Database

1) A garage that services and repairs cars uses a relational database to keep track of the jobs that customers have booked. 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)

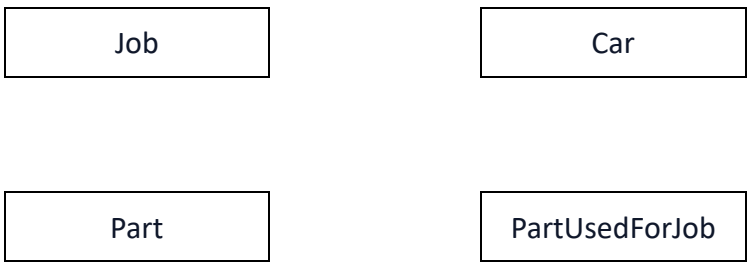
- A booking made for a car on a particular date counts as one job, regardless of how many different tasks are completed upon it.

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 a Primary Key instead?

[1 mark]

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



[2 marks]

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

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 2**.

Figure 2

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

EventType (EventTypeID, Gender, Distance, AgeGroup)

Fixture (FixtureID, FixtureDate, LocationName)

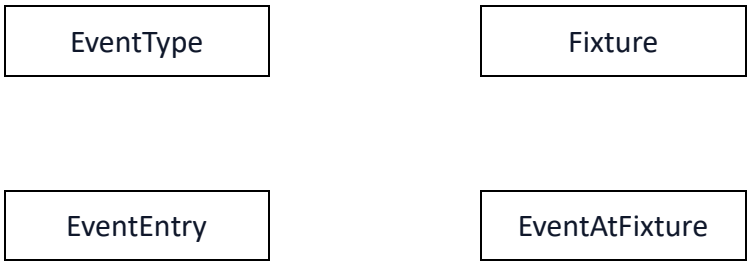
EventAtFixture (FixtureID, EventTypeID)

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.

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



[2 marks]

3) A veterinary practice with five different surgeries intends to use a relational database to store the data that it needs to manage its business.

Customers of the practice are pet owners who bring their pets to one of the surgeries for an appointment. The surgeries are staffed by veterinarians.

- Each customer is identified by a unique identity number and the customer's forename, surname, address and telephone number are recorded.
- Each pet is identified by a unique identity number and the pet's name, type and the data of birth are recorded.
- Each surgery is identified uniquely by its name. The town in which it is located and the surgery's telephone number are recorded.
- Each vet is identified by a unique identity number and the vet's forename and surname are recorded.

A pet is owned by one or more customers and each customer may own any number of pets. Over their lifetimes, pets may attend many appointments.

To make an appointment for a pet, a customer contacts a surgery. The appointment is made for the pet to take place on a particular date and time at a specific surgery.

Each vet is associated with one surgery which they work at; each surgery is staffed by several vets.

a) Complete the entity-relationship diagram below for a **fully normalised** relational database to store the data required by the veterinary practice.

Draw the remaining **three** entities and show the relationships between the entities.

[3 marks]

4) An estate agency makes details of the properties that it has for sale available to potential customer through a website. The details of the properties and other data that are useful to the agency are stored in a relational database.

Figure 3 shows the structure of the relations in the database.

Figure 3

Property (PropertyID, HouseNum, Street, Area, Postcode, Bedrooms, Bathrooms, AskingPrice, SellerID)

Seller (BuyerID, Title, Forename, Surname, Telephone)

Buyer (BuyerID, Title, Forename, Surname, Telephone, DesiredArea, MinBedrooms, MaxPrice)

Viewing (BuyerID, PropertyID, ViewingDate, ViewingTime)

Sale (SaleID, PropertyID, BuyerID, SalePrice)

A composite primary key has been selected for the Viewing relation. This consists of the attributes BuyerID, PropertyID and ViewingDate.

a) In selecting these attributes to form the primary key, what assumption has the database designer made about the behaviour of the buyers?

[1 mark]

- **That the buyer will only view the same property once on a particular day**

5) A sport centre uses a relational database to store information about its facilities and the bookings that have been made to use them.

Figure 4 shows the structure of the relations in the database.

Figure 4

Facility (FacilityID, Description, MaxPeople, PricePerHour)

FacilityForSport (Sport, FacilityID)

Booking (FacilityID, BookingDate, StartTime, EndTime, CustomerID)

Customer (CustomerID, Forename, Surname, EmailAddress)

- The Facility relation stores the different facilities available at the sports centre. Each one is identified by a unique number and has a brief description. For example, the facility with FacilityID 8 has a description 'Outdoor Pitch B'.
- PricePerHour is the price of hiring a facility for 1 hour.
- The FacilityForSport relation identifies which facilities are suitable for which sports. For example, the facility with FacilityID 1 is suitable for football, rugby and hockey and would therefore require three separate records in this relation.
- The Booking relation stores the bookings that have been made. Bookings must start and end either on the hour, at quarter past, half past or quarter to the hour. A customer can make bookings for more than one facility for the same time. However, each facility can only be booked by one customer at any one time.

The entity identifier (primary key) for the Booking relation is a composite entity identifier, consisting of these three attributes:

FacilityID, BookingDate, StartTime

An alternative entity identifier could have been chosen, composed of different attributes.

Which of the following groups of attributes (A-D) would form a valid alternative entity identifier for the Booking relation.

A. BookingDate, StartTime, EndTime
B. FacilityID, StartTime, CustomerID
C. FacilityID, BookingDate, EndTime, Sport
D. FacilityID, BookingDate, EndTime

[1 mark]

- **D**

6) A network of zoos uses a relational database system to store information about the animals that they have so that they can be matched up with animals at other zoos in a breeding programme.

Figure 5 shows the structure of the relations in the database.

Figure 5

Zoo (ZooName, Town, Country)

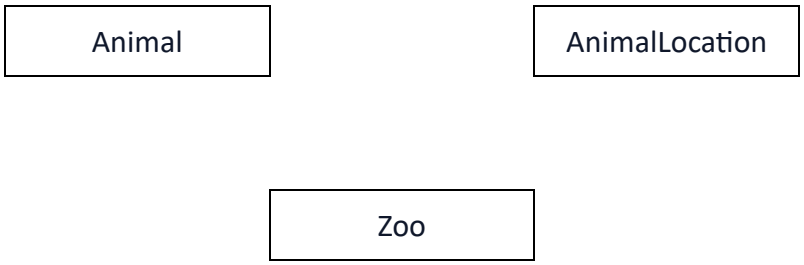
AnimalLocation (AnimalID, ZooName, DateArrived, DateLeft)

Animal (AnimalID, IndividualName, Species, DataOfBirth, Sex)

Match (AnimalFemaleID, AnimalMaleID, DateOfMatch, Successful)

- The Zoo relation stores details of the zoos that participate in the breeding programme. Each zoo is uniquely identified by its ZooName.
- The AnimalLocation relation identifies which zoos each animal has lived at. The zoo that the animal is currently at can be identified because the DateLeft attribute is set to 01/01/0001 to indicate that the animal has not left.
- The Animal relation stores details of the individual animals that are available to be matched with other animals for breeding. Each animal is identified by a unique number, the AnimalID.
- The Match relation stores details of matches that have been made. The attributes AnimalFemaleID and AnimalMaleID refer to the AnimalID values of the two matched animals in the Animal relation.

Complete the entity relationship diagram below for part of the database shown in **Figure 5**.



[2 marks]

7) A school stores information about its sports day in a relational database.

Figure 6 shows the structure of the relations in the database.

Figure 6

Athlete (AthleteNumber, Forename, Surname, Class, Gender, DateOfBirth)

Race (RaceNumber, Gender, Distance, Type, StartTime)

RaceEntryAndResult (RaceNumber, AthleteNumber, TimeSet)

Each athlete who takes part in a race is given a unique AthleteNumber. Athletes can run in more than one race. If they do, they keep the same AthleteNumber for the entire day.

The primary keys in the Athlete and Race relations have been identified in Figure 7 by underlining them. The correct primary key for the RaceEntryAndResult relation has not been identified.

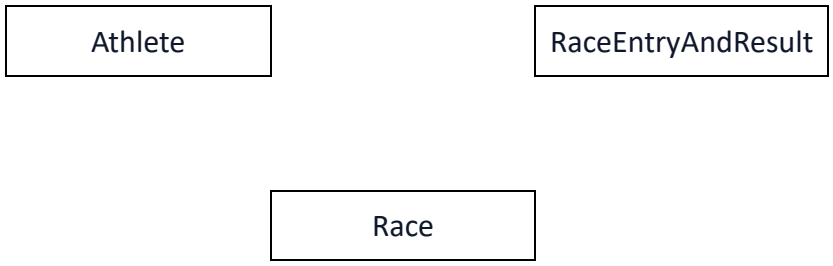
a) Underline the appropriate attribute name(s) to identify the correct primary key for this relation.

RaceEntryAndResult (RaceNumber, AthleteNumber, TimeSet)

[1 mark]

- **RaceEntryAndResult (RaceNumber, AthleteNumber, TimeSet)**

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



[2 mark]