Case Study for both sections A and B

Q-Taxi

Q-Taxi is a small independent taxi company operating in a major city. Q-Taxi owns 25 taxis which it rents out to drivers on an annual basis. Each vehicle is effectively rented out to three drivers to cover three 8 hour shifts in a day: therefore there are 75 taxi drivers contracted to Q-Taxi at any given time. Q-Taxi is a profitable company because it has built up a good reputation locally, and there is always a waiting list of drivers wanting to apply to rent a vehicle.

Each driver pays an annual rental fee in advance to Q-Taxi giving them use of a vehicle for 8 hours a day every day of the year. In addition to the annual rental, Q-Taxi takes 5% of the money a driver earns every week. Q-Taxi is responsible for taxing, insuring and maintaining the vehicles. If a vehicle is due for a service or needs to be repaired Q-Taxi contacts a garage and arranges it. Q-Taxi keeps an account of the repair and service costs for each vehicle.

At the end of each shift drivers give the money they have earned to Q-Taxi. If they needed to refuel the vehicle they also submit an expense claim at the end of the shift. At the end of every week Q-Taxi calculates the amount owing to each driver based on the money earned from fares, the expense claims and the deduction of 5%. The drivers are then paid.

[Turn over]
Section A
Answer Section A questions in Answer Book A

A1
a) Produce an activity diagram with swim lanes to represent the business activities and processes of Q-Taxi (you do not need include activities that only happen once a year).  
(11 marks)
b) List the processes and the external entities that you would include on a LOGICAL top level data flow diagram (DFD) of Q-Taxi. (You do not need to draw the DFD).  
(7 marks)
c) Explain the differences between a logical DFD and an activity diagram. Use your answers to parts (a) and (b) to illustrate your points. (You should not compare the notation).  
(7 marks)

A2
a) Explain what a prototype is and describe how it can be used in requirements gathering.  
(8 marks)
b) What are the advantages and disadvantages of prototyping?  
(10 marks)
c) Briefly describe how prototypes can be used in other stages of the system development life cycle.  
(7 marks)

A3
a) What is a CASE tool and what features would you expect a CASE tool to have?  
(11 marks)
b) Describe how a CASE tool can help to improve the quality of a system being developed.  
(14 marks)
The table below shows an example of an annual report produced for all vehicles/taxis in the Q-Taxi company described in the case study showing the maintenance services done on each vehicle.

<table>
<thead>
<tr>
<th>Vehicle No: T501ABC</th>
<th>Make: Ford</th>
<th>Date of registration: 4/10/2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver: J Smith</td>
<td>Driver's tel. no: 6031240</td>
<td></td>
</tr>
<tr>
<td>Driver: A Brown</td>
<td>Driver's tel.no: 5084222</td>
<td></td>
</tr>
<tr>
<td>Driver: J Patel</td>
<td>Driver's tel.no: 6012345</td>
<td></td>
</tr>
<tr>
<td>Service date: 3/2/2014</td>
<td>Description: Regular service</td>
<td>Garage name: ZCars</td>
</tr>
<tr>
<td>Garage address: 1 Main Street, London</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service date: 12/8/2014</td>
<td>Description: Regular service</td>
<td>Garage name: Apollo cars</td>
</tr>
<tr>
<td>Garage address: 3 Commercial Rd, London</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service date: 23/11/2014</td>
<td>Description: Additional service</td>
<td>Garage name: ZCars</td>
</tr>
<tr>
<td>Garage address: 1 Main Street, London</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle No: X887TWV</th>
<th>Make: Opel</th>
<th>Date of registration: 15/9/2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver: B Jones</td>
<td>Driver's tel.no: 6221207</td>
<td></td>
</tr>
</tbody>
</table>

a) Normalise the table to produce a set of relations in the Third Normal Form. You must show all of your workings, explaining each step.

(18 marks)

b) Explain briefly how you would map an inheritance hierarchy in a class diagram to relational database tables. Consider two possible approaches.

(7 marks)
a) Consider the following extra information about the Q-taxi company described in the case study:

“In addition to drivers who rent taxis Q-Taxi plans to employ car owners who will be using their own cars, for example chauffer driven limousines. The following data will be stored about each driver: Driver name, Tel. number, Address. For drivers who rent taxis Annual rental fee is also stored. For drivers who own their cars Car registration number is stored.”

“An object of class Vehicle consists of a chassis and an engine.”

Explain the following relationships between classes using examples from the Q-Taxi company system to illustrate your answers:

i) Association,

ii) Aggregation or Composition,

iii) Generalisation/Inheritance.

(15 marks)

b) There are many characteristics/attributes of a good software design. List FIVE of them and provide a brief explanation of each.

(10 marks)

B6

a) Discuss briefly the similarities and differences between the following UML diagrams:

- Sequence diagram
- Communication/collaboration diagram.

(6 marks)

b) Give a brief explanation of the role that sequence diagrams play in systems modelling with the emphasis on designing the interaction between the user and the system.

(6 marks)

c) Produce a sequence diagram for the use case ‘Arrange a vehicle repair’ in the Q-Taxi system described in the case study. A brief description of this use case is given below.

“The details of a vehicle to be repaired are entered by a manager. The system responds by displaying a list of all drivers who are allocated to this vehicle. The manager also enters a brief description of the fault and the details of a garage. The system then creates a corresponding fault repair record”.

(13 marks)