

**BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT**

April 2011

EXAMINERS' REPORT

Systems Analysis & Design

General Comments

Part A – Analysis: Questions 1 and 2 were attempted by 75% of candidates, while question 3 was less popular. Most candidates attempting questions 1 and 2 gave reasonable answers, but question 3 was in general answered less well. The pleasing aspect of this is that the questions requiring the application of knowledge were answered better than the question mainly based on remembering book learning.

Section A

Question A1

Learning Outcomes:

3. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.
4. Use appropriate methods and techniques to produce an analysis of a given scenario
6. Provide suitable documentation for systems analysis and design activities.

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.

- a) Taking the Q-Taxi office as the scope of the system under investigation produce a top level data flow diagram.

(15 marks)

- b) Compare the notation of a dataflow model with that of a use case model, and explain what each element of the notation represents.

(10 marks)

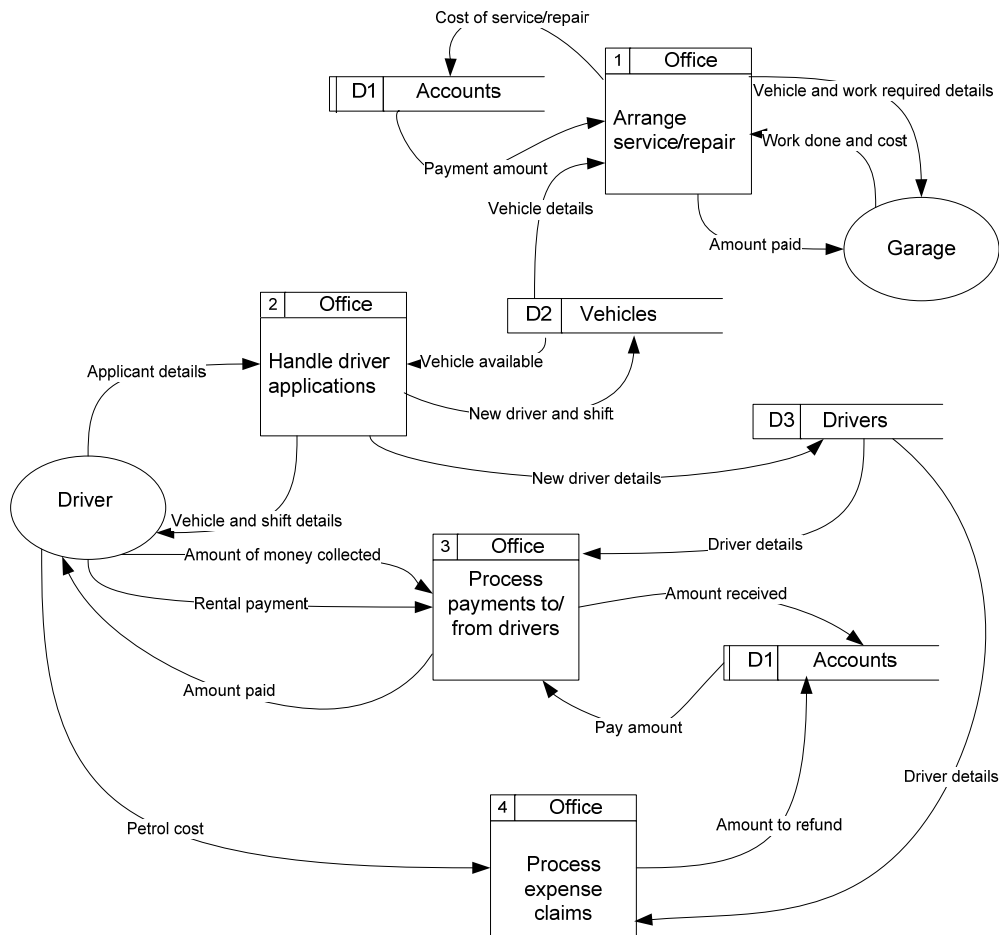
Answer Pointers/Model answer

- a) Marks were given for a good representation of the scenario as follows:

Correct external entities	3
Correct data stores	3
Correct processes and dataflows	5
Correct notation	4

1a) 15 marks

Note that the example solution below does not include the process for a driver withdrawing from the company, nor external entities concerned with regulatory aspects of a company (for example tax and insurance). These were not mentioned in the scenario description but candidates could gain marks for including them on the DFD.



- b) 1 mark for each correct comparison + 1 mark for explaining the representation up to max 10 marks.
e.g. A DFD models a system which can be a human activity system or a logical system – a use case models the functional requirements of a computer system.

DFD notation represents external entities – use case notation represents actors. An external entity is a source or sink of information but an actor is a role that directly interacts with the computer system

DFD models processes – UCD models functional requirements

DFD models data flow – UCD models dependencies between actors and use cases

DFD models data stores – UCD does not model data

DFM supports decomposition – UCM supports partitioning

1b) maximum 10 marks

Question 1 total 25 marks

Examiners' Guidance Notes

a) A common mistake with data flow diagrams is to either not name data flows or to label them as actions e.g. update accounts. Candidates should be clear that data flows are flows of information and should be labelled as such e.g. amount paid. Some candidates identified more specific external entities such as Driver and Applicant rather than just Driver, and marks were awarded for this. Similarly some candidates divided the data stores up, for example having Driver Rentals, Driver Payments, and Repair Costs etc. instead of one Accounts data store. Again marks were awarded for this.

Another mistake was to represent the wrong scope of the system. For example, including the customers of the taxis was outside the required scope of the Q-Taxi office.

b) Many candidates focused their comparison between a DFM and a Use Case model on the drawing shapes (e.g. rectangle v ellipse) rather than on what the two notations could represent. Candidates who did explain what the various notations represented did so with little comparison between the two models.

Question A2

Learning Outcomes:

2. Discuss various approaches to systems analysis and design and explain their strengths and weaknesses.

a) List **seven** techniques for eliciting requirements

2a) maximum 7 marks

b) Explain **two** of these techniques in detail including the advantages and disadvantages of each technique.

2b) maximum 18 marks

Answer Pointers/Model answer

a) Techniques identified could have included:

Interviews

Brainstorming workshops

Observation

Scenarios

Prototyping

Questionnaires

Document analysis
Joint application development
Other correct techniques also accepted

1 mark for each technique up to a maximum of 7

2a) maximum 7 marks

- b) Maximum 9 marks for each of the 2 techniques chosen – 5 marks for explanation + 4 marks for advantages and disadvantages.

e.g. points made about Interviews could include:

interview key stakeholders

it can identify personal issues and problems as well as requirements

preparation is required – arrange where and when in advance

ask questions covering who, what, why, when, how and where

arrange follow up to confirm understanding

take notes or record interview

Advantage – can form good relationship between stakeholder and analyst

Advantage – gives various viewpoints from different stakeholders

Disadvantage – time consuming for analyst and stakeholders

Disadvantage – all key stakeholders must be interviewed or requirements may be incomplete

2b) maximum 18 marks

Question 2 total 25 marks

Examiners' Guidance Notes

Most candidates answering this question were able to identify five to seven appropriate techniques. The most popular techniques explained were questionnaires, observation, interviews, and prototyping. Techniques other than those shown in the model answer above were accepted if they were a recognised technique.

Question A3

Learning Outcomes:

1. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.
6. Provide suitable documentation for systems analysis and design activities.

- a) When in the system development life cycle would you produce a business case, and why?

3a) maximum 4 marks

- b) Describe the contents of a business case.

3b) maximum 21 marks

Answer Pointers/Model answer

(This question was mainly based on ch 12 of Business Analysis, BCS 2006. This is one of the recommended texts)

- a) The business case is initially produced after the feasibility study. Answers to the effect that it is an on-going document also accepted.

It presents a course of action, or various options, to the decision makers with a justification in terms of cost and benefits.

3a) maximum 4 marks

- b) Introduction - Explains why the project has been proposed and the business case presented

Management summary – a brief summary of the main parts of the document e.g what the project is about, the options with advantages and disadvantages of each, and a recommendation.

Current situation – description of situation and problems

Options considered – explanation of each option investigated and why it is not being recommended

Cost/benefit analysis – in depth analysis of tangible and intangible benefits and costs.

Impact assessment – describing the impact of the proposed project on the organisation as not all impacts have a financial cost to them

Risk assessment – identifying risks, the impact should the risk occur and contingencies

Recommendations – Summary of the business case and recommended course of action

Maximum 3 marks for each point with explanation, up to maximum 21 marks

3b) maximum 21 marks

Question 3 total 25 marks

Examiners' Guidance Notes

A number of candidates attempting this question seem to have misunderstood what was being asked. Some based their answers on the system development life cycle, describing each phase in detail. Others described a feasibility study. Marks were given for any relevant headings that could reasonably be part of a business study, but even so marks gained were significantly below the maximum for those who misinterpreted the question.

Section B

General Comments

Part B – Design: 75% of candidates attempted Question 4. 90% of candidates attempted Question 5, while Question 6 was attempted by less than 38% of candidates. Most candidates attempting Questions 4 and 5 gave reasonable and satisfactory answers, but Question 6 caused more problems.

Question B4

Learning outcomes:

5. Use appropriate methods and techniques to produce a design for a given scenario
6. Provide suitable documentation for systems analysis and design activities

The table below shows an example of an annual report produced for all vehicles/taxis in the Q-Taxi company described in Question 1 showing the maintenance services done on each vehicle.

Vehicle No: T501ABC	Make: Ford	Date of registration: 4/10/2006	
	Driver: J Smith	Driver's tel. no: 6031240	
	Driver: A Brown	Driver's tel.no: 5084222	
	Driver: J Patel	Driver's tel.no: 6012345	
Service date: 3/2/2008	Description: Regular service	Garage name: ZCars	Garage address: 1 Main Street, London
Service date: 12/8/2008	Description: Regular service	Garage name: Apollo cars	Garage address: 3 Commercial Rd, London
Service date: 23/11/2008	Description: Additional service	Garage name: ZCars	Garage address: 1 Main Street, London
.....
Vehicle No: X887TWV	Make: Opel	Date of registration: 15/9/2007	
	Driver: B Jones	Driver's tel.no: 6221207	

- 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) Draw an entity relationship diagram (ERD) based on the relations produced in part (a).

(7 marks)

Answer Pointers/Model answer

Question 4 solution

a) The steps of normalisation are shown below.

UNF	1NF	2NF	3NF	Relations
VehicleNo Make Dateofregistration	<u>VehicleNo</u> Make Dateofregistration	<u>VehicleNo</u> Make Dateofregistration	<u>VehicleNo</u> Make Dateofregistration	Vehicle
Driver Driver's tel.no	<u>VehicleNo</u> <u>Driver</u> Driver's tel.no	<u>VehicleNo</u> <u>Driver</u> Driver's tel.no	<u>VehicleNo</u> <u>Driver</u> Driver's tel.no	Vehicle/Driver
Service date Description Garage name Garage address	<u>VehicleNo</u> <u>Service date</u> Description Garage name Garage address	<u>VehicleNo</u> <u>Service date</u> Description Garage name Garage address	<u>VehicleNo</u> <u>Service date</u> Description Garage name* <u>Garage name</u> Garage address	Driver Service Garage

For correct 1NF with explanation (remove repeating groups) **5 marks**

For correct 2NF with explanation (remove part key dependencies) **5 marks**

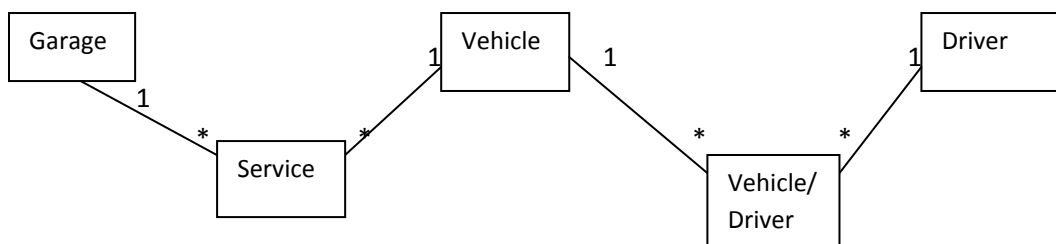
For correct 3NF with explanation (remove non-key dependencies) **5 marks**

For correct relations

3 marks

4a) maximum 18 marks

b)



NB. Solutions without the link entity Vehicle/Driver (with one to many association between Vehicle and Driver) are also acceptable (as we can assume that each driver rents one vehicle only).

For correct relationships and their multiplicities

5 marks

For correct entities

2 marks

4b) maximum 7 marks

Question 4 total 25 marks

Examiners' Guidance Notes

- a) Only a small number of candidates provided a full and correct explanation of each step. Many candidates identified correct relations/tables.
- b) Most candidates were able to draw a correct (or partly correct) diagram

Question B5

Learning outcomes:

- 3. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.
- 5. Use appropriate methods and techniques to produce a design for a given scenario
- 6. Provide suitable documentation for systems analysis and design activities

Consider the following extra information about the Q-taxi company described in Question 1:

"Q-Taxi plans to expand to rent out minibuses as well. The following data must be stored about each vehicle (both taxis and minibuses): *Registration number, Make, Date of registration*. For taxis *Taximeter code* also must be stored, while for minibuses *Max number of passengers* should be stored."

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

- a) Explain the following relationships between classes using examples from the Q-Taxi company system to illustrate your answers:
 - i) Association,
 - ii) Aggregation or Composition, and
 - iii) Generalisation/Inheritance.

(15 marks)

- b) Discuss at least TWO similarities and TWO differences between Class diagrams and Entity Relationship diagrams (ERDs).

(10 marks)

Answer Pointers/Model answer

Question 5 solution

- a)
 - Explanation of Association **2 marks**
 - Example of association (e.g. between classes Vehicle and Driver) **3 marks**
 - Explanation of Composition (it seems to be more suitable than Aggregation in this case) **2 marks**
 - Example of composition (an object of class Vehicle 'consists of' Chassis and Engine objects) **3 marks**

Explanation of Inheritance/Generalization

2 marks

Example of inheritance/generalization (Vehicle –super class, with two subclasses: Taxi and Minibus)

3 marks

5a) maximum 15 marks

b)

At least 2 similarities and 2 differences should be briefly discussed.

For reasonable similarities

5 marks

For reasonable differences

5 marks

For example:

Similarities:

- Both diagrams show the structure of data in the system i.e. ‘things’ (entities, objects) about which data should be stored
- Both diagrams show the relationships between these ‘things’

Differences:

- In Class Diagrams there are 3 types of relationships: associations, aggregations and inheritance while in ERDs relationships correspond to associations
- Classes of course are semantically ‘richer’ than entities – as they encapsulate both the attributes and operations (entities encapsulate attributes only)

5b) maximum 10 marks

Question 5 total 25 marks

Examiners’ Guidance Notes

- a) Many candidates provided reasonable explanations and examples of relationships between classes. Some candidates however confused relationships (aggregation and generalisation in particular).
- b) Most candidates were able to identify some similarities and differences. Many focused however more on the notational rather than on the semantic aspects of both diagrams.

Question B6

Learning outcomes:

- 5. Use appropriate methods and techniques to produce a design for a given scenario
- 6. Provide suitable documentation for systems analysis and design activities

a) Explain how the following UML diagrams relate to one another.

- i) Class diagrams,
- ii) Sequence diagrams,
- iii) State machines/statecharts.

(7 marks)

- b) i) Give a brief explanation of the role state machines/statecharts play in systems modeling.

(4 marks)

- ii) Produce a state machine/statechart for the class Vehicle in the Q-Taxi system described in Question 1. You may assume that objects of this class are affected by the following 'events': *registration of a new vehicle, de-registration of a vehicle, start of vehicle rental, end of vehicle rental, start of vehicle repair/servicing, end of vehicle repair/servicing.*

(14 marks)

Answer Pointers/Model answer

a)

A class diagram shows classes of objects (with their attributes and operations). The interactions between these objects for a particular use case are shown in a sequence diagram. The sequence diagram shows relevant operations/messages. Objects progress through states and these can be identified from the sequence diagrams. The collection of all these states and the transitions between them are shown on a state machine/ state chart. The transitions are usually caused by operations.

For all 'main points' (underlined) **7 marks**

6a) maximum 7 marks

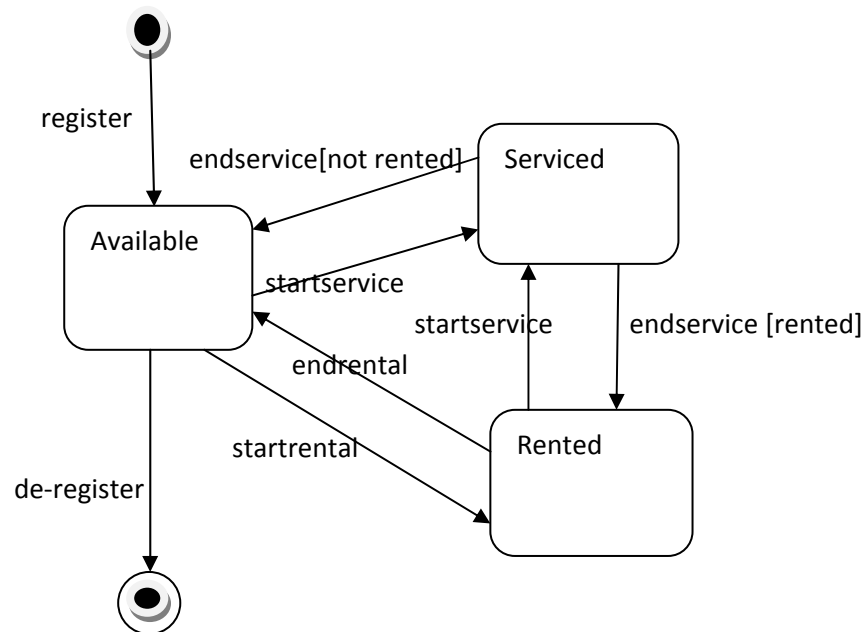
b)

(i) State machines/state charts model states and state-dependent behaviour for a modelling element (typically a class, but we can also produce state machines for subsystems, interfaces, etc). They model the 'dynamic' aspect of the modelled element (typically a class). For a specific class, its state machine captures the impact of events on that class and it shows the resulting state changes with their limitations on behaviour.

For all 'main points' (underlined) **4 marks**

6b(i) maximum 4 marks

(ii) Candidates were expected to produce the following (or similar) diagram:



correct state nodes	3 marks
initial and final states	2 marks
correct transitions	8 marks
guard condition	1 mark

6b(ii) maximum 14 marks

Question 6 total 25 marks

Examiners' Guidance Notes

This question caused more problems than questions 4 and 5.

- a) A few candidates were able to explain how the diagrams relate to each other. Most candidates tried to explain the diagrams instead. Unfortunately many of them did not explain the diagrams properly.
- b)
 - (i) Many candidates confused state machines/state charts with activity diagrams. A few candidates discussed other diagrams e.g. Gantt charts.
 - (ii) Most candidates were unable to produce a proper state machine/state chart.