BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

SYSTEMS ANALYSIS & DESIGN

EXAMINERS' REPORT

September 2015

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.

Section A

General Comments

Question 2 was the most popular question in section A with nearly 90% of candidates attempting this question. Question 1 was also popular with over 70% of candidates choosing to answer it. There is still a tendency for candidates to write everything they know related to the topic of a question rather than to understand the question posed and answer it concisely. Although a few marks may be gained using this strategy, it results in time being wasted during the examination leaving insufficient time to complete other questions.

Question Number 1

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.

Question

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).

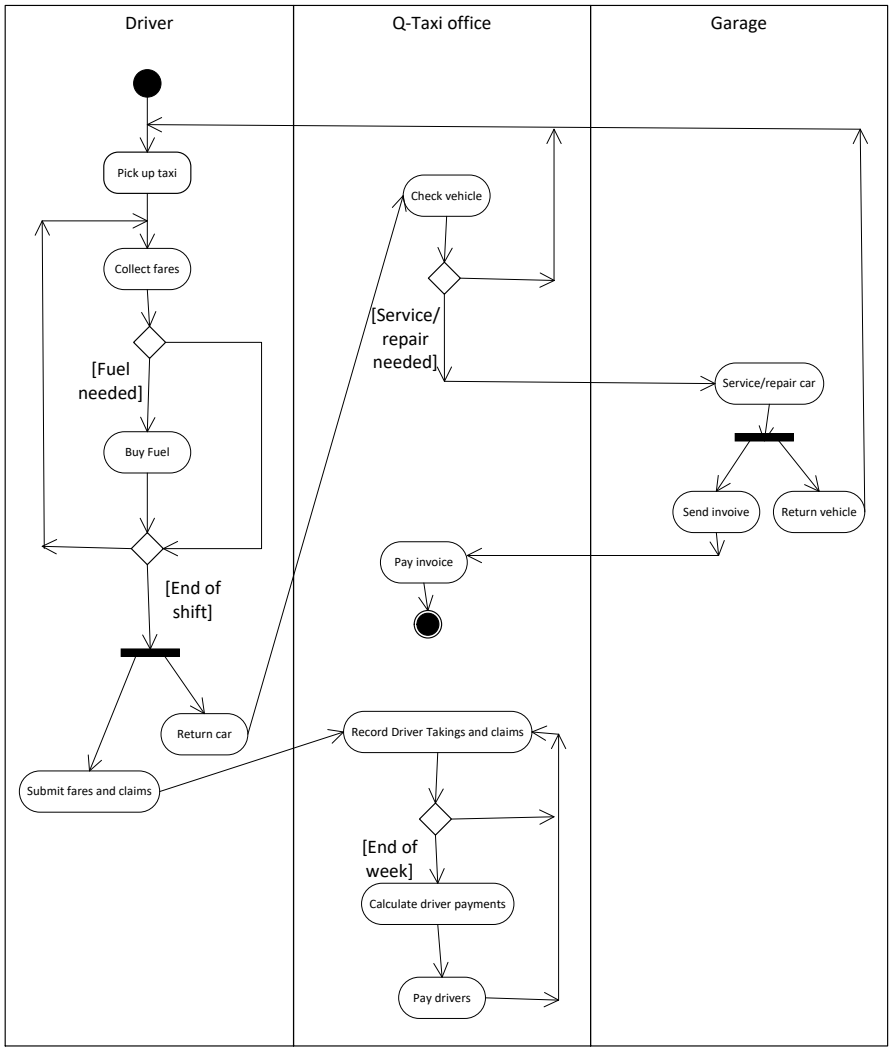
(7 marks)

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)

Answer Pointers/Model answer

a) Activities:



½ mark for each activity

Up to 6 marks for correct activities in each swim lane + correct notation

1a – 11 marks

b) Indicative Processes: Arrange Service/Repair
Handle driver application
Process payments from drivers
Process Expense Claims

External entities: Driver, Garage, Office staff

1b – 7 marks

b) Answers should include discussion about different system boundaries (Human activity outside of DFD boundary v swim lanes), level of abstraction/detail, sequence, inclusion of data, and decomposition. Marks will not be awarded for a factual comparison of notation. Examples should be included in the answer.

1c – 7 marks

Question 1 - 25 marks

Examiners' Guidance Notes

Some candidates only answered the parts of this question that related to DFDs. Approximately half the candidates attempting this question achieved a pass mark for it.

a) There is evidence that not all candidates answering this question were familiar with an activity diagram. A few attempted to produce a sequence diagram, while others produced DFDs. Most answers that were activity diagrams were not particularly good representations of the activities of Q-Taxi because the diagrams lacked relevant decision points and concurrent activities.

Although the question stated that annual activities need not be included in the activity diagram, many candidates did include these, and marks were given accordingly.

b) Most candidates answered part b well, possibly because they are more familiar with the traditional DFD. Some answers listed low level processes rather than thinking about top level processes. Many answers named Q-Taxi as an external entity. Although not strictly correct a mark was given for this making the assumption it meant the office staff.

c) This final part of the question was answered the least well. Many answers did compare notation so did not gain marks. Few answers contained examples from the case study. Some candidates said that activity diagrams represented classes or use cases. Although activity diagrams can be applied in this way, this was not the case in the context of the question.

Question Number 2

Learning Outcomes:

1. Describe different life cycle models and explain the contribution of the systems analysis and design within them.

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

3. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.

Question

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**

Answer Pointers/Model answer

a) A system or partially complete system built quickly to explore requirements. It can be low fidelity or high fidelity. It can be throwaway or evolutionary.
It helps users visualise the system, and hence know their requirements.

2a) maximum 8 marks

b) Advantages:

- Eliminates ambiguity and misunderstanding in requirements
- Identifies missing requirements
- Usefulness of system can be gauged
- Users more likely to accept the new system because they are involved in development
- Reduces training need
- Reduces risk of project failure

Disadvantages:

- Raises user expectation of time scales or possible functionality
- Can put focus on interaction issues rather than functionality
- User involvement necessary – taking up users' time
- Prototyping cycle needs managing to prevent constant changing of requirements and scope creep

2b) maximum 10 marks

c) Examples: In Feasibility – proof of concept prototypes

In Design -Interface prototypes are refined by designers to produce GUI

- Demonstrating/evaluating alternative design solutions
- To evaluate an implementation platform or DBMS

In Test - Performance prototypes to test loading/response times

Up to 2 marks for each with description

2c) maximum 7 marks

Question 2 - 25 marks

Examiners' Guidance Notes

Nearly 90% of candidates attempted this question, only about a third of these achieved a pass mark for their answer. Many candidates who did not pass this question wrote long, repetitive answers that did not address the question asked.

a) There is evidence that most candidates knew what a prototype is, but there were a few who went on to describe other requirement gathering techniques.

b) There is evidence that some of the advantages and disadvantages given were not specific enough. For example, answers such as cheaper/more expensive, quicker/slower to develop etc. Without further explanation such answers did not gain marks.

c) The final part of the question is where most candidates failed to gain marks. The evidence shows that the view of a prototype seemed to be limited to one that elicited functional or GUI requirements and evolved into the system. Very few candidates were aware of prototypes used for other purposes in the SDLC.

Question Number 3

Learning Outcomes:

3. Evaluate the tools and techniques of systems analysis and design that may be used in a given context.

Question

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

Answer Pointers/Model answer

a) Computer Aided Software (or System) Engineering tool. A set of s/w tools to support the technical, management or administration tasks in system development. Upper CASE, lower CASE or whole development process.

Max 5 marks

Possible features:

- Checks for syntactic correctness.
- Repository holds descriptions of all the diagrams, descriptions of diagrams and all the elements in the system.
- Checks for consistency and completeness
- Navigation to linked diagrams or models – easy movement between levels of abstraction or different views of the same element.
- Layering – representation of different levels of abstraction or decomposition
- Traceability – It should be possible to trace from a requirement through the analysis diagrams and design models to the code.
- Reporting – generation of reports about the models in a suitable format
- System simulation
- Performance analysis
- Code generation

Max 6 marks

b)

- Checks syntactic correctness of models – checks that the correct notation is being used and that links are made in the correct way
- Checks consistency and completeness of models– elements that appear on more than one diagram are checked for consistency, and elements missing from a diagram are identified. Error reports may be produced.
- Central repository ensures the team are using same documents etc.
- Standardised notation etc. improves team communication
- Version control
- Requirements traceability to make sure system meets requirements
- Standardised process supported by the tool

2 marks for these or any other valid point with explanation
Only 1 mark if a mark already given in part (a)

Max 14 marks
Question 3 - 25 marks

Examiners' Guidance Notes

Less than a third of candidates attempted this question with only a relatively small number achieving a pass mark. Most candidates were able to define what CASE stood for (Computer Aided System Engineering or Computer Aided Software Engineering) but were did not explain what a CASE tool would consist of or how it could be used to support system development.

Some answered described office automation tools (e.g. MS Word, MS Excel etc.) rather than an integrated CASE tool.

Section B

General Comments

Questions 4 and 5 were much more popular than Question 6 and the corresponding results reflect this trend.

Question Number 4

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

Question

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.

Vehicle No: T501ABC	**Make:** Ford	**Date of registration:** 4/10/2009	
	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: 3/2/2014	**Description:** Regular service	**Garage name**: ZCars	**Garage address:** 1 Main Street, London
Service date: 12/8/2014	**Description:** Regular service	**Garage name**: Apollo cars	**Garage address:** 3 Commercial Rd, London
Service date: 23/11/2014	**Description:** Additional service	**Garage name**: ZCars	**Garage address:** 1 Main Street, London
.....	.....	.....	.....
Vehicle No: X887TWV	**Make:** Opel	**Date of registration:** 15/9/2010	
	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) Explain briefly how you would map an inheritance hierarchy in a class diagram to relational database tables. Consider two possible approaches.

(7 marks)

Answer Pointers/Model answer

a) The steps of normalisation are shown below.

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

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) There are three approaches to mapping:

Only the superclass is implemented as a table. Attributes of subclasses become attributes of the superclass table and have null values when they are not used. This approach is in particular useful when subclasses differ from their superclass more in behaviour (operations) than in attributes.

Only the subclasses are implemented as tables. The attributes of the superclass are kept in the subclass tables. This works if the superclass is *abstract* (i.e. there are no instances of it).

All the classes (both the subclasses and the superclass) are implemented as separate tables. To retrieve the data for a subclass, both its own table and the table of its superclass must be accessed.

Any two approaches should be sufficiently discussed.

4b) – maximum 7 marks

Question 4 – 25 marks

Examiners' Guidance Notes

a) There is evidence that many candidates had problems with the normalisation process and did not provide any explanations.

b) Many candidates did not answer this part satisfactorily; many answers were irrelevant e.g. a general discussion of inheritance instead.

Question Number 5

Learning outcomes:

2. Discuss various approaches to systems analysis and design and explain their strengths and weaknesses.
5. Use appropriate methods and techniques to produce a design for a given scenario
6. Provide suitable documentation for systems analysis and design activities

Question

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)

Answer Pointers/Model answer

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 (Driver –super class, with two subclasses: Renting driver, Owner). **3 marks**

5a) maximum15 marks

b) Possible characteristics of a good software design are: Functional, Efficient, Economical, Reliable, Secure, Flexible, General, Manageable, Maintainable, Usable, Reusable.

Five of these should be briefly explained **(2 marks * 5)**

5b) maximum 10 marks

Question 5 – 25 marks

Examiners' Guidance Notes

a) The evidence shows that only a small number of candidates provided sufficient explanations of various relationships between classes. In many cases explanations were missing. Examples in general were adequate, but many candidates did not produce any diagrams.

b) Some answers were sufficient. However, a substantial group of candidates discussed the user interface design principles instead.

Question Number 6

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

Question

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)

Answer Pointers/Model answer

a) Proper discussion of similarities e.g. both diagrams represent interaction diagrams, both diagrams show 'realisation' of use cases, etc. **(3 marks)**

Proper discussion of differences e.g. sequence diagrams place an emphasis on a time sequence, while communication/collaboration diagrams place an emphasis on the links between objects/classes, etc. **(3 marks)**

6a) maximum 6 marks

b) Sequence diagrams are used to model :
interactions between objects (during the realisation of a use case), and
interactions between the user and the system ('represented' by e.g. the boundary object)

Sequence diagrams can be used as Analysis technique (more general 'model' of interactions) or as a Design technique (more detailed 'model' of interactions).
When modelling user-system interactions they focus on messages exchanged between the user and the system/the boundary object.

6b) maximum 6 marks

c) Actor: Manager **1 mark**

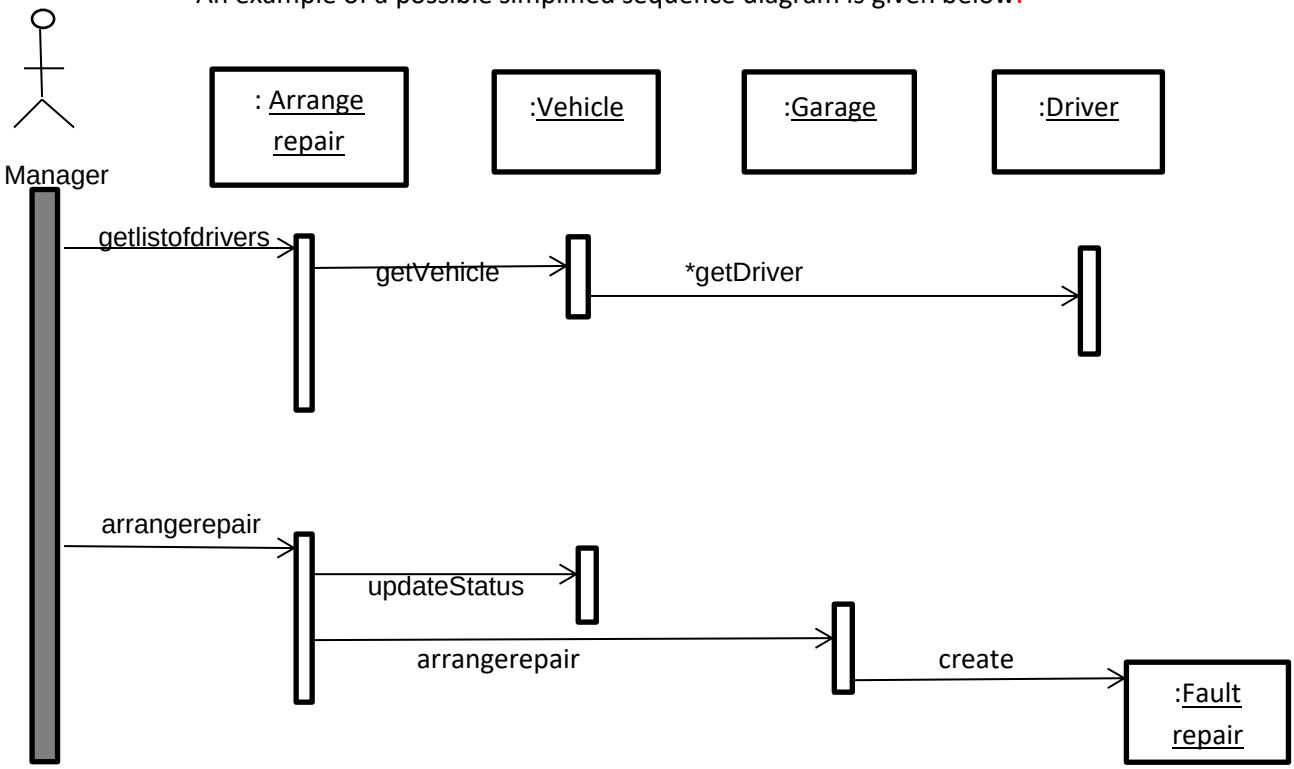
Classes/objects: Vehicle, Garage, Fault repair (created), Driver, possible User interface

5 marks

Messages: **5 marks**

Loop (to display the list of drivers): **2 marks**

An example of a possible simplified sequence diagram is given below.



N.B.' Arrange repair' class represents both the boundary and control class for this use case.

6c) maximum 13 marks

Question 6 – 25 marks

Examiners' Guidance Notes

a) Only a small number of candidates provided a clear discussion of the similarities and differences between Sequence diagrams and Communication diagrams.

b) Only a few candidates provided satisfactory answers.

c) A small group of candidates produced different types of diagrams (e.g. activity diagrams).

The following comments apply to candidates who produced a sequence diagram:

- Almost all candidates identified the right actor (manager),
- Many candidates identified inappropriate classes e.g. System, Database, etc.
- Messages in general were adequate,
- Only a small number of candidates included a loop in their diagrams.