

**BCS THE CHARTERED INSTITUTE FOR IT**  
**BCS HIGHER EDUCATION QUALIFICATIONS**  
BCS Level 5 Diploma in IT  
March 2014

**EXAMINERS REPORT**  
**Systems Analysis and Design**

**Section A**

**General Comments**

In general candidates are beginning to demonstrate a little knowledge of newer development approaches, and some agile methods. However, there is generally a lack of skill in being able to apply this knowledge to practical examples. Answers to questions 1, 2 and 3 suggest that many candidates are still focussing on more traditional techniques and methodologies, and have a limited understanding of more recent approaches.

**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**

You should not include invoices and payments in your answer to this question.

- a) List the processes and the external entities that you would include on a top level data flow diagram of the Wheelies company. (You do not need to draw the DFD). **(8 marks)**
- b) Produce a use case diagram for a computer system to support Wheelies' business processes. **(9 marks)**
- c) Compare the types of information conveyed by a DFD and a use case diagram. Use your answers to parts (a) and (b) to illustrate your points. (You should not compare the notation) **(8 marks)**

### Answer Pointers/Model answer

a) Processes:

- Receive Customer Order
- Produce manufacturing forecast
- Purchase parts from suppliers
- Receive parts from suppliers
- Assemble bicycles (add to stock)
- Ship Customer Order

External entities: Customers and Suppliers

**(1a – 8 marks)**

b) Use Cases: Warehouse actor Add a supplier

	Place a purchase order
	Receive part from supplier
	Allocate bicycle to a customer order
	Ship customer order
Customer	Place customer order
	Register as a new customer
Manufacturing	Produce forecast
	Add bicycle to stock
	Consume parts

**1 mark for each use case with appropriate actor ( $\frac{1}{2}$  if actor not correct)**

**(1b – 9 marks)**

- b) Answers could include discussion about different system boundaries, level of abstraction/detail, actors and external entities, decomposition and partitioning, data flow/stores shown on DFD, and the difference between physical and logical DFDs. Marks were not awarded for a factual comparison of notation.

**Up to 2 marks for each point discussed and illustrated**

**1c – 8 marks**

**Question 1 - 25 marks**

### Examiners' Guidance Notes

This was a popular question with 95% of candidates attempting it. Most candidates answered part a) well, but answers to parts b) and c) were very varied. Candidates need to be clear that a use case is a goal the actor wishes to achieve with the computer system, not a physical process. Therefore processes from a DFD do not directly translate into use cases. Very few answers included examples from parts a) and b) to illustrate points made in part c)

## Question Number 2

### 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

### Question

- a) The computerised system for Wheelies allows customers to place their orders over the internet. Wheelies sells to cycle shops not individuals, therefore they invoice and collect payment after delivery of the bicycles. Produce a system use case description for the normal scenario of the use case 'Place an order'. **(10 marks)**
- b) Explain what an alternative scenario is in a use case description, and why it may occur. **(5 marks)**
- c) Write the alternative scenarios for the use case description in part a. **(10 marks)**

### Answer Pointers/Model answer

These are sample solutions. Marks will be given for other reasonable answers.

- a) Actor 'Customer'
  1. The Customer enters their details.
  2. The system checks whether the customer already exists
  3. The system displays the models and prices
  4. The Customer enters the required model
  5. The system displays the price and estimated delivery date
  6. The Customer confirms the order
  7. The system displays an order number
  8. The use case ends

1 mark for the actor and each correct step  
2 marks for the clarity of actor and system responsibilities

**(2a) maximum 10 marks)**
- b) An alternative scenario is an alternative path through a use case starting from any step. It can occur because of actor choice, invalid entry, or a system constraint or condition not met.

**(2b) maximum 5 marks)**

- c) In step 2 the Customer is new  
The system informs the Customer that they must be a recognised customer  
The use case ends

In step 4 the model number entered is not recognised  
The system informs the Customer  
The use case ends

In step 6 the Customer does not confirm the order  
The use case ends

**(2c) maximum 10 marks)**  
**Question 2 - 25 marks**

### **Examiners' Guidance Notes**

Around 30% of candidates attempted this question with only about a third of those passing it. A common error was to describe a business process rather than a single use case interaction between the actor and the system. Similarly, alternative scenarios were often described as alternative business processes.

### **Question Number 3**

#### **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.

### **Question**

- a) What are the FOUR key principles or values of agile software development?

**(12 marks)**

- b) Using an agile method of your choice (for example: DSDM; eXtreme programming; Scrum) describe the iterative/incremental project life cycle. You should illustrate your answer with a diagram of your chosen method's life cycle.

**(13 marks)**

**Answer Pointers/Model answer**

a) Actual values in manifesto are:

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

**3 marks each for these 4 values. Other answers may include iterative/incremental, small teams, timeboxing etc. Allow 1 mark for each reasonable point.**

**(3a - max 12 marks)**

b) For an answer describing iterative and incremental development without referring to a specific Agile method the maximum mark for this part of the question is 7.

For a good explanation of the method

**(6 marks)**

For correct diagram

**(7 marks)**

**(3b – 13 marks)**

**Question 3 - 25 marks**

**Examiners' Guidance Notes**

Nearly 46% of candidates answered this question with the majority of them passing it. None of the candidates quoted the Agile Manifesto's 4 values. However, most answers consisted of other agile ideas such as those shown above. Only a minority of candidates answered part b) fully by including a diagram of the method. Candidates in general seemed to find it hard to interpret a method's life cycle model as a generic iterative and incremental life cycle.

**Section B****General comments:**

Design: 100% of candidates attempted Question 4, and 95% of candidates attempted Question 5. Question 6 was attempted by less than 25% of candidates. As in section A, the answers to the questions in section B suggest that candidates learn the theory of 3NF, UML notation and design, but are less skilled at applying the techniques to examples.

**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

This question refers to the case study described above (i.e. Wheelies Bicycle Manufacturer). The table below shows an example of a list of bicycle parts provided by different suppliers.

<b>Part No.: 8765</b>	<b>Part Name:</b> Titanium Small Frame	<b>Part Type Code:</b> FS	<b>Part Type Name:</b> Frame-Small	
	<b>Supplier No.:</b> S12	<b>Supplier Name:</b> BicParts	<b>Supplier's Part Ref No:</b> Frame237	<b>Cost Price:</b> 350.00
	<b>Supplier No.:</b> S15	<b>Supplier Name:</b> XYZBikes	<b>Supplier's part Ref No:</b> BF234X	<b>Cost Price:</b> 320.00
	.....	.....	.....	....
<b>Part No.: 7654</b>	<b>Part Name:</b> Aluminium Medium Frame	<b>Part Type Code:</b> FM	<b>Part Type Name:</b> Frame-Medium	
	<b>Supplier No.:</b> S15	<b>Supplier Name:</b> XYZBikes	<b>Supplier's Part Ref No:</b> BF123Y	<b>Cost Price:</b> 180.00
	....	.....	....	....
<b>Part No.: 4567</b>	<b>Part Name:</b> Leather Small Seat	<b>Part Type Code:</b> SS	<b>Part Type Name:</b> Seat-Small	
	<b>Supplier No.:</b> S10	<b>Supplier Name:</b> BikeParts4You	<b>Supplier's Part Ref No:</b> SeatSS134	<b>Cost price:</b> 39.99
	.....	.....	.....	.....
	.....	.....	.....	.....

- a) Normalise the table to produce a set of relations in the Third Normal Form. You must show all of your working 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

a) The steps of normalisation are shown below:

UNF	1NF	2NF	3NF	Relations
Part No Part Name Part Type Code Part Type Name	<u>Part No</u> Part Name Part Type Code Part Type Name	<u>Part No</u> Part Name Part Type Code Part Type Name	<u>Part No</u> Part Name Part type Code*  <u>Part Type Code</u> Part Type Name	Part   Part type
Supplier No Supplier Name Supp Part Ref No Cost Price	<u>Part No</u> <u>Supplier No</u> Supplier Name Supp Part Ref No Cost Price	<u>Part No</u> <u>Supplier No</u> Supp Part Ref No Cost Price	<u>Part No</u> <u>Supplier No</u> Supp Part Ref No Cost Price	Part/Supplier
		<u>Supplier No</u> Supplier Name	<u>Supplier No</u> Supplier Name	Supplier

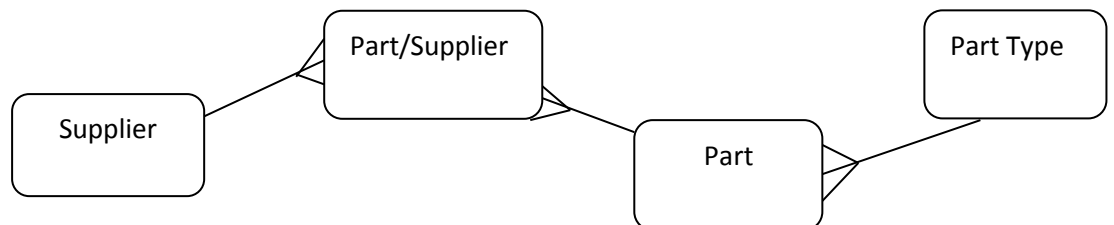
For correct 1NF with explanation (remove repeating groups) **(5 marks)**

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 - 18 marks)**

b)



For correct relationships and their multiplicities **(5 marks)**

For correct entities **(2 marks)**

**(4b – 7 marks)**

**Question 4 - 25 marks**

### Examiners' Guidance Notes

- a) A substantial number of candidates provided a correct explanation of each step and identified correct relations/tables. However, the step into 2NF seemed to be a stumbling block with many candidates not identifying Cost and Supplier Part Ref No as being dependent on **both** Supplier No and Part No.
- b) Most candidates answered this part reasonably well. A few candidates had problems with relationships and their multiplicities.

### 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) Provide a brief explanation of the following concepts in object orientation:
  - i) Class and object,
  - ii) Encapsulation,
  - iii) Message passing.

**(7 marks)**

- b) Consider the following extra information about the Wheelies Bicycle Manufacturer described above:

*“There are two types of suppliers: local suppliers and foreign suppliers. The following data are stored about each local supplier: Supplier No, Supplier name, Email address, Town.*

*The attributes of each foreign supplier are: Supplier No, Supplier name, Email address, Country, Currency. Each Bicycle Model consists of a frame, 2 wheels, a handlebar, and a seat.”*

Explain the following relationships between classes using examples from the Wheelies system to illustrate your answers:

- i) Association,
- ii) Aggregation or Composition, and
- iii) Generalisation/Inheritance.

The examples should show relevant fragments of a class diagram.

Explain also the differences between generalisation/inheritance and aggregation relationships between classes.

**(18 marks)**



**Answer pointers/Model answer**

- a) Proper explanation of class and object. (3 marks)
- Proper explanation of encapsulation. (2 marks)
- Proper explanation of message passing. (2 marks)

(Question 5a- 7 marks)

- b) Explanation of association (2 marks)
- Example of association (e.g. between Customer and Customer order) (3 marks)
- Explanation of aggregation (2 marks)
- Example of aggregation (e.g. object of class BicycleModel 'has' frame, 2 wheels, handlebar, seat) (3 marks)
- Explanation of inheritance/generalization (2 marks)
- Example of inheritance/generalization (e.g. Supplier – superclass with two subclasses: Local Supplier, Foreign Supplier) (3 marks)
- Explanation of the differences between generalisation and aggregation. (3 marks)

(Question 5b – 18 marks)

**Question 5 - 25 marks**

**Examiners' Guidance Notes**

- a) This part was generally answered well, but some candidates who appeared to understand Class and Object, and Encapsulation seemed confused about message passing.
- b) Most candidates answering this question provided reasonable explanations of the different relationships but some could not illustrate their answers with an example from the case study.

**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

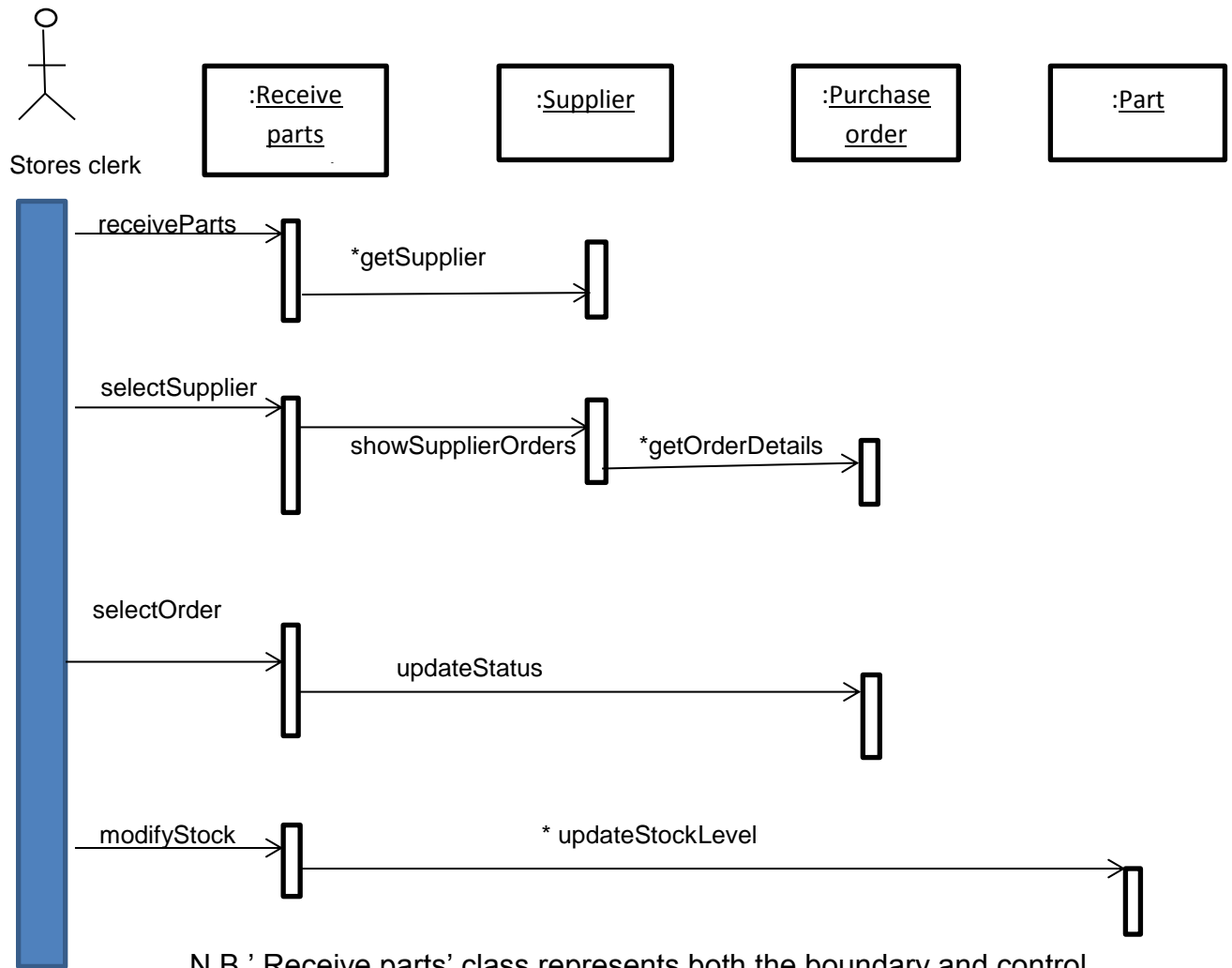
## Question

- a) Discuss briefly the purpose of sequence diagrams and state machines/charts. **(4 marks)**
- b) Produce a sequence diagram for the use case 'Receive parts' in the Wheelies system described above. A brief description of this use case is given below.
- "A list of all current suppliers is displayed by the system. A stores clerk selects the required supplier from the list. The system responds by displaying all pending purchase orders placed by Wheelies with this supplier. The clerk selects the purchase order which has been delivered and modifies its status from pending to fulfilled. Finally the clerk enters quantities for all delivered parts and the system updates the corresponding stock levels."* **(13 marks)**
- c) Produce a state machine/chart for the class Customer Order in the Wheelies system. You may assume that the objects of this class are affected by the following 'events' (listed below in alphabetical order):
- allocate bicycles to order
  - cancel an order
  - despatch an order
  - fulfil an order
  - place an order
- (8 marks)**

## Answer pointers/Model answer

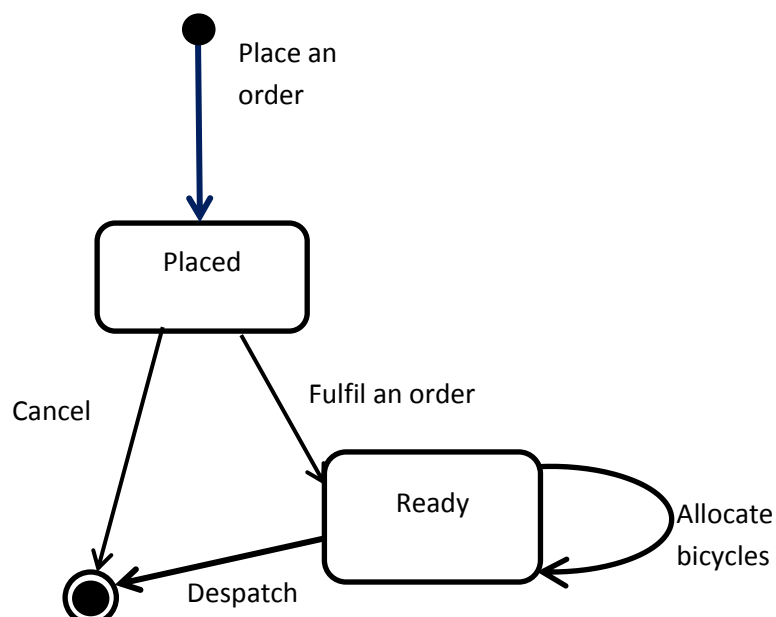
- a) The purpose of sequence diagrams. **(2 marks)**  
The purpose of state machines/charts. **(2 marks)**
- Question 6a – 4 marks**
- b) The sequence diagram should have the following elements:
- Actor – Stores clerk **(2 marks)**
  - Classes/Objects: Supplier, Purchase\_order, Part. **(5 marks)**
  - Right messages/operations **(4 marks)**
  - Loops (to show lists displayed by the system) **(2 marks)**
- Question 6b– 13 marks**

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



N.B.' Receive parts' class represents both the boundary and control class for this use case

- c) A state machine should have the following elements: states, initial and final states, transitions. Possible states are Placed and Ready, but other states can also be identified e.g. Allocated as a result of 'Allocate bicycles'.



correct state nodes (3 marks)  
initial and final states (1 mark)  
correct transitions (4 marks)  
(Question 6c - 8 marks)

**Question 6 - 25 marks**

### **Examiners' Guidance Notes**

This question was not popular with only around 25% of candidates attempting the question. Of these only a small number answered it well. Although part a) was answered reasonably well, the practical application of the diagrams to the case study for parts b) and c) was not achieved satisfactorily by most candidates.

- a) Insufficient or incorrect objects were often included in the interaction, along with inconsistent messages between objects.
- b) Only a small number of candidates produced good state charts. A common mistake was to name the states as actions, and to omit naming of the transitions.