

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

SYSTEMS ANALYSIS & DESIGN

~~Monday 21st~~ March 2016 - Morning

Answer **any** FOUR questions out of SIX. All questions carry equal marks
Time: TWO hours

Answer any Section A questions you attempt in Answer Book A
Answer any Section B questions you attempt in Answer Book B

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are NOT allowed in this examination

Case Study for both sections A and B

The 'Exotic Treat' company

The 'Exotic Treat' company is a small, independent business that sells exotic sweets and cakes to the public. The proprietor is very keen on baking and specialises in making homemade sweets and cakes for sale in the shop. As well as making much of the confectionery sold in the shop, the proprietor also buys sweets and some cakes from suppliers to increase the range of products for sale.

At the end of each day the proprietor reviews the sales of the homemade items. He then decides how many sweets and cakes to make for the next day. This is also partly to replenish any stock that needs to be bought from suppliers, and also to keep track of the sales. Once a week the proprietor checks the stock to dispose of anything that is past its 'use by' date. He also checks to see if any raw ingredients for the homemade products, or any pre-made sweets and cakes need to be ordered from the suppliers.

The proprietor orders supplies on a Cash On Delivery basis, so all deliveries are paid for immediately.

Section A

General Comments

Part A – Question 1 was the least popular question, while substantially fewer candidates attempted this question than Questions 2 and 3. ~~This follows the pattern from previous years where candidates seem less comfortable with putting their knowledge into practice than with questions that allow more discursive answers.~~

Questions 2 and 3 were both attempted by the majority of candidates. Many candidates provided clear answers to these questions, but a minority wrote lengthy answers that did not focus specifically on the question being asked.

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.

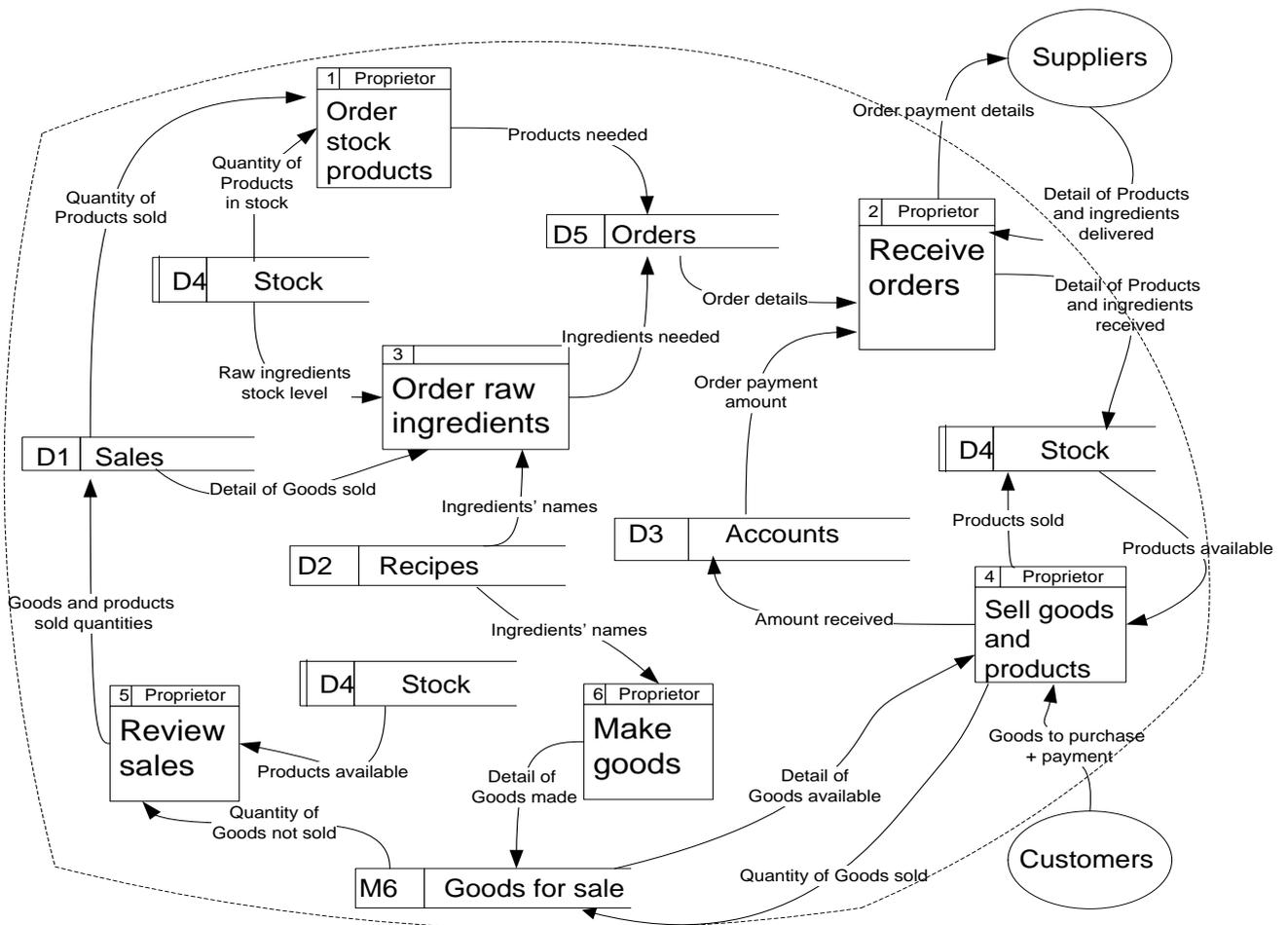
Question

- a) Produce a top level data flow diagram of the 'Exotic Treat' company.
(20 marks)
- b) Compare a data flow model with an Entity Relationship model. There is no need to produce a complete ERD but you may wish to illustrate your answer with example.
(5 marks)

Answer Pointers

- a) For good representation of scenario:

Correct external entities	4
Correct data stores	4
Correct processes	5
Correct notation	5
Completeness	2



1a - maximum 20 marks

- b) DFD shows process, boundary, unstructured data stores, information flow, decomposition.
 ERD shows data entities and relationships, static model, can be partitioned
 For each correct comparison – 1 mark

1b - maximum 5 marks

Question 1 - 25 marks

Examiners' Guidance Notes

- a) Many candidates **made the mistake of naming** dataflows as actions e.g. 'update accounts', **this is incorrect**. Candidates should be clear that dataflows are flows of information and should be labelled as such e.g. 'amount paid'.
- b) The majority of candidates answering this question **knew explained** the basic differences between a DFD and an ERD. Only a minority of candidates took the option of supplying an example ERD which was not required but was helpful in illustrating the points made.:-

Question Number A2

Learning Outcomes:

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

Question

- a) Describe the role and responsibilities of the following:
 - i) Business Analysts
 - ii) Stakeholders

(10 marks)
- b) Describe the phases of the Systems Development Life Cycle explaining the involvement of the two roles in Part (a) in the relevant phases.

(15 marks)

Answer Pointers

- a)
 - i) Business Analyst – investigates business systems (organisational structure, processes, IT systems); identifies how to improve systems, solves the business problem; presents the business case or feasibility study; gathers and documents business requirements.

2a(i) - 5 marks
 - ii) A Stakeholder is someone affected by or with influence upon/involved in a project. They could be internal to project team, internal to organisation or outside organisation.

2a(ii) - 5 marks
- b) The Business analyst is likely to be involved in the feasibility study and analysis phases, also possibly implementation and testing. Stakeholders, particularly users, are involved in requirements gathering, agreeing requirements and user acceptance testing.

2b - 15 marks

Question 2 - 25 marks

Examiners' Guidance Notes

Some candidates spent a lot of time explaining the phases of the SDLC in a familiar way but without discussing the roles of the Business Analyst or Stakeholders.

Question Number A3

Learning Outcomes:

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 is meant by prototyping and why this is used in systems development.

(6 marks)
- b) Explain the differences between throwaway prototyping and system (or evolutionary) prototyping and how each approach is used in systems development.

(10 marks)

- c) Describe the basic process of User Interface Design and the role that prototyping plays in this process.

(9 marks)

Answer Pointers

- a) A prototype is 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, hence know their requirements.

3a - maximum 6 marks

- b) The important difference is that evolutionary prototypes actually become the final system that will be used. Throwaway prototypes are only used to clarify user requirements. This should be explained in some detail.

3b - maximum 10 marks

- c) A full answer could discuss the development of wireframe models from use case descriptions, guidelines for transforming these into more interactive prototypes and how these would be used in walkthroughs with users.

3c - maximum 9 marks

Question 3 - 25 marks

Examiners' Guidance Notes

- a) Some candidates spent ~~too much~~ lot of time discussing how prototyping is used outside of software development (~~e.g.~~ e.g., in the design of buildings or bridges).
- b) This part of the question was mostly answered well but some candidates discussed the issue very superficially.
- c) A significant number of candidates did not attempt this part of the question. Those who did make an attempt tended to make a good job of it answer well.

Part B

General comments

Part B – Design: 87% of candidates attempted Question 4 and Question 5 while Question 6 was attempted by 12% of candidates only. Most candidates attempting Question 5 gave reasonable and satisfactory answers. Question 4 caused some problems, but the answers were satisfactory. Question 6 caused many problems and only a few candidates provided adequate answers.

Question Number B4

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

The table below shows an example of a list of products ordered by the 'Sweet Treat' company described above.

Product code: C7	Product name: Madeira cake	Supplier no.: S23	Supplier name: A Jones	Cost per item: £2.70	
	Order no: 27/2011	Order date: 3/8/2011	Order total: £210	Delivery code: 8/8/2011/1	Delivery firm: ABC
	Order no: 34/2011	Order date: 1/9/2011	Order total: £112	Delivery code: 6/9/2011/3	Delivery firm: XYZ

Product code: C9	Product name: Carrot cake	Supplier no.: S11	Supplier name: B Young	Cost per item: £2.50	
	Order no: 29/2011	Order date: 14/8/2011	Order total: £112	Delivery code: 20/8/2011/11	Delivery firm: XYZ
	
Product code: C6	Product name: Pavlova	Supplier no.: S23	Supplier name: A Jones	Cost per item: £2.40	
	Order no: 25/2011	Order date: 24/7/2011	Order total: £150	Delivery code: 30/7/2011/10	Delivery firm: Z cars

- 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. You may assume that each product is provided by one supplier. State any further assumptions you made.

(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

a) The steps of normalisation are shown below:

UNF	1NF	2NF	3NF	Relations
Product code Product name Supplier no. Supplier name Cost per item	<u>Product code</u> Product name Supplier no. Supplier name Cost per item	<u>Product code</u> Product name Supplier no. Supplier name Cost per item	<u>Product code</u> Product name Supplier no.* Cost per item	Product
			<u>Supplier no.</u> Supplier name	Supplier
Order no Order date Order total Delivery code Delivery firm	<u>Product code</u> <u>Order no</u> Order date Order total Delivery code Delivery firm	<u>Product code</u> <u>Order no</u> <u>Order no</u> Order date Order total Delivery code Delivery firm	<u>Product code</u> <u>Order no</u> <u>Order no</u> Order date Order total Delivery code*	Product/Order Order
			<u>Delivery code</u> Delivery firm	Delivery

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) 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 discussed.

4b - 7 marks

Examiners' Guidance Notes

- a) A substantial number of candidates provided a full and correct explanation of each step and identified correct relations/tables. However, there is evidence that the transition from 1NF to 2NF caused many problems. Some candidates did not provide sufficient explanation of the normalisation steps.
- b) Only a small number of candidates provided proper explanation of mapping. Many tried to explain things such as inheritance instead.

Question Number 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

Question

- a) Consider the following extra information about the 'Sweet Treat' system described above:

'There are two types of products: sweets and cakes. The following data should be stored about sweets: *Product code. Product name, "Use by" date, Price per kilo.* The following data should be kept about cakes: *Product code. Product name, "Use by" date, Price per cake.*'

An object of class Order consists of an order heading followed by order lines."

Explain the following relationships between classes using examples from the 'Sweet Treat' 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.

(15 marks)

- b) Provide a brief explanation of the following characteristics/attributes of a good software design: Reliable, General, Flexible, Reusable.

Which characteristic is particularly important for a design of a nuclear plant control system? Explain why.

(10 marks)

Answer Pointers

a)

Explanation of association	2 marks
Example of association (e.g. between Product and Supplier)	3 marks
Explanation of aggregation	2 marks
Example of aggregation (e.g. object of class Order 'consists' of Heading and iteration of Lines)	3 marks

Explanation of inheritance/generalization

2 marks

Example of inheritance/generalization (e.g. Product –superclass with two subclasses: Cake and Sweet)

3 marks

5a - maximum 15 marks

b) Explanations of characteristics

2marks * 4

Reliability is very important for such applications (explanation)

2 marks

5b - maximum 10 marks

Examiners' Guidance Notes

a) Many candidates produced reasonable explanations and examples of relationships between classes. Some candidates however gave ~~however~~ wrong examples or confused relationships (aggregation and generalisation in particular).

b) Many candidates identified reliability as an important characteristic. There is evidence that the Eexplanation of characteristics caused however some problems.

Question Number B6

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) Activity diagrams can be used to model different aspects of a system. Give examples of three different applications of activity diagrams in systems modelling.

(6 marks)

b) UML statecharts/state machines and activity diagrams are based on a similar notation. They have however completely different meaning. Discuss the main differences between these diagrams.

(6 marks)

c) Produce a state machine/statechart for the class Order in the 'Sweet Treat' system described above. You may assume that objects of this class are affected by the following 'events': placing a new order, order cancellation, order delivery, amending an order, deleting an order. Note that existing orders can be amended only once and that orders are deleted automatically a few weeks after their delivery.

(13 marks)

Answer pointers

a) Business process modelling
Use case specifications (the logic of use cases)
Class operations/methods specification (the logic of operations)

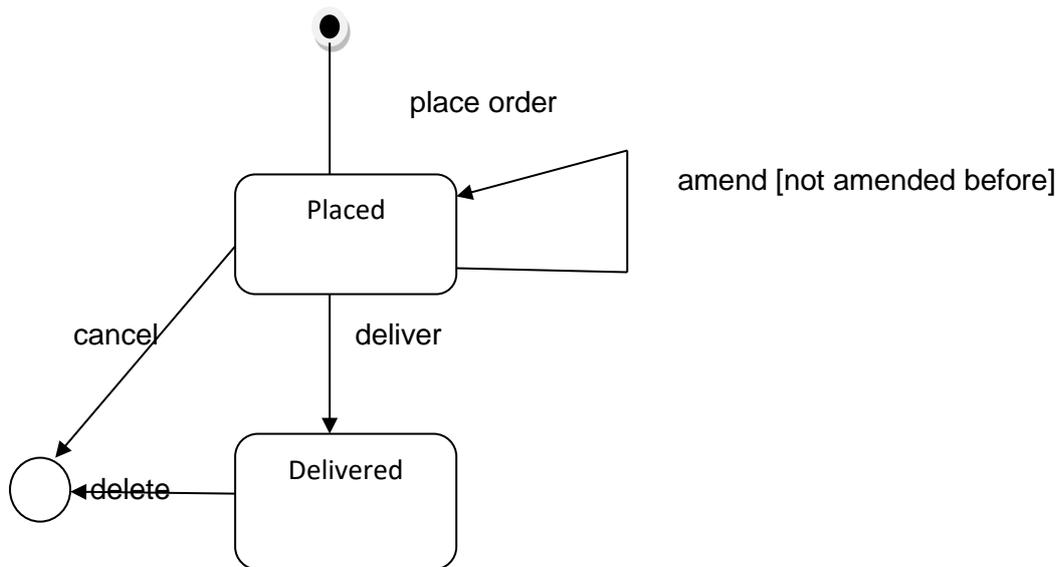
6a - 6 marks

b) A brief explanation of both diagrams
Differences

**2 marks
4 marks**

6b- 6 marks

c)



correct state nodes	2 marks
initial and final states	2 marks
transitions	5 marks
guard condition	1 mark
right notation	3 marks

6c - maximum 13 marks

Examiners' Guidance Notes

There is evidence that This question caused candidates some problems~~more problems than questions 4 and 5.~~

- Most candidates did not answer or provided wrong answers such as e.g. examples of concrete applications: washing machines, heating systems, etc.
- The evidence shows that Mmost candidates were unable to properly explain the main differences between both diagrams.
- Only a few candidates produced reasonable state machines/charts. Some candidates drew activity diagrams instead.