

IS/SQP241

Information
Systems
Higher

Time: 2 hours 30 mins

NATIONAL
QUALIFICATIONS

Specimen Question Paper
for use in and after 2006

Attempt **all** of Section I, **all** of Section II and **one** part of Section III.

Sections I and II — Attempt **all** questions.

Section III — This section has three parts:

Part A—Applied Multimedia

Part B—Expert Systems

Part C—The Internet.

Choose **one** part and attempt all of the questions in that part.

Read all questions carefully.

Write your answers in the answer book provided. Do not write on the question paper.

Write as neatly as possible.

SECTION I

Attempt ALL questions in this Section.

1. Below is a sample taken from a hotel booking database created from data in un-normalised form.

Customer Name	John Clarke
Customer Address	34 Gray Street, Glasgow
Customer Phone No	0141 666 7511
Hotel Name	Copthorne Hotel
Hotel Location	Aberdeen
Hotel Phone No.	01224 333424
Date	21/07/04

Customer Name	John Clarke
Customer Address	34 Gray Street, Glasgow
Customer Phone No	0141 666 7511
Hotel Name	Moat House
Hotel Location	Edinburgh
Hotel Phone No.	01224 333424
Date	23/07/04

- Describe **two** problems of inserting data into this database. 2
2. A characteristic of normalised data is that it allows for *referential integrity*. Define the term “referential integrity”. 2
3. Employees of a large multinational company are given a *meaningful identifier* consisting of their initials, a department code plus four random digits to make the identifier unique. For example, Janice Brown, who works in the Accounts Department has the identifier JBAC6942.
- Describe **two** problems associated with using this meaningful identifier as a primary key. 2
4. Give **two** reasons why a *surrogate key* might be used in a database. 2

5. Peter has set up a database to store information about all his CD albums. He uses the structure.

Album(number, title, artist, track).



Identify a *multi-valued attribute* from this structure and give a reason for your choice.

2

6. Explain why a text *data type* is the most appropriate for storing a telephone number.

2

7. The following is an extract from a local youth club's staff database.

<i>Staff ID</i>	<i>Surname</i>	<i>Forename</i>	<i>Photograph</i>	<i>First Aider</i>
67575	Buchan	Hilary		<input checked="" type="checkbox"/>
46565	Thomson	Peter		<input type="checkbox"/>

Identify suitable data types for the fields Photograph and First Aider.

2

8. State the *cardinality* of each of the following relationships.

(a) Date of birth and person

(b) Actor and film

2

	<i>Marks</i>
9. Define the term <i>Information System</i> .	1
10. Explain the difference between <i>information</i> and <i>knowledge</i> . Use an example to illustrate your answer.	2
11. For each of the following examples state whether the information is <i>internal</i> or <i>external</i> and whether it is <i>formal</i> or <i>informal</i> .	
(a) A head teacher's diary	
(b) A despatch note for a computer being delivered to a customer	
(c) An answering machine message saying that a pupil will be absent today	
(d) A note on an employee's desk from a colleague suggesting a lunch date.	4
12. List two factors which affect the quality of information.	2
13. Name one type of general purpose software package that could be part of a decision support system. Describe a feature of this package which supports this purpose.	2
14. Identify one factor that would have to be considered in a decision to upgrade a company's computer hardware. Justify your answer.	2
15. Which of the following organisations does not have to comply with the Freedom of Information (Scotland) Act 2002?	
(a) A local authority	
(b) A hospital	
(c) A company	
(d) A university	1
	(30)

[END OF SECTION I]

SECTION II

Attempt **all** questions in this section.

SECTION II

Attempt ALL questions in this Section.

16. Members of Strathcraig Youth Club take part in many activities. Each member can take part in as many activities as they wish but for each activity they have to indicate the level, beginner, intermediate or advanced, at which they wish to participate. Each activity takes place on a single evening at a single venue and has a single leader. Each leader is responsible for only one activity.

Data about members and their activities is stored manually on record cards at present.

Member Card

Member Number:	01243
Member Name:	Matthew Black
Member Address:	125 Main Street
Member Telephone:	0237 677719

Member Number:	00945
Member Name:	Cassandra McGregor
Member Address:	13b Westland Way
Member Telephone:	0237 677719

Activity Card

Strathcraig Youth Club			Strathcraig Youth Club		
Activity: Hockey Evening: Thursday			Activity: Swimming Evening: Monday		
Venue: High School Astroturf Cost: 10.00			Venue: Community Pool Cost: £15.00		
Leader: Anne Gordon			Leader: John Chen		
Leader Telephone: 0122 90213			Leader Telephone: 0122 90213		
Name	Level	Paid	Name	Level	Paid
A Grant	Intermediate	No	L Stenton	Beginner	Yes
J Smith	Intermediate	Yes	J Smith	Beginner	Yes
W Cochrane	Beginner	Yes	W McDonald	Advanced	No
K Lee	Advanced	Yes	K Martin	Intermediate	No

16. (continued)

(a) Data from these cards can be represented in un-normalised form as:

member_no
 member_name
 member_address
 member_telephone
 activity
 evening
 venue
 cost
 leader
 leader_telephone
 member_level
 paid

- | | | |
|---------|--|----------|
| (i) | Explain why member_no would be a suitable key for this data. | 1 |
| (ii) | Transform this un-normalised data to first normal form by removing repeating groups. | 3 |
| (iii) | Identify all primary and foreign keys. | 3 |
| (b) (i) | Transform this first normal form to second normal form by removing partial dependencies. | 4 |
| (ii) | Identify all primary and foreign keys. | 2 |
| (c) (i) | Transform this second normal form to third normal form by removing non-key dependencies. | 3 |
| (ii) | Identify all primary and foreign keys. | 2 |

17. Inverdon Cottage Hospital has set up a doctors' appointment system using a relational database.

The data is held in the following tables.

Patient	Doctor	Appointment	Ward
<u>Patient No</u>	<u>Doctor No</u>	<u>Patient No*</u>	<u>Ward No</u>
Patient Name	Doctor Name	<u>Doctor No*</u>	Ward Name
Bed No	Consulting Room	<u>Date</u>	Ward Telephone
Ward No*	Doctor Telephone	Time	

- (a) State the relationships which exist between the entities to allow this report to be produced.

3

Ward No	13	Date	24/06/2004
Ward No	12	Date	24/06/2004
Ward No	11	Date	24/06/2004
Patient Name	Bed No	Doctor Name	Time
Kirkpatrick H	21	Gormlay	11.00
Anderson J	15	Carmichael	11.30
Garfield J	17	Renwick	11.30
Buchanan S	19	Gormlay	11.30
Richards F	12	Gormlay	12.00
Evans K	18	Carmichael	12.00

- (b) With reference to a Relational Database Management System (RDBMS) application package with which you are familiar, describe fully how the features of the package are used to extract and present the report for Ward 11.

9

18. Strathmore Suites Ltd is a company which deals with rented accommodation throughout Scotland. All customer and rental information is stored centrally in a computerised database at the main office in Glasgow. The office also contains a number of networked computers with access to this database. Sales representatives at the office can access the database to show potential customers high quality images and virtual tours of the available apartments. The company is to open a branch office in Manchester for 15 staff and is considering requests from employees to work from home.

(a) Discuss the factors relating to topology, hardware and communications which the company should consider in their network strategy for the new Manchester office. 6

(b) Describe the security implications which should be considered if the company is to allow employees to access the company network from home. 3

(c) Recommend a security strategy that the company should adopt before allowing employees to access the company network from home. 6

19. Cute Kids Clothing produces outfits for young children. It has six factories located throughout the UK. The company has the following staff structure.

Job Title	Job Description
Managing Director	Overall executive control of the business
Sales Representative	Sells company's products to clothing outlets
Sales Manager	Manager of a team of sales representatives
Factory Manager	In charge of local production
Shift Leader	Responsible for production workers and day-to-day matters
Personnel Officer	Responsible for recruitment, staff welfare and pay

(a) For the job titles listed in the table above identify:

(i) **one** where the level is operational;

(ii) **one** where the level is tactical;

(iii) **one** where the level is strategic. 3

(b) For the **three** jobs you have selected in part (a) give **one** example of a typical decision that would be made at this level and **one** piece of information that would be needed in order to make this decision. 6

(c) Cute Kids Clothing employs a team of people to develop a website to market its products. A style sheet is used to ensure consistency in the appearance of the Web pages.

Identify **three** elements of a Web page which may be affected by the application of a style sheet. 3

(d) The website team uses project management software to plan and monitor the progress of the website project. Identify **three** features of project management software that allow them to do this. 3

(60)

[END OF SECTION II]

SECTION III

Part B – Expert Systems

Attempt ALL questions in this part.

25. Large hospitals use a range of information systems including *executive information systems*, *relational database management systems* and *expert systems*.
- (a) Distinguish between an “executive information system” and an “expert system”. Give an example to illustrate your answer. 2
- (b) The MYCIN expert system was developed for use within hospitals. Describe the MYCIN expert system in terms of its category, domain and main characteristics. 4
26. A national parcel delivery company has a range of vehicles which includes motorcycles, light vans, trucks and articulated lorries. Drivers make journeys 24 hours a day and 7 days a week. The company uses a relational database to store information about drivers and vehicles they are qualified to drive. The information is used to help allocate drivers to journeys. This process has proved to be time consuming and liable to errors so the company are considering developing an expert system to assist with this task.
- (a) Describe **two** benefits to the company of the use of an expert system for this task. 2
- (b) Describe **two** factors which the company should take into account when deciding whether or not to proceed with developing the expert system. 2
- (c) Compare a Relational Database Management System (RDBMS) and an Expert System in terms of representation and extraction of data. 2
- (d) The following predicates represent statements about vehicles and drivers.

Predicate	Statement
hgv(bus)	a bus is a heavy goods vehicle (HGV)
hgv(artic_lorry)	an articulated lorry is a HGV
licence(john, hgv)	John has a licence to drive a HGV
can_drive(john, light_van)	John can drive a light van

Represent the following statements using predicate logic.

- (i) John can drive a light van and a motorcycle. 1
- (ii) Anyone who can drive an articulated lorry can drive a truck. 2
- (e) Explain how expert systems techniques can extend the capabilities of a relational database. 2

27. Making scones requires a certain degree of expertise. Scones are made from flour, margarine, milk and sugar, and must be baked in a hot oven. Scones can easily go wrong if the wrong type of flour is used, if too much milk is added, or if the oven is too hot or not hot enough. This information is shown in the following expert system rules.

IF the scone is flat AND
 the scone is sticky
 THEN the flour was the wrong type (0.6).

IF the scone is flat AND
 the scone is sticky AND
 the scone is pale

THEN too much milk was added (0.8).

IF the scone is flat AND
 the scone is NOT pale

THEN the oven was too hot (0.8).

IF the scone is flat AND
 the scone is pale

THEN the oven was not hot enough (0.6).

Suppose the following facts are known with the certainty factors given:

The scone is flat 0.6

The scone is pale 0.7

The scone is sticky 0.4

- (a) Calculate the certainty of the conclusion that the flour was the wrong type. Show your working. 2
- (b) Which conclusion will be drawn from the given facts? Explain your answer. 3
- (c) This expert system uses forward chaining rules. In a forward chaining expert system
- (i) explain what is meant by a *conflict set*; 1
 - (ii) explain how a conflict set is identified; 2
 - (iii) describe how the *recency* conflict resolution strategy works. 2

28. The following paragraph outlines a limited domain of knowledge about cloud formations. This knowledge is to be represented by an expert system using an expert system shell. A user of the expert system should be given advice about the chances of rain.

A	Clouds form at three levels—high, medium and low levels. The lower a cloud, the darker is its colour. Thus high level clouds are white, medium level clouds are grey and low level clouds are almost black.
B	Cirrus clouds are examples of high level clouds. They are wispy clouds that indicate that it will rain soon.
C	Altostratus is a medium level cloud that forms a thick layer blocking out the sun though rain is unlikely.
D	Nimbostratus is a low level cloud that forms a flat, featureless layer and frequently produces rain.
E	Cumulus clouds can be high, medium or low level clouds that have the appearance of pieces of cotton wool and if they are thick enough then they will produce showers.

- (a) Represent the knowledge contained in paragraph A above, to conclude a cloud's level given its colour. 3
- (b) In paragraphs B–D, identify two words which indicate uncertainty in the conclusion. 2
- (c) Represent the knowledge in paragraphs C and D, to give the conclusion “it will rain”. Your rules should refer to your answer to (a), and include an appropriate certainty factor. 4
- (d) Describe the nature of the uncertainty in paragraph E. 1
29. Consider a forward chaining expert system containing the following rule base, where the letters A to H represent facts which are known or can be concluded.

- 1 If A and D then E.
- 2 If A and B then G.
- 3 If A and C then E.
- 4 If A and E then F.
- 5 If A and B and C then D.
- 6 If A and C and D then H.

Suppose the working memory contains the facts A, B and C, added in that order.

- (a) Which rules exist in the conflict set? 1
- (b) Which rule will fire using a *first-come-first-served* (also known as *rule ordering*) conflict resolution strategy? 1
- (c) Which rule will fire using the “*specificity*” conflict resolution strategy? 1
- (d) After a rule has fired, what is the effect of the “*refractoriness*” strategy? 1

30. A printer has three status lights (red, orange, green) which can be used to help diagnose problems with the printer. The on-line help includes a troubleshooting guide in the form of an expert system.

The following backward chaining rules represent advice to “replace toner”, “clear paper jam”, “call service engineer”, and “check paper tray”.

Advice is replace toner
 IF orange light lit
 AND NOT red light lit
 AND NOT green light lit.

Advice is clear paper jam
 IF NOT orange light lit
 AND red light lit
 AND NOT green light lit.

Advice is call service engineer
 IF orange light lit
 AND red light lit
 AND NOT green light lit.

Advice is check paper tray
 IF NOT orange light lit
 AND NOT red light lit
 AND green light lit.

- (a) (i) What is the first question asked by the expert system? 1
- (ii) The user asks why the question is being asked. Describe how the expert system explains its reasoning in terms of a *rule tree*. 2
- (b) The expert system gives the advice to “clear paper jam”. With reference to a rule tree, describe the *justification* the expert system would give for this advice. 2
- (c) Represent the rules above in the form of a *decision tree*. 4

(50)