

2022 EXAMINATIONS



**Part II**

**COMPUTING AND COMMUNICATIONS – On-line Assessment [150 Minutes]**

**SCC.201      Databases**

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*Candidates are asked to answer **THREE** questions from **FOUR**; each question is worth a total of 25 marks.*

**[Please turn over]**

### Question 1

Consider the following database relations for COVID-19 Test Providers. The designed system is there to help you choose the testing type, method and location that suits your testing needs. Tests are carried out in different ways depending on where they take place, and if they are supervised. 'Supervised' means staff will take the sample for you. If you take the test at home, you may be able to have a video call with staff who will explain what you need to do. 'Self Swab' means you will take the sample yourself without supervision either at home or on site at the provider's location. The Testing Providers (Firms) are scattered around the UK to make it easier for those who prefer on site testing. The Government does not approve or recommend any test providers but have created a list of providers who demonstrated compliance with the relevant minimum standards for their commercial provision of testing. Using those relations answer questions **1.a** to **1.d** below.

Testing	TestID	FirmID	Test Type	Test Method	Test Location	Price
	31	1	Day 2 PCR Test	Self Swab	On Site	£40
	32	2	Day 2 and Day 8 PCR Tests	Supervised	On Site	£110
	33	2	Day 2 PCR Test	Supervised	At Home	£31
	34	3	Test to Release	Self Swab	At Home	£35
	35	3	Day 2 PCR Test	Supervised	At Home	£85
	36	4	Day 2 PCR Test	Self Swab	On Site	£55
	37	4	Day 2 PCR Test	Supervised	On Site	£95
	38	5	Day 2 and Day 8 PCR Tests	Self Swab	At Home	£145
	39	5	Day 2 and Day 8 PCR Tests	Supervised	At Home	£165
	40	6	Test to Release	Self Swab	At Home	£45
	41	6	Day 2 PCR Test	Supervised	On Site	£100
	42	7	Day 2 PCR Test	Self Swab	On Site	£66
	43	7	Day 2 and Day 8 PCR Tests	Supervised	At Home	£139
	44	8	Day 2 PCR Test	Self Swab	At Home	£65
	45	8	Day 2 and Day 8 PCR Tests	Self Swab	On Site	£159
	46	8	Day 2 PCR Test	Self Swab	At Home	£80

Firms	FirmID	FirmName	FirmLocation	GOV.UK List
	1	Abicare Health	Scotland	Yes
	2	247HomeTesting	Scotland	No
	3	Vital Clinic	England	Yes
	4	Nucleotide Laboratories	Wales	Yes
	5	Asteria Healthcare	Wales	No
	6	Apollo Healthcare	England	No
	7	Premier Clinic Ltd	Northern Ireland	Yes
	8	MyHealthcare Clinic	Northern Ireland	No

Question 1 continues next page

[Please turn over]

**1.a** Being careful to declare any keys, give an SQL statement that would create:

- i. The 'Testing' table.
- ii. The 'Firms' table

**[6 marks]**

**1.b** Produce two separate SQL statements to reflect the following changes.

- i. GOV.UK added '247HomeTesting' to their list as they have demonstrated compliance with the minimum standards.
- ii. 247HomeTesting have increased the testing prices by 35%.

**[5 marks]**

**1.c** Write two SQL statements to produce:

- i. A list of Testing Providers showing the provider names and location as well as the testing price and testing location for tests that can be done at home. The providers should be located in Wales or Northern Ireland. Only show providers where the word 'Health' appears in their firm names.
- ii. For firms in England, Scotland or Wales, show how much it costs on average to perform a 'Day 2 and Day 8 tests' package. Make sure you show those details in your query and provide an appropriate name for any new columns.

**[8 marks]**

**1.d** Use SQL to create a view calling it "Overpriced Firms" that shows the 2 most expensive firms according to the price of their "Day 2 PCR Test" and "Test to Release", showing the names of those firms, their location, the price for the tests and in addition showing the method of the tests and the location of where the test can be taken. The ones that are more expensive should appear first.

**[6 marks]**

**Total 25 marks**

**[Please turn over]**

## Question 2

**2.a** Provide a complete Entity-Relationship diagram for the following database description, including all entities and their relationships.

You are asked to help develop a new database for a Spaceport (space airport) that is relocating into a new area in two years. The database is intended to hold information about the proposed launching-points (a platform from which a spacecraft is launched) and the space-routes they will serve (that is destinations in our Solar System).

After initial discussion between the database designers and the spaceport's executives, it was agreed that the spaceport will continue to use its existing systems to timetable spacecrafts. Space-route numbers must be stored. But at this stage, no spacecraft stop, or operating times are to be stored in the database.

The Spaceport plans to establish several launching-points and operates several different types of spacecrafts. Each launching-point will typically have a few spacecrafts of each type. The company doesn't make modifications to spacecrafts, but the spacecraft registration, and both the maintenance and certification dates must be held for each individual spacecraft.

Each space-route is operated from a single launching-point.

Not all astronauts will be able to operate all the different types of spacecrafts and so must be signed off for the spacecraft they can operate. The signing off is done online and a checker number (checker-no) will be generated along with the date at which the check was completed.

Similarly, astronauts must undergo an online training to learn a given space-route. Again, a checker-no will be generated along with the date at which the training was taken.

Each astronaut will be based at a single launching-point and the database needs to hold the first and last names for each astronaut, their date of birth and years of service.

**[10 marks]**

**2.b** Consider the following database of an 'Athletes Training Centre' where registered athletes can join any sport they like for a fee, an athlete cannot join the same sport twice. Each coach manages only one sport. Similarly, each sport will only have one coach. Different athletes can join different sports. Each athlete has an ID along with their names and membership status (i.e., Bronze, Silver or Gold). Answer questions **2.b.i** to **2.b.iii**.

Athletes	ID	AName	Status	Sport	Fee	CoachID	CoachName
	1	Ahmed	Gold	Cardio	£200	1	Afamefuna
				Futsal	£250	2	Sakura
				Badminton	£180	3	Kareem
	2	Chioma	Silver	Badminton	£180	3	Kareem
				Yoga	£180	4	Aisha
	3	Chyou	Bronze	Taekwondo	£120	5	Farah
	4	Bukuria	Silver	Futsal	£250	2	Sakura
				Badminton	£180	3	Kareem

**2.b.i.** State the requirements for a relation being in First Normal Form (1NF), highlight why the above Athletes relation is not in 1NF, and finally convert it into 1NF.

**[3 marks]**

**2.b.ii.** Using the solution from question **2.b.i**, identify and clearly state any non-trivial and non-transitive dependencies and convert the relation into Second Normal Form (2NF).

**[6 marks]**

**2.b.iii.** State the requirement for a relation to be in Third Normal Form (3NF). Identify and state any remaining dependencies and then convert the relation(s) from question **2.b.ii** into 3NF.

**[6 marks]**

**Total 25 marks**

**[Please turn over]**

### Question 3

**3. a** What are 5 of the most commonly used data types used in relational databases **[5 marks]**

**3. b** Explain the difference between a block a cluster and a header **[3marks]**

**3. c** With an example, explain how secondary indexes can be used with primary and non key fields. **[6 marks]**

**3. d** What are the main aims of a search tree **[3 marks]**

**3. e** With diagrams show how the following data and tree structured would evolve as the following data is added to a database with a b-tree index on an integer field

1,2,3,10,9,8,7,6,4,5 where the order of each node is 3.

NB at each step, you must highlight and explain any nodes which have been modified along with the rules used to decide on the change.

You may use <https://www.cs.usfca.edu/~galles/visualization/BPlusTree.html> to help you draw the changes.

**[5 marks]**

**3. f** From your worked example, show how the tree would be changed if the value 7 is removed and then re-inserted. NB you must again show which nodes are affected and explain why. **[3 marks]**

**[Please turn over]**

#### Question 4

**4. a** Access routines are used to speed up the retrieval of data from databases. Using the facebook leaked data Entity Relationship Diagram (see next page) used in the lab sessions, suggest suitable access routines for the following sql statements:

i) select \* from Person where commonName like "John%" order by commonName [4 marks]

ii) select familyName, commonName, country, language from person natural join Country natural join Language [3 marks]

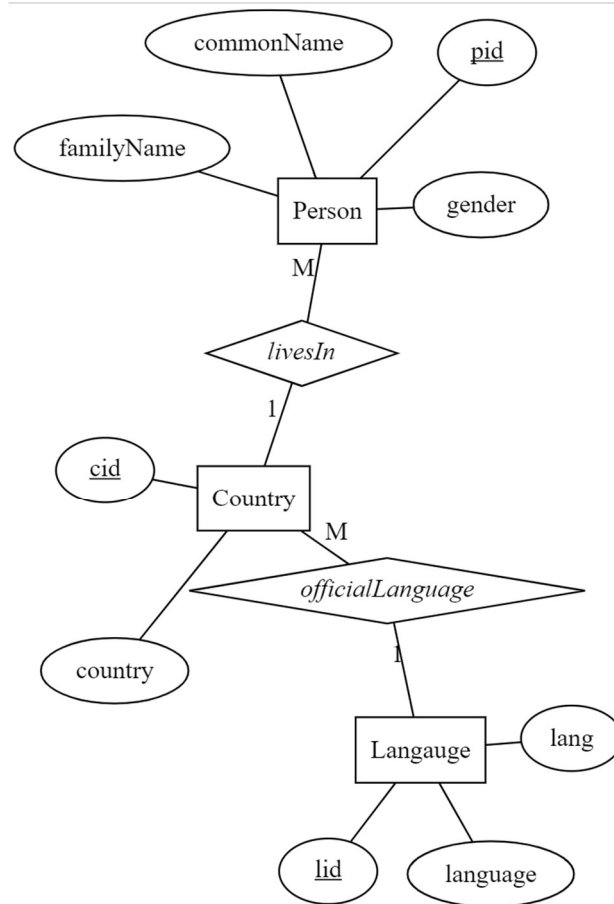
iii) select familyName, count(\*) from person natural join Country natural join Language where language="English" [4 marks]

**4. b** Show how your queries can be converted into relational algebra and then show how the relational algebra can be re-arranged to optimise the query for a very large database. [6 marks]

**4. c** When changes occur in a database, it may be necessary to log the changes.

Explain the purpose of logging and describe scenarios where a log can be used in the event that a power failure occurs for a machine running a relational database. [8 marks]

[Please turn over]



Facebook leaked data  
Entity Relationship Diagram

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