2022-DSE
ICT
PAPER 2A

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Candidate Number										

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2022

INFORMATION AND COMMUNICATION TECHNOLOGY

PAPER 2A

Databases

Question-Answer Book

11:15 am – 12:45 pm (1 hour 30 minutes)
This paper must be answered in English

INSTRUCTIONS

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5 and 7.

(2) Answer **THREE** out of four questions. Write your answers in the spaces provided in this Question-Answer book. Do not write in the margins. Answers written in the margins will not be marked.

(3) Supplementary answer sheets will be supplied on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this book.

(4) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

(5) The last page of this Question-Answer book contains SQL commands and symbols used in entity-relationship diagrams which you may find useful.

* A 2 0 0 E 0 2 A *

Answer THREE questions only.

1. A university holds an activity to encourage staff to walk more. Every day, participants have the number of their steps recorded automatically in a database table `READING` via a smart watch. The more steps recorded, the greater their reward points would be. Three database tables `PAR`, `LEV` and `READING` are used to store information on participants, reward points and smart watch readings respectively.

`PAR`

Field name	Description	Example
`PID`	Identity code of participant	P0023
`PNAME`	Name	Susan Li
`DEPT`	Department	Accounting

Primary key: `PID`

`LEV`

Field name	Description	Example
`LID`	Identity code of level attained	A08
`LSTEP`	Lowest number of steps per day	8000
`HSTEP`	Highest number of steps per day	8999
`POINT`	Reward points	5

Primary key: `LID`

`READING`

Field name	Description	Example
`PID`	Identity code of participant	P0023
`RDATE`	Recording date	20/03/2022
`STEP`	Number of steps	9500

Primary key: `PID + RDATE`
Foreign key: `PID` references `PID` of `PAR`

Write SQL statements to complete the following tasks from (a) to (d).

(a) List the lowest numbers of steps, and the corresponding reward points of each level where the reward points are between 5 and 10 inclusive.

(2 marks)

Answers written in the margins will not be marked.
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(b) A certificate will be issued to participants who have walked at least 10 000 steps in a day. List the number of participants who will have certificates.

(2 marks)

(c) Participants can earn reward points every day. List the total reward points obtained by all the participants in the accounting department, that is `DEPT = 'Accounting'`.

(3 marks)

(d) A department will be awarded a trophy if the average number of steps of any participant in the department was greater than 9 000. List those departments.

(4 marks)

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(e) (i) What is the purpose of the following SQL statement?

```
SELECT DISTINCT PID FROM READING
WHERE STEP >= ALL
  (SELECT STEP FROM READING
   WHERE RDATE = '20/03/2021')
```

_____

_____

(1 mark)

(ii) Give an advantage of using a view.

_____

_____

(1 mark)

(iii) Consider the following view MYREAD.

```
CREATE VIEW AS MYREAD
SELECT MAX(STEP) AS MYSTEP FROM READING
WHERE RDATE = '20/03/2021'
```

Use MYREAD to complete the following SQL statement, that produces the same result in (e)(i).

```
SELECT PID FROM READING

WHERE _____ >=

  (SELECT _____ FROM MYREAD)
```

(2 marks)

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2. A project team of a tour bus company develops a database application system to collect and analyse data recorded in buses, such as their geographic locations.

(a) Some stages of the development are shown below:

1. Requirements collection
2. System definition
3. Prototyping
4. Testing
5. Operational maintenance

Match each of the following processes with one stage above.

	Stage
Create a backup of data regularly.	_____
Detect program bugs.	_____
Design a database schema.	_____

(3 marks)

(b) Give an example to illustrate why the project team may revisit previous stages after completing Stage 4 Testing.

_____

_____

_____

_____

(2 marks)

The project team creates database tables `BUS` and `BPOS` to store the information on buses and geographic locations respectively.

`BUS`

Field name	Description
`BNO`	Identity code of bus
`BSEAT`	Number of seats

Primary key: `BNO`

`BPOS`

Field name	Description
`BNO`	Identity code of bus
`RTIME`	Arrival date and time
`LOC`	A code between 1 and 10000 to represent the location of the bus

Primary key : `BNO + RTIME`
Foreign key: `BNO`

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(c) Identify **two** mistakes in the following sample data that should be detected during testing.

BUS

	BNO	BSEAT
Sample 1	A101	16
Sample 2	C105	80
Sample 3	C105	25

BPOS

	BNO	RTIME	LOC
Sample 1	A101	14/04/2022 3:21	8318
Sample 2	A101	15/04/2022 3:23	10002
Sample 3	C105	14/04/2022 12:50	1002

(2 marks)

(d) Assume that the data in BUS and BPOS are:

BUS

BNO	BSEAT
E121	50
F123	50

BPOS

BNO	RTIME	LOC
F123	13/03/2022 11:00	1234

Give one new record of BPOS to illustrate each of the following problems:

(i) Referential integrity problem

BPOS

BNO	RTIME	LOC

(1 mark)

(ii) Entity integrity problem

BPOS

BNO	RTIME	LOC

(1 mark)

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(e) The system includes a module of security cameras for recording what passengers and drivers are doing in bus cabins. Every time a driver begins a session of duty, a staff code should be entered into the system. A video will then be recorded for each session as a file.

The names and staff codes of drivers, and the timestamps (date and time) and filenames of the videos should be stored in a database. `DRIVER` and `BVIDEO` store the information on drivers and videos respectively. Complete the following database design for this. Write 'N/A' if not applicable.

`DRIVER(`_____`,` _____`)`

Primary key: _____

Foreign key: _____

`BVIDEO(`_____`,` _____`,` _____`)`

Primary key: _____

Foreign key: _____

Description of field names:

_____

_____

_____

_____

(4 marks)

(f) A team member suggests that drivers can watch the videos for training. Give a potential violation of data privacy and the corresponding solution.

_____

_____

_____

_____

(2 marks)

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3. A company is going to organise an online inhouse conference that includes various forums. Staff can join the forums through video conferencing software.

The company uses a database table FORUM to store information on forums.

FORUM

Field name	Description	Example
FID	Identity code of forum	0059
MDATE	Date and time of forum	14/04/2022 2:30 PM
HOST	Staff code of the staff member who is the person in charge of the forum	M1001
PWD	A password with a maximum of 12 characters	Ffg7i6d2on

(a) Consider the following SQL statement:

```
CREATE TABLE FORUM (
FID INT,
MDATE DATE NOT NULL,
HOST CHAR(6) NOT NULL,
PWD CHAR(12) UNIQUE,
PRIMARY KEY (FID) )
```

State the potential issue in each of the following fields.

(i) FID _____

_____

(1 mark)

(ii) PWD _____

_____

(1 mark)

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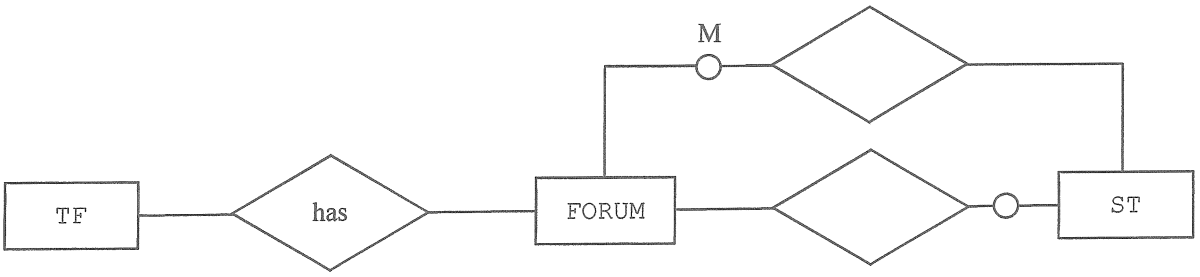
(b) The requirements of the database are described below:

In the conference, each topic will be discussed in one or several forums. Each forum is on one topic only. All staff must join at least one forum, while each forum is hosted by one staff member.

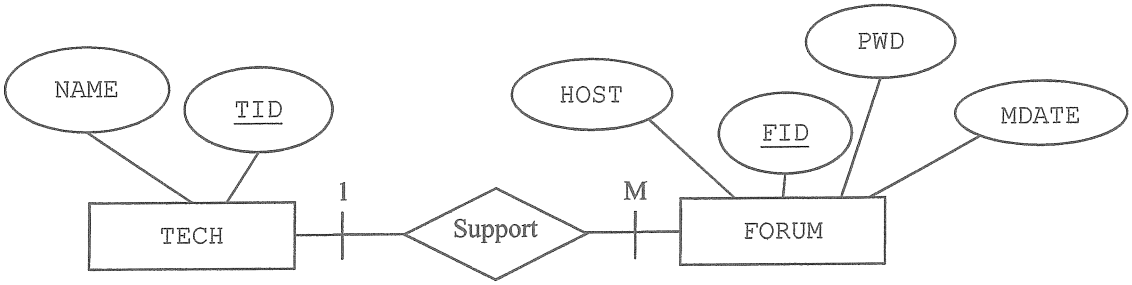
`TF` and `ST` store the information on topics and staff respectively. Complete the ER diagram below for this database. It is not necessary to draw attributes.



(4 marks)

The company is going to employ some technicians to provide technical support for the forums. `TECH` stores the information on the technicians.

(c) The relationship between `TECH` and `FORUM` is shown below:



There are two methods for implementing the relationship:

Method 1: Create a new database table that consists of `TID` and `FID` only.

Method 2: Add `TID` to `FORUM`

Explain why Method 2 is better than Method 1.

_____

_____

_____

_____

(2 marks)

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(d) `ST` and `TECH` are two different database tables that have the same structure. A technician is one of the staff members.

(i) Describe how to migrate the records in `TECH` to `ST` such that `TECH` will no longer be used.

(2 marks)

(ii) Write a SQL statement to remove `TECH`.

(1 mark)

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(e) The company needs reports on forums within a specific date range. The information in the reports should be listed in ascending or descending order of the number of participants or the date of a forum.

Create a user-friendly interface for generating the reports. Annotate your design, where appropriate.

(4 marks)

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4. ABC company sells various limited products through its online platform. Members can only order one kind of product each time. Database tables PROD and ORD are used to store the information on products and orders respectively.

PROD

Field Name	Description	Example
PCODE	Identity code of product	C1
PNAME	Name	Racing car 1966
PRICE	Unit price	500
QUAN	Quantity in stock	10

ORD

Field Name	Description	Example
ORDERTIME	Date and time to make the order	14/02/2022 14:30:11
MEMBERID	Identity code of member	M123
MNAME	Name of member	Tim
PCODE	Identity code of product	C1
NUM	Number of units that the member orders	2
SHOPID	Identity code of the shop to collect the product	S12
SHOPADD	Address of the shop	18 Nathan Road

Part of the records are as follows:

PROD

PCODE	PNAME	PRICE	QUAN
C1	Racing car 1966	500	10
C2	Sport shoe 2001	2300	5
C3	Sport shoe 2003	5000	2

ORD

ORDERTIME	MEMBERID	MNAME	PCODE	NUM	SHOPID	SHOPADD
14/02/2022 14:32:54	M123	Tim	C1	2	S12	18 Nathan Road
14/02/2022 14:32:54	M456	May	C3	3	S30	1 Canton Road
15/02/2022 09:30:22	M123	Tim	C2	1	S12	18 Nathan Road
14/02/2022 14:30:04	M888	Peter	C3	3	S30	1 Canton Road
15/02/2022 09:30:12	M999	Peter	C3	1	S30	1 Canton Road

(a) Write suitable fields below to show the existing dependencies in ORD.

_____ depends on MEMBERID.

PCODE, NUM depends on _____.

_____ depends on SHOPID and NUM.

(3 marks)

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(b) Change the database table `ORD` in Third Normal Form. Identify the corresponding primary keys and foreign keys, or write 'N/A' if not applicable.

`ORD (`_____`,` _____`,` _____`, PCODE, NUM)`

Primary key: _____

Foreign key: `PCODE` references `PCODE` of `PROD`.

Foreign key: _____

Foreign key: _____

`MEMBER (`_____`,` _____`)`

Primary key: _____

`SHOP (`_____`,` _____`)`

Primary key: _____

(4 marks)

(c) Members always search for products which are nearly sold out. In order to improve such searching, an index on `QUAN` in `PROD` is created.

(i) Write a SQL statement to create the index.

(1 mark)

(ii) When using the index, the search efficiency is not improved much. Explain briefly.

_____

_____

_____

(1 mark)

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(d) The loading of search queries on product information is very heavy. The company plans to install several separate servers where each server stores all the product information.

(i) Give a benefit of the plan above.

(1 mark)

(ii) It is expected that members place orders frequently and then the data in `PROD` will change. Describe the issue that might be encountered in this plan.

(2 marks)

(e) Describe how data mining can be used to help deliver promotional messages to the members.

(3 marks)

END OF PAPER

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Database (SQL commands - based on SQL-92 Standard)

Constants	FALSE, TRUE
Operators	+, –, *, /, >, <, =, >=, <=, <>, %, _ , ' , AND, NOT, OR
SQL	ABSOLUTE (ABS), AVG, INT, MAX, MIN, SUM, COUNT ASC, AT, CHAR (CHR), CHAR_LENGTH (LEN), LOWER, TRIM, SPACE, SUBSTRING (SUBSTR/MID), UPPER, VALUE (VAL) DATE, DAY, MONTH, YEAR ADD, ALL, ALTER, ANY, AS, ASC, BETWEEN, BY, CREATE, DELETE, DESC, DISTINCT, DROP, EXISTS, FROM, GROUP, HAVING, IN, INDEX, INNER JOIN, INSERT, INTEGER, INTERSECT, INTO, LEFT [OUTER] JOIN, LIKE, MINUS, NULL, RIGHT [OUTER] JOIN, FULL [OUTER] JOIN, ON, ORDER, SELECT, SET, TABLE, TO, UNION, UNIQUE, UPDATE, VALUES, VIEW, WHERE

Symbols Used in Entity-Relationship Diagrams

Meaning	Symbol	Meaning	Symbol
Entity	Entity	One-to-One Relationship	1 Relationship 1
Attribute	Attribute	One-to-Many Relationship	1 Relationship M
Key Attribute	Attribute	Many-to-Many Relationship	M Relationship N
Relationship	Relationship	Participation constraints: Use | on Mandatory side Use ○ on Optional side	Relationship

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