2023-DSE
ICT
PAPER 2A

Please stick the barcode label here.

Candidate Number

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2023

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.

Answer THREE questions only.

1. A company operates several fitness centres for members to book services. It uses three database tables MEMBER, CENTRE and BOOKING to store information on members, fitness centres and booking records respectively.

MEMBER

Field name	Description	Example
MID	Identity code of member	M0008
MNAME	Name	Mary Lam
MEMAIL	Email address	mary@abc.com.hk
MTYPE	Type of member: G – Gold S – Silver B – Bronze	S
JDATE	Joining date	20/01/2010
POINT	Reward points	5
REFER	Identity code of referring member	M0002

Primary key: MID

CENTRE

Field name	Description	Example
CID	Identity code of fitness centre	C08
CNAME	Name of fitness centre	Tuen Mun shop

Primary key: CID

BOOKING

Field name	Description	Example
BID	Identity code of booking record	R0002
MID	Identity code of member	M0002
CID	Identity code of centre	C08
BDATE	Booking date	30/03/2023

Primary key: BID
Foreign key: MID references MID of MEMBER
CID references CID of CENTRE

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

(a) List the identity codes of Silver members who have reward points greater than 20 in descending order of JDATE.

(2 marks)

Answers written in the margins will not be marked.

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(b) List the identity code of members, without duplication, who booked services of fitness centres in September 2022.

(2 marks)

(c) List the identity codes and joining dates of members who have no booking records.

(2 marks)

(d) List the identity codes of the fitness centres that have more than 500 booking records on 30/09/2022.

(3 marks)

Answers written in the margins will not be marked.

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

```
CREATE VIEW V1 AS
SELECT M1.MID, COUNT(M1.MID) AS REFERRAL
FROM MEMBER M1, MEMBER M2
WHERE M1.MID = M2.REFER
GROUP BY M1.MID
```

_____

_____

(2 marks)

(ii) The company decides to give 10 reward points to those members who have referred more than 5 persons to become a member. Complete the following SQL statement for doing so.

```
UPDATE _____
SET _____ = _____
WHERE MID IN (SELECT MID FROM V1 WHERE REFERRAL > 5)
```

(2 marks)

(iii) Complete the following SQL statement that lists the identity codes of members who have not referred any person to become a member.

```
SELECT MID FROM _____
MINUS
SELECT MID FROM _____
```

(2 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

2. Peter leads a project team to develop a database system for students to choose their elective subjects. A student chooses three subjects, but only two subjects will be assigned to the student.

(a) The main stages in the database application development lifecycle are

(1) Requirements collection and analysis
(2) Application and database design
(3) Implementation
(4) Conversion and loading
(5) Data migration
(6) Testing
(7) Operational maintenance

Match a stage for each of the following tasks in the development.

Task	Stage
Design the database schema	(_____)
Prepare test cases	(_____)
Define the problem statement	(_____)

(3 marks)

The project team creates the database tables `STUDENT`, `CHOICE` and `ELECTIVE` to store the information on students, students' choices and assigned subjects respectively.

`STUDENT`

Field name	Description	Data Type
SNO	Identity code of student	Integer
CLASS	Class	Character
CLASSNO	Class number	Integer

`CHOICE`

Field name	Description	Data Type
SNO	Identity code of student	Character
SUBJECT1	Chosen Subject 1	Character
PREF1	Priority of choice 1 (1, 2 or 3)	Integer
SUBJECT2	Chosen Subject 2	Character
PREF2	Priority of choice 2 (1, 2 or 3)	Integer
SUBJECT3	Chosen Subject 3	Character
PREF3	Priority of choice 3 (1, 2 or 3)	Integer

`ELECTIVE`

Field name	Description	Data Type
SNO	Identity code of student	Integer
YR	Year of enrolling in the subject	Integer
SUBJECT1	Assigned subject 1	Character
SUBJECT2	Assigned subject 2	Character

(b) Complete the database constraints for data validation in the following table.

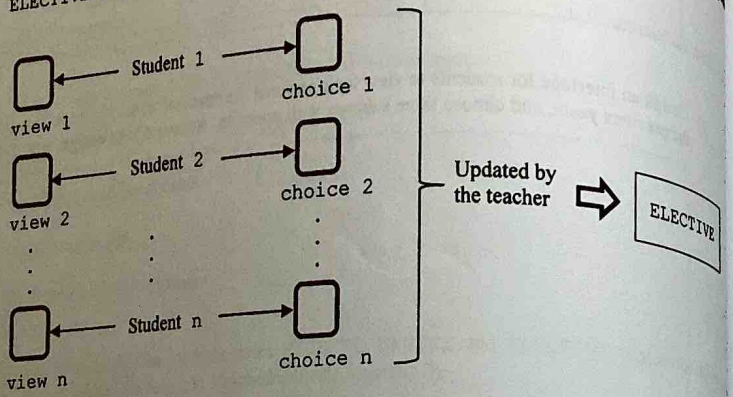
Field name	Invalid data	Database constraint
PREF1	9	1. Data range
YR	"YY22"	2. Data _____
SNO	Null value	3. _____
		4. _____

(3 marks)

(c) Design an interface for students to view their personal information, check the popularity of subjects in the previous years, and choose three subjects with priorities. Annotate your design, where appropriate.

(5 marks)

(d) In the database system, a teacher creates views (view 1, view 2, ..., view n) from database tables and creates working tables (choice 1, choice 2, ..., choice n) with the same database structure of CHOICE for n students to access. view i stores student i's personal information and the popularity of subjects. choice i stores student i's choices. The teacher will update ELECTIVE according to the working tables.



Tick the following boxes to indicate the corresponding access rights.

Database object	Student 1		Teacher	
	Read	Write	Read	Write
view 1	☐	☐		
choice 1	☐	☐	☐	☐
ELECTIVE			☐	☐

(4 marks)

Answers written in the margins will not be marked.

3. A clinic uses the database tables DOCTOR, NURSE, PATIENT and VREC to store information on doctors, nurses, patients and visit records respectively.

DOCTOR

Field name	Description	Example
DID	Identity code of doctor	0001
HKID	HKID number	Z1234567
DEPNO	Department code	S02

Primary key: DID

NURSE

Field name	Description	Example
NID	Identity code of nurse	0002
HKID	HKID number	Z2345678
DEPNO	Department code	02
DID	Identity code of the doctor that he/she works with	0003

Primary key: NID

PATIENT

Field name	Description	Example
PID	Identity code of patient	P0002
HKID	HKID number	Z3456789
BDATE	Date of birth	23/03/1980
NOOFVISIT	Number of visits	20

Primary key: PID

VREC

Field name	Description	Example
PID	Identity code of patient	P0002
DID	Identity code of doctor	0001
DATE	Date of visit	23/03/2023

Primary key: PID + DID + DATE

(a) Which field can be regarded as a derived attribute? State a benefit of using a derived attribute.

_____

_____

_____

_____

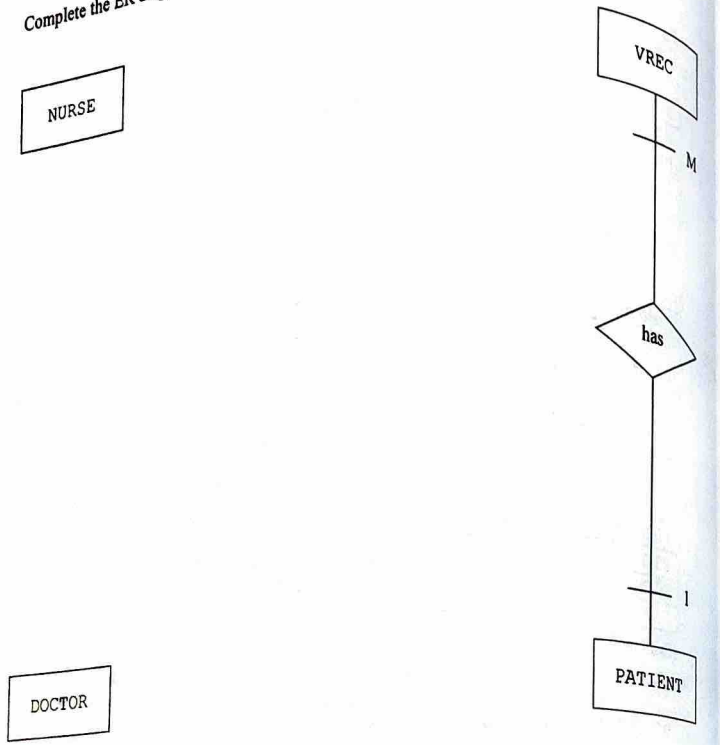
(2 marks)

Answers written in the margins will not be marked.

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

In the clinic, each doctor has one to three nurses to work with. Each nurse works with one doctor or without any doctor. Each patient and each doctor have at least one record in VREC.

Complete the ER diagram below for this database. It is not necessary to draw attributes.



(4 marks)

Answers written in the margins will not be marked.

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The clinic decides to merge NURSE and DOCTOR. Part of the records in the database are as follows:

NURSE

NID	HKID	DEPNO	DID
0002	Z2345678	02	0003
0004	Z3456789	03	0005

Primary key: NID

DOCTOR

DID	HKID	DEPNO
0001	Z1234567	S02
0002	Z4567891	S02

Primary key: DID

(c) State **two** issues that will occur during merging. Suggest a solution for each issue.

(4 marks)

Answers written in the margins will not be marked.

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(d) The clinic uses a new database table STAFF to store the merged data of NURSE and DOCTOR with the following tasks:

Task 1: Create STAFF with related attributes

Task 2: [?]

Task 3: [?]

Task 4: Remove DOCTOR and NURSE

(i) NURSE , DOCTOR and STAFF are involved in Task 2. Briefly describe Task 2.

(2 marks)

(ii) VREC is involved in Task 3. Briefly describe Task 3.

(1 mark)

(iii) To remove DOCTOR in Task 4, there are two suggested methods:

Method 1: DELETE FROM DOCTOR
Method 2: DROP TABLE DOCTOR

What is the major difference between the above two methods?

(2 marks)

4. A movie centre sells tickets through its vending machines in its lobby. There are two cinemas in the movie centre. It uses a database table TINFO to store ticket information.

TINFO

Field Name	Description	Example
MID	Identity code of movie	M001
MNAME	Movie name	The way we dance
MTIME	Date and time	14/02/2023 14:00
CID	Identity code of cinema	S2
CTYPE	Type of cinema	A
TN	The number of seats in the cinema	150
SNO	Seat number	18

Part of the records are as follows:

MID	MNAME	MTIME	CID	CTYPE	TN	SNO
M001	The way we dance	14/02/2023 14:00	S2	A	150	1
M001	The way we dance	14/02/2023 14:00	S2	A	150	2
M001	The way we dance	14/02/2023 18:00	S2	A	150	1
M003	Echoes of the rainbow	14/02/2023 14:00	S1	B	200	5
M002	Beach spike	18/02/2023 11:00	S1	B	200	5
M002	Beach spike	18/02/2023 11:00	S2	A	150	6
M999	Men on the dragon	15/02/2023 09:30	S1	B	200	10

(a) Write suitable fields below to show the data dependencies in TINFO.

MNAME depends on _____.

_____, _____ depend on CID.

(3 marks)

(b) (i) The movie centre provides VIP tickets with seat numbers 1 to 10. Complete the following SQL statement with an aggregate function to list the number of VIP tickets sold for each showtime.

```
SELECT CID, MTIME, _____
FROM TINFO
WHERE SNO <= 10
GROUP BY CID, MTIME
```

(1 mark)

(ii) Write a SQL statement to create an index 'SHOWTIME' on CID and MTIME for TINFO.

(2 marks)

(iii) Give a benefit of using the index 'SHOWTIME'.

_____

_____

(1 mark)

(c) Complete the following database schema in Third Normal Form. Identify the corresponding primary keys and foreign keys.

MOVIE(MID, _____)

Primary key: MID

CINEMA(_____, _____, TN)

Primary key: _____

TICKET(MID, MTIME, _____, _____)

Primary key: _____ + _____ + _____

Foreign key: MID references MID of MOVIE

Foreign key: _____ references _____ of _____

(6 marks)

(d) The movie centre stores members' personal information in a database. Suggest two methods related to database security to protect the information.

_____

_____

_____

_____

(2 marks)

END OF PAPER

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 — ○