Answer all questions.

1. Ms Lee is organising a debating competition. She uses a database table DEBATE to store information on debates in the competition.

DEBATE

Field name	Description
MID	Identity code of the debate
PROID	Identity code of the pro team (argue in favour)
PRONAME	Name of the pro team
PROM	Mark of the pro team
CONID	Identity code of the con team (argue in opposition)
CONNAME	Name of the con team
CONM	Mark of the con team
DD	Date of the debate
TD	Topic of the debate

Some sample records are shown below:

MID	PROID	PRONAME	PROM	CONID	CONNAME	CONM	DD	TD
M01	T01	Tiger	80	T02	Rockets	92	10-3-18	Homework should be banned.
M03	T03	Dragon	95	T02	Rockets	60	17-3-18	Hong Kong should have no tax.
M08	T04	Lucky	90	T03	Dragon	99	24-3-18	Money can buy you happiness.
M10	T06	Happy	88	T05	Red lion	90	17-3-18	Hong Kong should have no tax.
M11	T09	Rabbit	85	T07	Red apple	70	24-3-18	TV is better than books.
M12	T12	Angels	83	T05	Red lion	80	24-3-18	TV is better than books.

(a) (i) Which field does CONNAME depend on? _____

(1 mark)

(ii) Give an example to illustrate the data redundancy problem in DEBATE.

_____

_____

(1 mark)

Answers written in the margins will not be marked.

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(b) (i) Ms Lee suggests the following database schema with some new fields to solve the data redundancy problem in DEBATE. DEBATE2 and TEAM store information on debates in the competition and teams respectively.

Complete the database schema. Identify the primary keys and foreign keys for DEBATE2 and TEAM. Write 'N/A' if not applicable.

DEBATE2 (_____)

Primary key: _____

Foreign key: _____

TEAM (_____)

Primary key: _____

Foreign key: _____

Description of new field names:

_____

_____

_____

_____

(5 marks)

(ii) Is this schema in Third Normal Form? Explain briefly.

_____

_____

_____

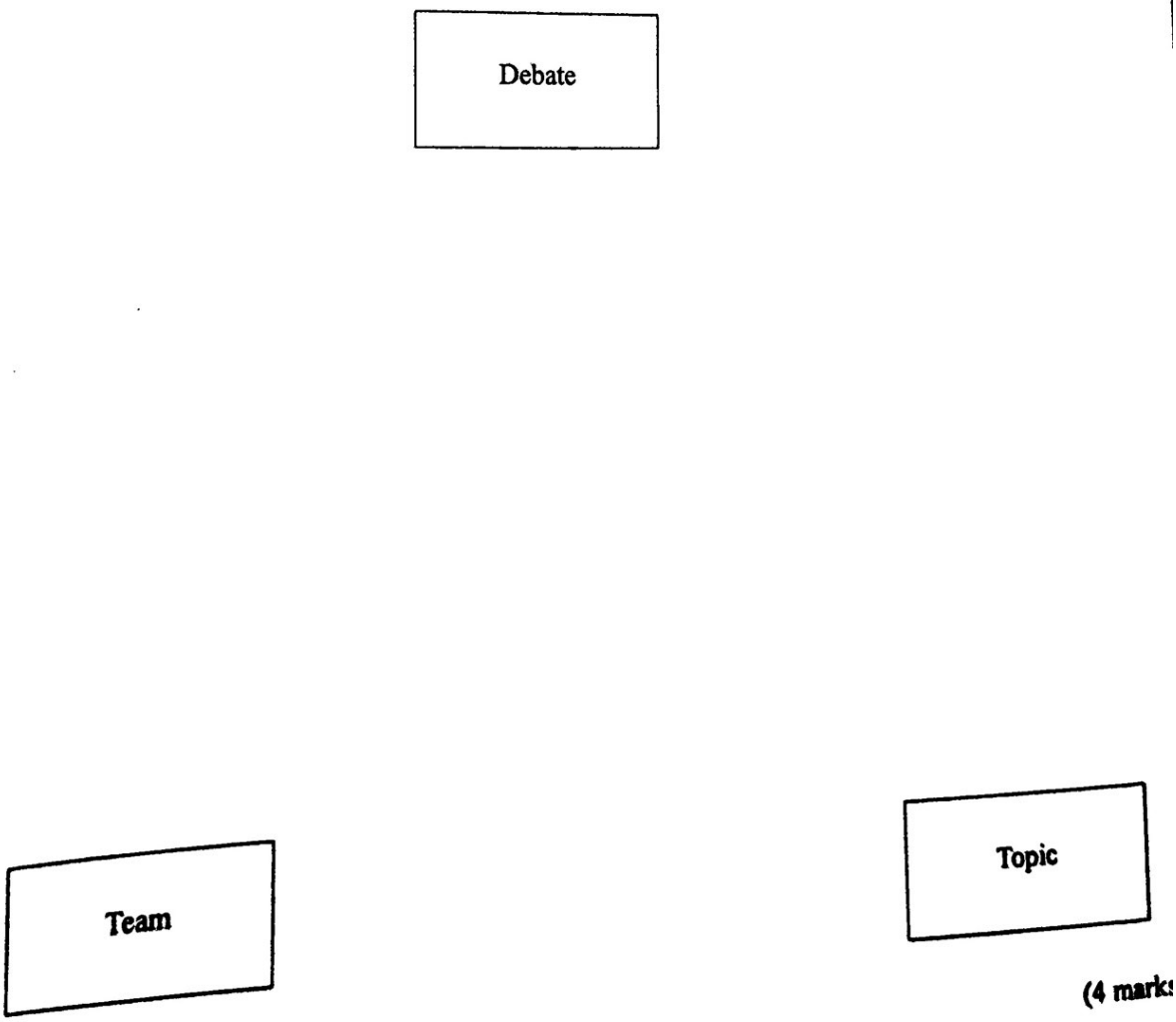
(2 marks)

Answers written in the margins will not be marked.

(c) When designing the database, Ms Lee has to follow the regulations of the competition below:

- There is only one topic in each debate.
- A topic can be used in more than one debate but some topics may not be used at all in the entire competition.
- Each team will be awarded a mark in a debate.

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



(4 marks)

(d) Ms Lee will video each debate and store all the videos in an online database server so that they can be watched by the public. Give **three** technical aspects to consider when providing this video service.

(3 marks)

Answers written in the margins will not be marked.

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2. Mr Li works in the IT Division of a school. He uses three database tables STUDENT, PARENT and ALUMNUS to store information on current students, parents and alumni respectively.

STUDENT

Field name	Type	Description	Example
SID	Character	Identity card number of the student	S123456
SNAME	Character	Name of the student	May Lee
FID	Character	Identity card number of the father	A123456
MID	Character	Identity card number of the mother	B345678
SL	Character	Secondary level	S6

PARENT

Field name	Type	Description	Example
PID	Character	Identity card number of the parent	A123456
PNAME	Character	Name of the parent	John Lee

ALUMNUS

Field name	Type	Description	Example
AID	Character	Identity card number of the alumnus	C123456
ANAME	Character	Name of the alumnus	Jane Hui
GRAD	Integer	Year of graduation	1986

Write SQL commands to complete tasks (a) to (c) below.

(a) List the names of the students and their fathers' names.

(2 marks)

(b) List the number of the students in each level.

(2 marks)

Answers written in the margins will not be marked.

(c) List the names of the parents who are **not** alumni of the school.

(3 marks)

(d) Secondary Six students graduate from the school and become alumni in 2018. They are no longer the current students, so Mr Li has to update some database tables.

(i) Complete the following command to add new alumni information to `ALUMNUS`.

```
INSERT INTO ALUMNUS (AID, ANAME, GRAD)
SELECT _____ FROM STUDENT
WHERE _____
```

(2 marks)

(ii) After executing the `INSERT` command above, what else should Mr Li do to complete the updating?

_____

_____

_____

_____

(2 marks)

Answers written in the margins will not be marked.

(e) Mr Li creates a view, MA, to list the identity card numbers of the students whose mothers are also alumni of the school.

(i) Write the SQL command for MA.

(2 marks)

Mr Li creates another view, FA, to list the identity card numbers of the students whose fathers are also alumni of the school.

(ii) Write a SQL command that lists the identity card numbers of the students whose mothers are alumni but their fathers are not.

(2 marks)

3. **Two online retail companies, Company A and Company B, are going to be merged into a single retail company. Eva, Greg and John are responsible for the merging of the database management systems (DBMS) of the two companies. They prepare the stages of the development lifecycle and expected deliverables.**

(a) Complete the table below by matching the stages of the development lifecycle with the deliverables.

Stages of the development lifecycle

1. Requirements collection and analysis
2. System definition
3. Application and database design
4. Prototyping
5. Data migration
6. Form and report design
7. Testing
8. Operational maintenance

Stage of the development lifecycle	Deliverable	Person-in-charge
4	A draft of the new DBMS	Eva
6	A set of forms and reports	Eva
7	Results of sample data	Eva
3	Coding for the new DBMS	Eva
	Expected system output	Greg
	System performance reports	John
	Functional specifications	Greg
	Merged records for the new DBMS	Eva

(4 marks)

(b) What kinds of database personnel are John and Eva?

John: _____

Eva: _____

(2 marks)

Parts of the database tables in the new DBMS are shown below:

ITEM

Field name	Type	Description
ItemID	Character	Identity code of the item
ItemName	Character	Name of the item
Des	Character	Description of the item

PRICE

Field name	Type	Description
ItemID	Character	Identity code of the item
PriceA	Integer	Selling price of the item
Stock	Integer	Number of items in stock

(c) Eva is going to put the data records of the two companies into a new DBMS. State one challenge that she may encounter with this data integration for each of the following aspects.

Database:

Schema:

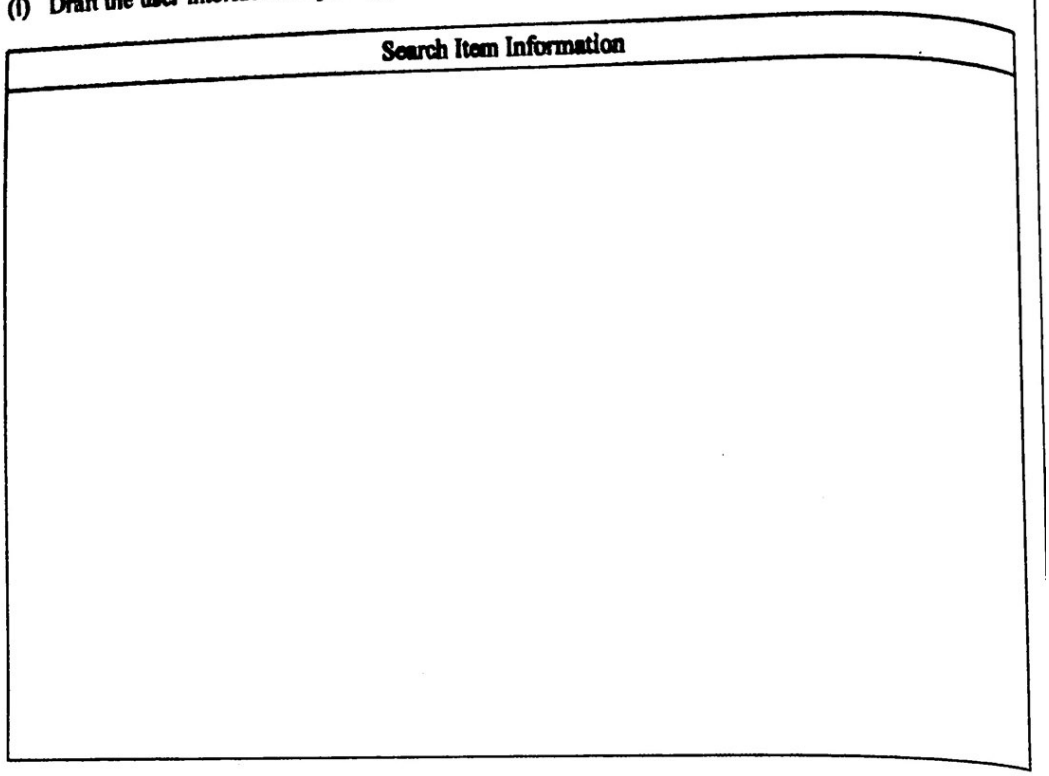
Data type:

(3 marks)

Answers written in the margins will not be marked.

Eva plans to create a user interface to search for item information in the new DBMS.

(d) (i) Draft the user interface and justify your design.

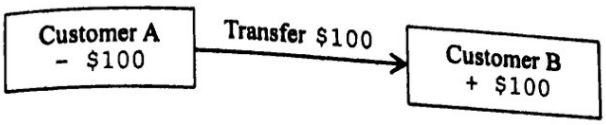


(3 marks)

(ii) The user interface will suggest some items that customers may be interested in buying. Describe how Eva applies data mining to generate a list of suggested items.

(2 marks

4. A financial company develops a mobile application for customers so that they can transfer money to each other. For example,



The following three database tables are used in the mobile application:

Database table	Description
CUSTOMER	Customer information
ACCOUNT	The account balance of the customer
TRAN	The transaction between customers

Part of the structure of ACCOUNT is:

ACCOUNT

Field name	Description	Example
AID	Identity code of the account	BZ0001
CREDIT	Account balance	500

(a) Consider the following transaction, composed of two SQL commands:

```
UPDATE ACCOUNT SET CREDIT = CREDIT - 200 WHERE AID = 'BZ0001'

UPDATE ACCOUNT SET CREDIT = CREDIT + 200 WHERE AID = 'BZ0002'
```

(i) What is the purpose of the transaction?

(1 mark)

(ii) Suppose that there is a system crash after executing the first SQL command. Describe the problem which may occur with the transaction.

(2 marks)

Answers written in the margins will not be marked.

(b) In order to solve the problem in (a)(ii), the company creates a recovery function to undo executed actions. Whenever a SQL command that involves data change is executed, a corresponding recovery SQL command will be stored in a log book. Complete the log book below. Write 'N/A' if not applicable.

Executed SQL command	Recovery SQL command
UPDATE ACCOUNT SET CREDIT = CREDIT - 50 WHERE AID = 'BZ0001'	UPDATE ACCOUNT SET CREDIT = CREDIT + 50 WHERE AID = 'BZ0001'
UPDATE ACCOUNT SET CREDIT = CREDIT + 200 WHERE AID = 'BZ0001'	UPDATE ACCOUNT SET CREDIT = CREDIT - 200 WHERE AID = 'BZ0001'
INSERT INTO ACCOUNT (AID, CREDIT) VALUES ('BZ0003', 0)	
SELECT * FROM ACCOUNT WHERE AID = 'BZ0004'	

(3 marks)

There are several servers located in different sites. The company has two methods for storing the database tables.

Method 1: Store a copy of the database tables on each server.
Method 2: Divide the data into several parts and store them on different servers.

(c) (i) For an operation that involves SELECT commands, which method would be more suitable? Explain briefly.

(2 marks)

(ii) For an operation that involves UPDATE commands, which method would be more suitable? Explain briefly.

(2 marks)

Part of the structure of TRAN is:

TRAN

Field name	Description	Example
TID	Identity code of the transaction	T001
PID	Identity code of the payment account	BZ0003
RID	Identity code of the receiving account	BZ0004
AMOUNT	Amount of the transaction	500

(d) (i) What is the purpose of the following SQL command?

```
SELECT AID
FROM ACCOUNT
WHERE ( SELECT COUNT(*)
        FROM TRAN
        WHERE AID = PID) > 2
```

(2 marks)

(ii) Rewrite the SQL command in (d)(i) **without** the use of sub-queries.

(3 marks)

END OF PAPER

Answers written in the margins will not be marked.