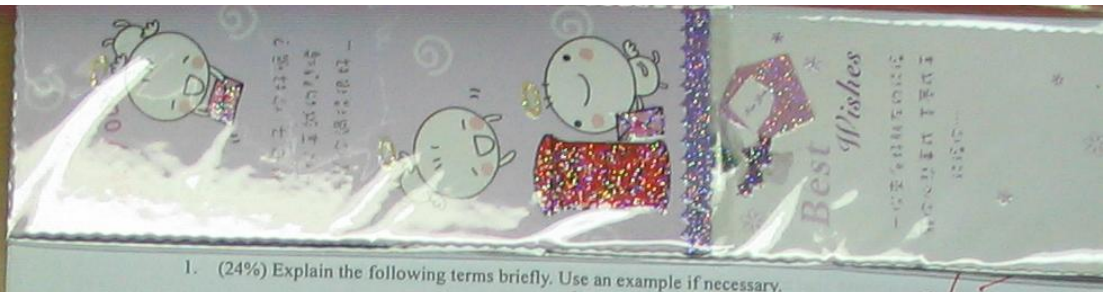
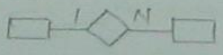


1. (24%) Explain the following terms briefly. Use an example if necessary.

- (3%) Attribute.
  屬性，描述 relation 中的特性 
- (3%) Domain
  值域，屬性所能使用值的範圍 { }
  定義域
- (3%) Entity
  實體，屬性中有 primary key 
- (3%) Relationship
  關聯，兩實體屬性相關 
- (3%) 1:N relationship



- (3%) Entity set
  實體集合
- (3%) Weak entity type
  弱實體型態，沒有 primary key 的實體型態 
- (3%) Relation instance

2. (30%) Newtown Records has decided to store information about musicians who perform on its albums (as well as other company data) in a database. Followings are the database requirements:

- Each musician that recorded at Newtown has an SSN, a name, an address, and a phone number. Poor paid musicians often share the same address, and no address has more than one phone.
- Each instrument used in songs recorded at Newtown has a unique identification number, a name (e.g., guitar, flute) and a musical key (e.g., C, B-flat).
- Each album recorded on the Newtown label has a unique identification number, a title, a copyright date, a format (e.g., CD or MC), and an album identifier.

- Each song recorded at Newtown has a title and an author.
- Each musician may play several instruments, and a given instrument may be played by several musicians.
- Each album has a number of songs on it, but no song may appear on more than one album.
- Each song is performed by one or more musicians, and a musician may perform a number of songs.
- Each album has exactly one musician who acts as its producer. A musician may produce several albums.

Design a conceptual schema for Newtown and draw an ER diagram for your schema. Be sure to indicate all key and cardinality constraints and any assumptions you make. Identify any constraints you are unable to capture in the ER diagram and briefly explain why you could not express them.

MUSICIAN

SSN	name	addr	phoneNum

FK MUSI_INST FK INSTRUMENT PK relationship

INSTRUMENT

id_num	name	musickey

FK INST-ALB FK ALBUM PK relationship

ALBUM

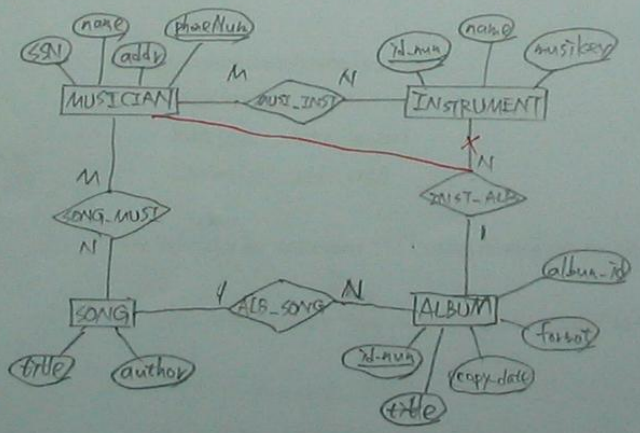
id_num	title	copy_date	format	album_id

FK ALB_SONG FK SONG PK relationship

SONG

title	author

FK SONG_MUSI FK MUSICIAN PK relationship



3. (10%) Consider the following instance of the Student relation.

Sid	Name	Login	Age	Gpa
50000	Dave	dave@yahoo	19	3.3
53666	Jones	jones@cs	18	3.4
53688	Smith	smith@ee	18	3.2
53650	Smith	smith@math	19	3.8
53831	Maya	maya@stat	11	1.8
53833	Gulda	gulda@music	12	2.0

- (5%) Give an example of an attribute (or set of attributes) that can deduce is NOT a candidate key, based on the above instance being legal. Explain why.

Name, Age, Gpa
會有重複

- (5%) Give an example of an attribute (or set of attributes) that can deduce IS a candidate key, based on the above instance being legal. Explain why.

-2

Sid, Login
不會重複, 唯一性

4. (36%) Consider the following schema:

Suppliers (*sid*, *sname*, *address*)
Parts (*pid*, *pname*, *color*)
Catalog (*sid*, *pid*, *cost*)

The key fields are underlined. The Catalog relation lists the prices charged for parts by Suppliers.

a. (6%) Write the query "*Find the names of all red parts*" in relational algebra.

P_C = $\sigma_{color=red}$ (Parts)

Result = π_{pname} (P_C)

b. (6%) Write the query "*Find the names of suppliers who supply some red parts*" in relational algebra.

$P\_C = \bowtie_{color=red}(Parts)$

$P = \bowtie_{pid=\pi_{pid}(P\_C)}(Catalog)$

$S = \bowtie_{sid=\pi_{sid}(P)}(Suppliers) * P$

$Result = \pi_{sname}(S)$

-2

c. (6%) Write the query "*Find the sids of suppliers who supply some red or green parts*" in **tuple** relational calculus.

$\{s.sid \mid Suppliers(s) \text{ AND } (EXIST\ p) \text{ AND } (EXIST\ c)$
$(s.sid = c.sid \text{ AND } p.pid = c.pid \text{ AND } p.color = red \text{ or } p.color = green)\}$

d. (6%) Write the query "*Find the sids of suppliers who supply every red parts*" in relational algebra.

$P\_C = \bowtie_{color=red}(Parts)$

$P = \bowtie_{pid=\pi_{pid}(P\_C)}(catalog)$

$S = \bowtie_{sid=\pi_{sid}(P)}(Suppliers) : \frac{1}{1} P$

$Result = \pi_{sid}(S) : * Suppliers)$

-2

e. (6%) Write the query "*For each supplier, retrieve the name of supplier, and the average cost of parts sold by the supplier*" in relational algebra. You may use grouping and/or aggregate functions for the query, if necessary.

$N = \pi_{sname}(Suppliers)$

$S = \bowtie_{sid=\pi_{sid}(Suppliers)}(Catalog)$

$C = \pi_{cost}(S)$

$Result = N * C$

-2

f. (6%) Write the query "*Find pairs of sids such that the supplier with the first sid charges more for some parst than the supplier with the second sid*" in **domain** relational calculus.

$\{gs \mid Suppliers(abc) \text{ AND } Catalog(deg) \text{ AND } (EXIST\ f) \text{ AND } (EXIST\ s)$
$(f.a = f.d \text{ AND } s.a = s.d \text{ AND } f.g > s.g)\}$

-3