1. Please briefly answer the following questions: (8+8+8+8=32)
   a) Explain the difference between files and Databases;

Files vs. Databases

- Application must stage large datasets between main memory and secondary storage (e.g., buffering, page-oriented access, 32-bit addressing, etc.)
- Special code for different queries
- Must protect data from inconsistency due to multiple concurrent users
- Crash recovery
- Security and access control

   b) What's ANSI-SPARC Architecture and how it supports data independence?

Levels of Abstraction: ANSI-SPARC Architecture

- Many *views*, single *conceptual (logical) schema* and *physical schema*.
  - Views describe how users see the data.
  - Conceptual schema defines logical structure
  - Physical schema describes the files and indexes used.

View 1   View 2   View 3
Conceptual Schema
Physical Schema

   c) Explain the difference between Data, Data model and Data Schema;

Data, Data Model and Data Schema

- *Data* are symbols for describing the things of real world. They are existing form of information.
- A *data model* is a collection of concepts and definitions for describing data.
- A *schema* is a description of a particular collection of data, using a given data model.
- The *relational model of data* is the most widely used model today.
  - Main concept: *relation*, basically a table with rows and columns.
  - Every relation has a *schema*, which describes the columns, or fields.

d) Explain the four parts of SQL;

2. The following relational modes are given: R = (A, B, C), S = (D, E, F). Let the relations r(R) and s(S) be known. Please give the tuple relational calculus expression equivalent to the following expression: (8+10+13=31)

   a) $\prod_A(r)$

   b) $\prod_{A,F}(\sigma_{C=D}(r \times s))$

   c) $r *\bowtie_{C=D} s$

   a) $\prod_A(r) = \{t[A]|t \in r\}$

   b) $\prod_{A,F}(\sigma_{C=D}(r \times s)) = \{t[AF]|t[ABC] \in r \wedge t[DEF] \in s \wedge t.C = t.D\}$

   c) $r *\bowtie_{C=D} s = \{t[ABCDEF]|(t[ABC] \in r \wedge t[DEF] \in s \wedge t.C = t.D) \vee$
   $(t[ABC] \in r \wedge \neg(t.C \in s[D]) \wedge t.D = NULL \wedge t.F = NULL \wedge t.F = NULL)\}$

3. Please draw the E-R diagram of the project relationship, the entities including employee, project, supplier, component. The relationship between the entities are as follows: (15)

   a) A project has multiple employees, and one employee can only work in one project;

   b) A project has multiple suppliers, and one supplier can supply multiple projects;

   c) A project requires multiple components, which can come from the same supplier or from different suppliers, and one kind of components can be used by multiple projects.

   Note: The entries have been given, please draw the E-R diagram that correctly represents these entities' relationships.

project	employee	supplier	component

(事际是 Many_to-Many)
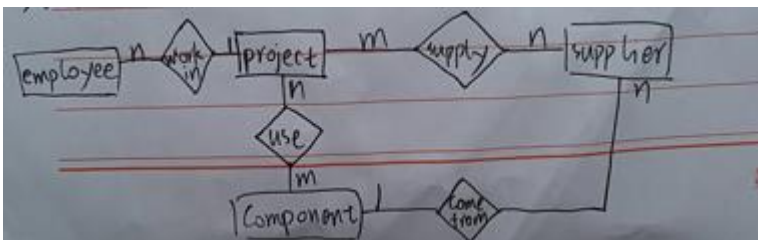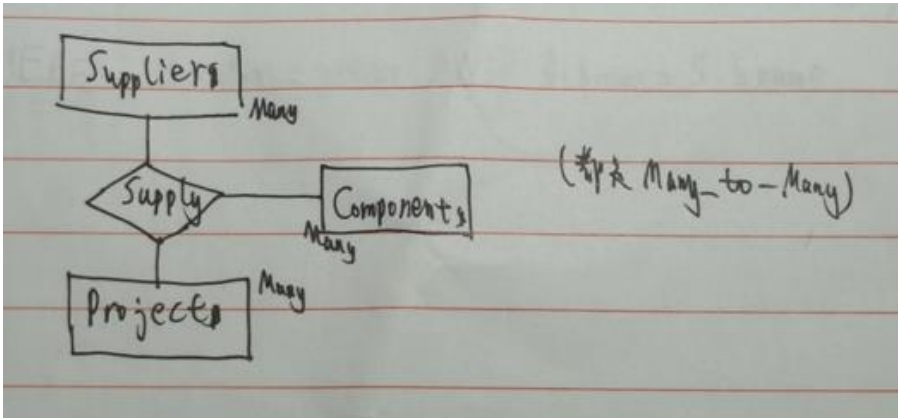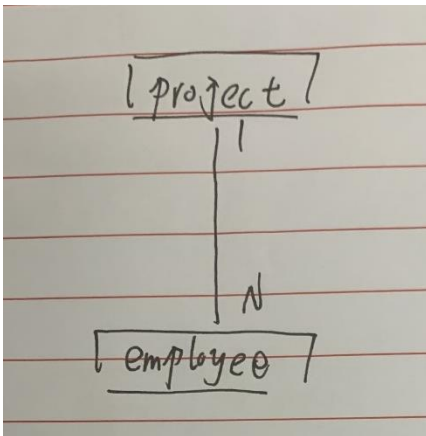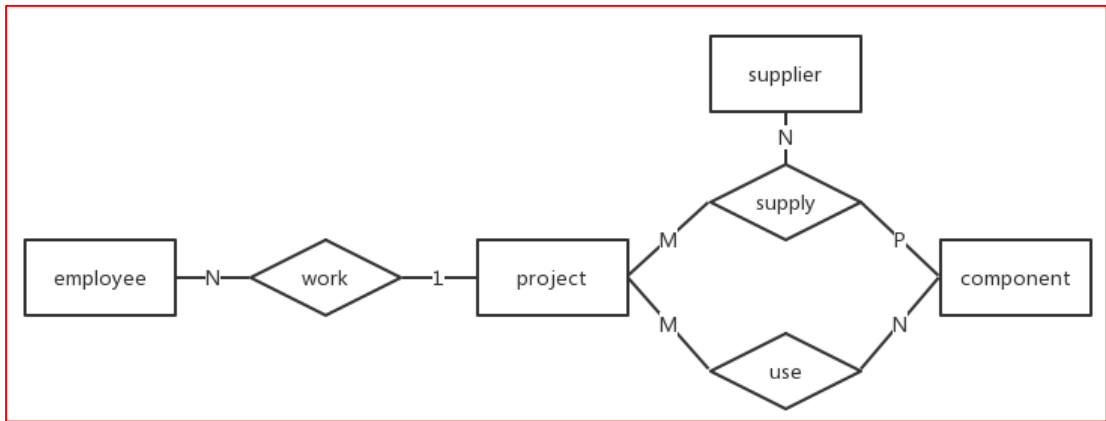
4. There is a work relationship table and the data schema is as follows:

       Work(warehouseID, employeeID, componentID, quantity)

One warehouse has multiple employees, and each employee only works in one warehouse. In each warehouse, one type of components is composed of one employee is responsible, but one employee can be responsible for a variety of components.

    Analyze all possible candidate keys for this pattern. (8)

        a. {employeeID, componentID}
        b. {warehouseID, componentID}

5. Answer these questions according to the tables:(6+8=14)

    a) Give the query result of "SELECT B.bname, R.day FROM Boats B, Reserves R WHERE B.bid=R.bid AND B.color=red";

    b) Write an SQL statement to query the names of sailors who've reserved green boat.

R

sid	bid	day
22	112	14/10/01
30	111	15/10/01
25	111	16/10/01

B

bid	bname	color
111	tiger	green
112	lion	red
113	hero	black

S

sid	sname	rating	age
22	paula	8	44
30	hebe	8	35
25	abby	10	50

a)

bname	day
lion	14/10/01

b) SELECT S.sname
FROM R, S, B
WHERE B.bid=R.bid AND S.sid=R.sid AND B.color='green';

```
(b) SELECT  S. bname
FROM    Sailors S
WHERE   S. bid in ( SELECT R. sid
                    FROM Reserves R
                    WHERE R.bid in ( SELECT B. bid
                                     FROM Boats B
                                     WHERE B.color=green)
                  )
```

```
a)  | bname | day |
    | Lion  | 14/10/01 |

b) select sname from S where sid = (
   select sid from R where bid = (
   select bid from B where color = 'green'));
```