THE QUESTIONS 3, 4, 5, 6 and 7 REFER TO THE RELATIONAL TABLES LISTED BELOW

```
CREATE TABLE APPLICANT(                   /* Applicants                 */
anumber     NUMBER(6)   NOT NULL,         /* Applicant number           */
fname       VARCHAR(20) NOT NULL,         /* First name                 */
lname       VARCHAR(30) NOT NULL,         /* Last name                  */
dob         DATE        NOT NULL,         /* Date of birth              */
city        VARCHAR(30) NOT NULL,         /* City                       */
phone       DECIMAL(10) NOT NULL,         /* Phone number               */
    CONSTRAINT APPLICANT_pkey PRIMARY KEY ( anumber ) );

CREATE TABLE EMPLOYER(                    /* Employers                  */
ename       VARCHAR(100)    NOT NULL,     /* Employer name              */
city        VARCHAR(30)     NOT NULL,     /* City                       */
phone       DECIMAL(10)     NOT NULL,     /* Phone number               */
    CONSTRAINT EMPLOYER_pkey PRIMARY KEY ( ename ) );

CREATE TABLE POSITION(                    /* Advertised positions       */
pnumber     DECIMAL(8)      NOT NULL,     /* Position number            */
title       VARCHAR(30)     NOT NULL,     /* Position title             */
salary      DECIMAL(9,2)    NOT NULL,     /* Salary                     */
extras      VARCHAR(50)             ,     /* Extras                     */
bonus       DECIMAL(9,2)            ,     /* End of year bonus          */
specification VARCHAR(2000)   NOT NULL,   /* Specification              */
ename       VARCHAR(100)      NOT NULL,   /* Employer name              */
    CONSTRAINT POSITION_pkey PRIMARY KEY ( pnumber ),
    CONSTRAINT POSITION_fkey FOREIGN KEY ( ename )
      REFERENCES EMPLOYER( ename ) );

CREATE TABLE SPOSSESSED(
anumber     DECIMAL(6)  NOT NULL,         /* Applicant number           */
sname       VARCHAR(30) NOT NULL,         /* Skill name                 */
slevel      DECIMAL(2)  NOT NULL,         /* Skill level                */
    CONSTRAINT SPOSSESSED_pkey PRIMARY KEY ( anumber, sname ),
    CONSTRAINT SPOSSESSED_fkey1 FOREIGN KEY ( anumber )
                  REFERENCES APPLICANT ( anumber ),
    CONSTRAINT SPOSSESSED_check1 CHECK ( slevel IN  ( 1,2,3,4,5 ) ) );

CREATE TABLE SNEEDED(
pnumber     DECIMAL(8)  NOT NULL,         /* Position number            */
sname       VARCHAR(30) NOT NULL,         /* Skill name                 */
slevel      DECIMAL(2)  NOT NULL,         /* Skill level                */
    CONSTRAINT SNEEDED_pkey PRIMARY KEY ( pnumber, sname ),
    CONSTRAINT SNEEDED_fkey1 FOREIGN KEY ( pnumber )
                  REFERENCES POSITION ( pnumber ),
    CONSTRAINT SNEEDED_check1 CHECK ( slevel IN  ( 1,2,3,4,5 ) ) );

CREATE TABLE APPLIES(
anumber           DECIMAL(6)  NOT NULL,   /* Applicant number           */
pnumber           DECIMAL(8)  NOT NULL,   /* Position number            */
appdate           DATE        NOT NULL,   /* Application date           */
    CONSTRAINT APPLIES_pkey PRIMARY KEY ( anumber, pnumber ),
    CONSTRAINT APPLIES_fkey1 FOREIGN KEY ( anumber )
                  REFERENCES APPLICANT ( anumber ),
    CONSTRAINT APPLIES_fkey2 FOREIGN KEY ( pnumber )
                  REFERENCES POSITION ( pnumber ) );
```

QUESTION 1 (8 marks)

Read and analyse the following specification of a sample database domain.

Pie in the Sky Securities Corporation (PSSC) is a brokerage firm that buys and sells stocks for its clients. The main actors are brokers and clients. PSSC has offices in different cities and each broker works in one of these offices. A broke can also be an office manager for the office he/she works in. brokers are described by and employee number, firs name, last name, and date of birth. Offices are described by an address (city, street building number, level number) and phone number. Address and phone number are the identifiers are the unique identifiers of offices.

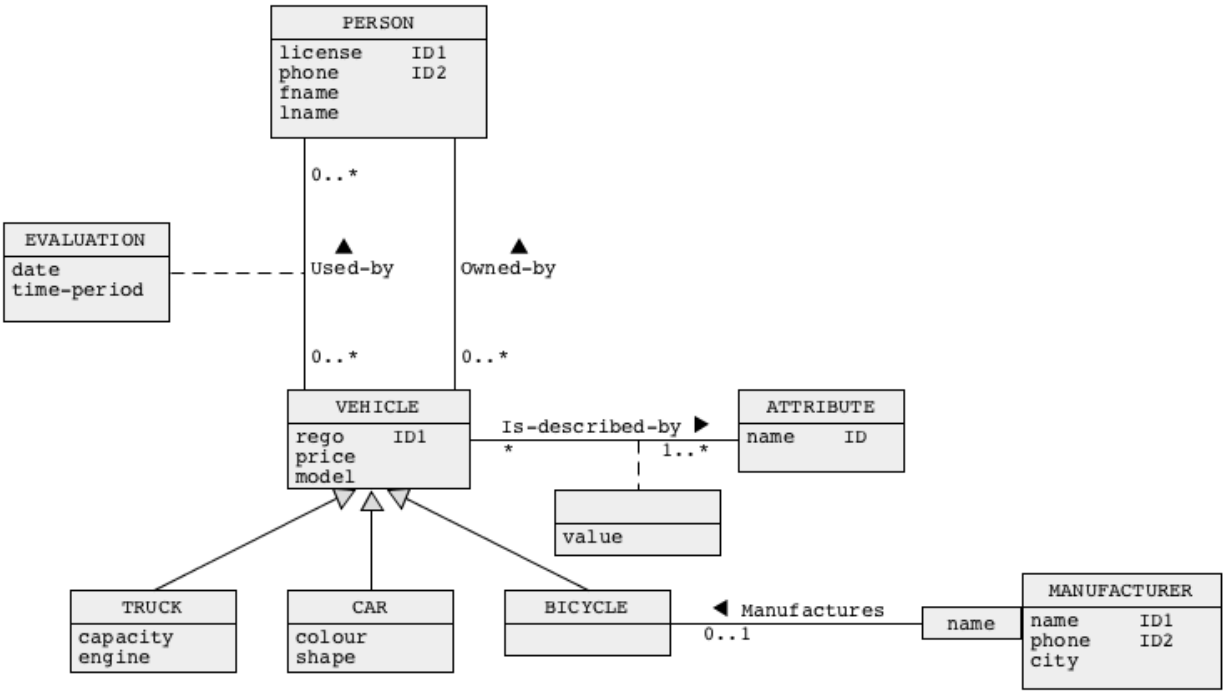
Clients own accounts, and any account can have more than one owner. An account is also managed by one broker. A client can have many accounts and a broker can manage many accounts. Each account is opened at a particular office. A client cannot have more than one account at one office. An account is described by account number, date when it was opened, and status (either active or suspended). An account number uniquely identifies each account within an office it has been opened in. An account number does not globally identify the accounts. Clients are described by client number (unique identifier), first name, last name, and phone number.

A database must contain information about the transactions performed by brokers and account owners on the accounts. A transaction is described by a unique timestamp when it has been performed, transaction type, and amount of money involved. If another account is involved in a transaction then its number must by recorded as well.

Draw a conceptual schema for the specification of a database domain listed above. Use a notation of UML simplified class diagrams explained to you during the lecture classes in the subject.

There is NO NEED to provide a detailed analysis how a conceptual schema has been created. The final conceptual schema expressed in a notation of UML simplified class is completely sufficient.

QUESTION 2 (9 marks)
Consider a conceptual schema given below.



Your task is to perform a step of logical database design, i.e. to transform a conceptual schema given above into a collection of relational schemas.

For each relational schema clearly list the names of attributes, primary key, candidate keys (if any), and foreign keys (if any). Assume, that **superset method** must be used to implement a generalization.

QUESTION 3 (10 marks)

Write the data definition statements of SQL that modify the structures of a database listed on a page 2 of the examination paper such that after the modifications the following data manipulations are possible.

(1) It should be possible to add to the database information about the present employer of each applicant.

(2) It should be possible to store in the database information about the courses passed by each applicant; assume that an applicant passes zero or more courses and each course is described by a unique name, no more than 30 characters long.

(3) It should be possible to store information about the types of position offered by the employer; assume that a type of position is either "admin" or "production" or "security".

(4) It should be possible to skip information about phone number when entering data of a new applicant or modifying data of already recorded applicant.

(5) The skill level that possessed by an applicant and needed for a position can be a positive integer that up to 10.

QUESTION 4 (10 marks)

Write the data manipulation statements of SQL that modify the contents of a database listed on page 2 of the examination paper in the ways described below. Note, that you are not allowed to modify and/or to drop any consistency constraints.

(1) An applicant number 7 applied today for a position number 21. Assume that information about applicant number 7 and position number 21 has been already entered into the database.

(2) Increase by 10% salaries of all position that have no applicants so far.

(3) Remove information about position number 22 from the database. Note, that you have to also remove all other information related to a position 22.

(4) Assume that a column `TOTAPPS` has been added to a relational table `APPLICANT`. Update the values in a column `TOTAPPS` such that each value is equal to the total number of applications submitted by an applicant.

QUESTION 5 (10 marks)

Write `SELECT` statements that implement the following queries.

(1) Find the full names of all applicants who apply for at least one position offered by an employer GoldenBolts.

(2) Find the total number of positions each applicant applies for. List an applicant number and the total number of positions applied. If an applicant does not apply for any position list his/her number with total number of positions applied equal to 0 (zero).

(3) Find the number of applicants who apply for more than 3 positions.

(4) Find the number of applicants who apply for both positions number 11 and number 22.

(5) Find the full names of the applicants that do not apply for any position at the moment.

QUESTION 6 (4 marks)

MySQL allows for specification of domain constraints as so called `CHECK` constraint in `CREATE TABLE` statement of SQL. However, at the moment, the latest version of MySQL does not automatically enforce such constraints in a database.
For the discreet domain constraints that restricts the values in a domain of a given attribute to a given set of values, like of example a `CHECK` constraint:

```
CONSTRAINT CHECK_CONSTRAINT CHECK sname IN ('reading', 'writing', 'thinking')
```

It is possible to enforce a domain constraint in a different way than directly through `CREATE TABLE` statement.

Implement a SQL statement that displays the information that violates a constraint below in the sample database.

The total applications submitted by each applicant must be less than or equals to 3 per day.

Display the applicant number, full name (fname and lname), the message "has submitted more than 3 applications in one day", and the date that the applicant has violated the above constraint.

QUESTION 7 (9 marks)

Assume that CREATE TABLE statements given on page 2 of the examination paper are included in a script file apps.sql. Write SQL script that performs the following operations by a user root.

(1) A user root with a password 'root' would like to create a database called apps.

(2) A user root would like to create, within a database apps, the tables given on page 2 of the examination paper.

(3) Then, a user root would like to create a new user account called admin with a password 'dadmin'.

(4) A user admin must have access in write mode to a relational table APPLIES with no rights to propagate such privilege to other users.

(5) A user admin must have access in read mode to all relational tables in the database. A user admin must have the rights to propagate such privilege to other users.

(6) A user admin must have the right to insert rows into the relational tables LIKES and APPLICANT with no rights to propagate the privilege to the other users.

(7) A user admin must have the rights to execute CREATE TABLE and CREATE VIEW statements with no rights to propagate the privilege to the other users.

(8) A user admin must have the rights to reference the primary keys in the relational tables APPLICANT and POSITION with no rights to propagate the privilege to the other users.

(9) A user admin must have the rights to create at any time at most 3 concurrent connections to the database.