1. For the following relation schema:

   - `employee(employee-name, street, city)`
   - `works(employee-name, company-name, salary)`
   - `company(company-name, city)`
   - `manages(employee-name, manager-name)`

   Give an expression in SQL for each of the following queries:

   a) Find the names, street address, and cities of residence for all employees who work for 'First Bank Corporation' and earn more than $10,000.

      ```sql
      select employee.employee-name, employee.street, employee.city from employee, works
      where employee.employee-name = works.employee-name
      and company-name = 'First Bank Corporation' and salary > 10000)
      ```

   b) Find the names of all employees in the database who live in the same cities as the companies for which they work.

      ```sql
      select e.employee-name
      from employee e, works w, company c
      where e.employee-name = w.employee-name and e.city = c.city
      and w.company-name = c.company-name
      ```

   c) Find the names of all employees in the database who live in the same cities and on the same streets as do their managers.

      ```sql
      select p.employee-name
      from employee p, employee r, manages m
      where p.employee-name = m.employee-name and m.manager-name = r.employee-name
      and p.street = r.street and p.city = r.city
      ```

   d) Find the names of all employees in the database who do not work for 'First Bank Corporation'. Assume that all people work for exactly one company.

      ```sql
      select employee-name
      from works
      where company-name <> 'First Bank Corporation'
      ```
e) Find the names of all employees in the database who earn more than every employee of 'Small Bank Corporation'. Assume that all people work for at most one company.

```sql
select employee-name
from works
where salary > all (select salary
                     from works
                     where company-name = 'Small Bank Corporation')
```

f) Assume that the companies may be located in several cities. Find all companies located in every city in which 'Small Bank Corporation' is located.

```sql
select s.company-name
from company s
where not exists ((select city from company where company-name = 'Small Bank Corporation')
                  except
                  (select city from company t where s.company-name = t.company-name))
```

g) Find the names of all employees who earn more than the average salary of all employees of their company. Assume that all people work for at most one company.

```sql
select employee-name
from works t
where salary >(select avg(salary) from works s
              where t.company-name = s.company-name)
```

h) Find the name of the company that has the smallest payroll.

```sql
select company-name
from works
group by company-name
having sum(salary) <= all (select sum(salary)
                          from works
                          group by company-name)
```

2. Let R=(A, B, C), S=(C, D, E) and let q and r be relations on schema R and s be a relation on schema S. Convert the following queries to SQL:

a) \{ \langle a \rangle \ | \ \exists b ( \langle a, b \rangle \in r \land b = 10) \}
\[ \text{select } A \text{ from } r \text{ where } B = 10 \]

b) \( q - r \)

\[ \text{select } * \text{ from } q \text{ where } (A, B, C) \text{ not in (select } * \text{ from } r) \]

\text{alternatively:}

\[ \text{select } * \text{ from } r \text{ except select } * \text{ from } s \]

c) \( \{ t \mid \exists p \in r \exists q \in s (t[A] = p[A] \land t[E] = q[E] \land p[C] = q[D]) \} \)

\[ \text{select distinct } A, E \text{ from } r, s \text{ where } C = D \quad */ 'distinct' \text{ is optional */} \]

d) \( \Pi_{A,C}(r) \bowtie \Pi_{C,D}(s) \)

\[ \text{select } r.A, r.C, s.D \text{ from } r, s \text{ where } r.C = s.C \]

\text{alternatively:}

\[ \text{select } r.A, r.C, s.D \text{ from } r \text{ natural inner join } s \]

e) \( r \times s \)

\[ \text{select distinct } * \text{ from } r, s \]

(based on text, questions 4.4 & 4.5)