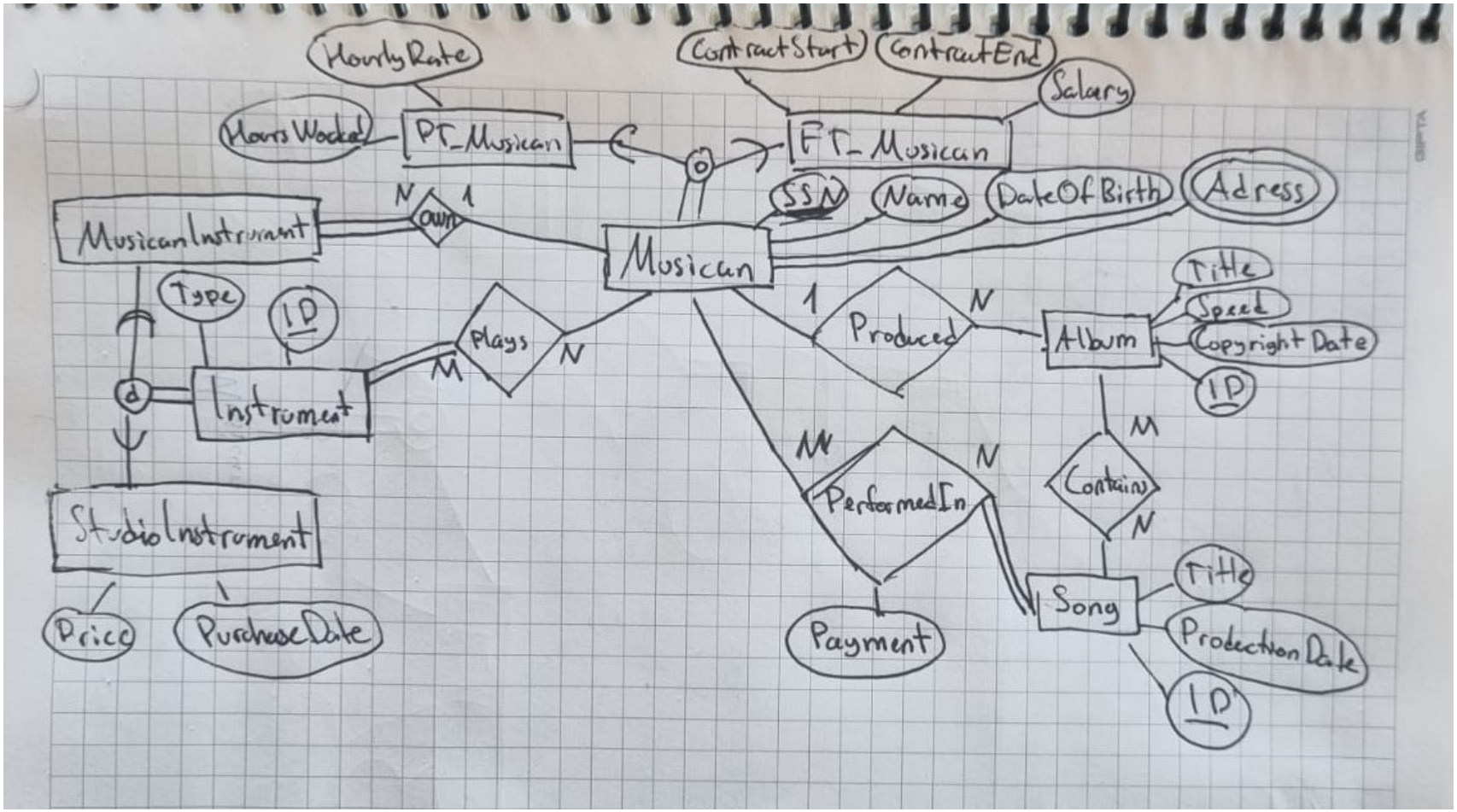


```
CREATE TABLE BOOK
(ISBN: INT,
 price: INT,
 title: CHAR(50),
 frontCoverType: CHAR(50),
 numberOfPages: INT,
 PRIMARY KEY (ISBN),

 -- BUYS relationship
 PaymentMethod: CHAR(50),
 PurchaseDate: CHAR(50)
 CID: INT,
 FOREIGN KEY (CID) REFERENCES (CUSTOMER)
```

```
 -- BORROWS relationship
 BorrowDate: CHAR(50),
 ReturnDate: CHAR(50),
 RegisteredCustomerID: INT,
 FOREIGN KEY (RegisteredCustomerID)
         REFERENCES (REGISTERED_CUSTOMER)
)

CREATE TABLE AUTHOR
(ID: INT,
 name: CHAR(50),
 PRIMARY KEY (ID)
)

CREATE TABLE WRITTEN_BY
(BOOK_ISBN: INT,
 AUTHOR_ID: INT,
 FOREIGN KEY (BOOK_ISBN) REFERENCES (BOOK),
 FOREIGN KEY (AUTHOR_ID) REFERENCES (AUTHOR),
 PRIMARY KEY (BOOK_ISBN, AUTHOR_ID)
)

CREATE TABLE CUSTOMER
(ID: INT,
 name: CHAR(50),
 PRIMARY KEY (ID),
)

-- Multivalued email
CREATE TABLE CUSTOMER_EMAIL
(CID: INT,
 EMAIL_ADDRESS: CHAR(50),
 PRIMARY KEY (CID, EMAIL_ADDRESS)
 FOREIGN KEY (CID), REFERENCES (CUSTOMER)
)

CREATE TABLE REGISTERED_CUSTOMER
(ID: INT,
 reg_date: CHAR(50),
 PRIMARY KEY (ID),
 FOREIGN KEY (ID) REFERENCES (CUSTOMER)
)

CREATE TABLE VISITING_CUSTOMER
(ID: INT,
 address: CHAR(50),
```

```
  phoneNumber: INT,
  PRIMARY KEY (ID),
  FOREIGN KEY (ID) REFERENCES (CUSTOMER)
)
```

Q3

a)

$$Q_1 = \sigma_{Dname=Sales}(\text{Department})$$

$$Q_2 = \sigma_{Bdate>01/01/1990}(\text{Employee})$$

$$\pi_{\text{Fname, Bdate, Address, Salary}}(Q_1 \bowtie_{Dnumber=Dno} Q_2)$$

b)

$$\pi_{\text{Fname, Minit, Lname}}(\sigma_{\text{Dnum}=8 \wedge \text{Hours}>20 \wedge \text{Pname}='DataPrivacy'}(\text{Employee} \bowtie_{Ssn=Essn} \text{Works\_On} \bowtie_{Pno=Pnumber} \text{Project}))$$

c)

Every Project Controlled By Departmen number 5:

$$Q_1 = (\sigma_{Dnumber=5}\ \text{Department}) \bowtie_{\text{Dnumber=Dnum}} \text{Project}$$

All Employees who work on Q_2:

$$Q_2 = \text{Employee} \bowtie_{Ssn=Essn} \text{WorksOn} \bowtie_{Pno=Pnumber} Q_1$$

Answer:

$$\pi_{\text{Lname, Salary}}(Q_2)$$

d)

$$\pi_{\text{Lname Salary Super.Lname}}(\rho_{12 \rightarrow \text{Super.Lname}}(\text{Employee} - \pi_{\text{Ssn}}(\text{Employee} \bowtie_{\text{Ssn=Essn}} \text{WorksOn})) \bowtie_{SuperSsn=Ssn} \text{Employee})$$

e)

$$\pi_{\text{Dname}}(\sigma_{\text{Location}='Istanbul'}(\text{Dept\_Locations})) \cup \pi_{\text{Dname}}(\sigma_{\text{Plocation}='Istanbul'}(\text{Project} \bowtie \text{Department}))$$

f)

$$\pi_{\text{Pnumber}}(\sigma_{\text{E.Lname}='Gursoy' \wedge \text{M.Lname}='Gursoy'}(\text{Employee AS E} \bowtie \text{Works\_On} \bowtie \text{Project} \bowtie \text{Department} \bowtie \text{Employee AS}$$

g)

$$\pi_{\text{Lname, Salary}}(\sigma_{\text{Mgr\_start\_date}=(\pi_{\text{MAX(Mgr\_start\_date)}}(\text{Department}))}(\text{Employee} \bowtie \text{Department}))$$

h)

$$\pi_{\text{Fname, Lname}}(\sigma_{\text{E1.Bdate}<\text{E2.Bdate} \wedge \text{E1.Ssn}=\text{E2.Super\_Ssn}}(\text{Employee AS E1} \bowtie \text{Employee AS E2}))$$