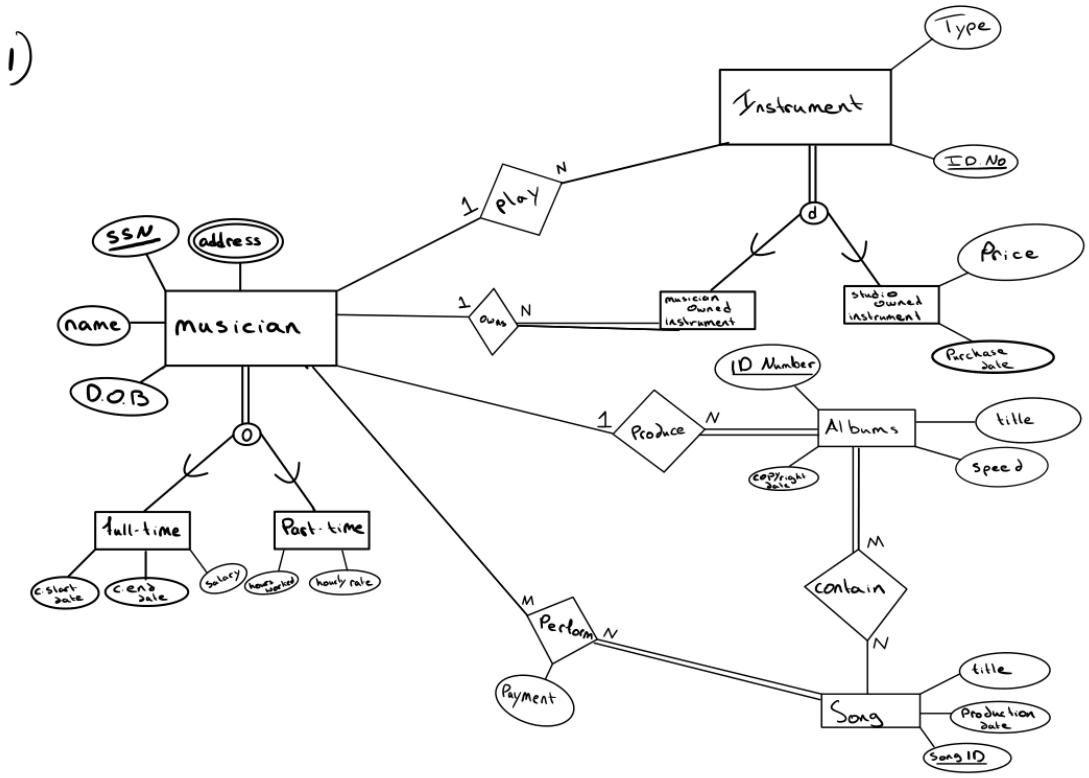
1)



2)

```
CREATE TABLE BOOK
      (price: INTEGER,
      title: CHAR(20),
      ISBN: INTEGER,
      front_cover_type: CHAR(10),
      no_of_pages: INTEGER,
      PRIMARY KEY (ISBN)
      in_customerID: INTEGER,
      FOREIGN KEY in_customerID REFERENCES CUSTOMER,
      payment_method: CHAR(10),
      purchase_date: CHAR(10)
      registered_customer_ID: INTEGER
      FOREIGN KEY registered_customer_ID REFERENCES REGISTERED_CUSTOMER
      borrow_date: CHAR(10)
      return_date: CHAR(10))

CREATE TABLE CUSTOMER
      (ID: INTEGER,
      name: CHAR(20),
      PRIMARY KEY (ID))
```

```
CREATE TABLE AUTHOR
      (name: CHAR(20),
      ID: INTEGER,
      PRIMARY KEY (ID))

CREATE TABLE REGISTERED_CUSTOMER
      (ID: INTEGER,
      reg_date: CHAR(20),
      PRIMARY KEY (ID),
      FOREIGN KEY ID REFERENCES CUSTOMER)

CREATE TABLE VISITING_CUSTOMER
      (ID: INTEGER,
      address: CHAR(20),
      phone_no: INTEGER,
      PRIMARY KEY (ID),
      FOREIGN KEY ID REFERENCES CUSTOMER)

CREATE TABLE CUSTOMER_EMAILS
      (ID: INTEGER,
      e-mail_address: CHAR(20),
      PRIMARY KEY (ID, e-mail_address),
      FOREIGN KEY ID REFERENCES CUSTOMER)

CREATE TABLE WRITTEN_BY
      (author_ID: INTEGER,
      book_ISBN: INTEGER,
      FOREIGN KEY author_ID REFERENCES AUTHOR,
      FOREIGN KEY book_ISBN REFERENCES BOOK,
      PRIMARY KEY (author_ID, book_ISBN))
```

3)

3)

a) $\pi_{fname,\ bdate,\ address,\ salary}$

$(((\sigma_{Bdate >= 01/01/1990 \wedge Dname = "sales"}(Employee \bowtie_{Dno = Dnumber} Department)))$

b) $\pi_{Fname, Minit, Lname}(\sigma_{Dnumber = 5 \wedge Hours > 20 \wedge Pname = "Pala\ Privacy"}(Employee \bowtie_{Dno = Dnumber} Department \bowtie_{SSN = ESSN} Works\_on \bowtie_{Pno = Pnumber} Project))$

c) $\pi_{Lname, salary}((\pi_{SSN, Pno}(\sigma_{Dno = 5}(Employees \bowtie_{Essn = ssn} Works\_On)) / \rho_{(Pno, Pnumber)}(\pi_{Pnumber}(\sigma_{Dnum = 5} Projects)) \bowtie Employees)$

d) $A = \rho(\_D(1 \to SSN), Works\_on)$

$B = (\pi_{SSN}(Employee) - \pi_{SSN}(A)) \bowtie Employee$

$C = B \bowtie_{superssn = Employee.ssn} \rho(4 \to SLname, Employee)$

$\pi_{Lname, salary, slname}(C)$

e) $\pi_{Dname}(\sigma_{Dlocation = "Istanbul"}(Department \bowtie Dept\_location))$

$\vee$

$\pi_{Dname}(C \sigma_{Plocation = "Istanbul"}(Proged \bowtie_{Pnumber = Pno} Department))$

f) $A = \text{Project} \bowtie_{Dnum = Dnumbe} \text{Department} \bowtie_{Mgrssn = ssn} \text{Employee}$

$\pi_{Pnumber}((\sigma_{Lname = \text{"Gurssoy"}} A \bowtie (\sigma_{Lname = \text{"Gurssoy"}} \text{Project} \bowtie_{Pnum = Pno} \text{Works\_on} \bowtie_{Essn = ssn} \text{Employee}))$

g) $R_1 \leftarrow \text{Employee} \bowtie_{Employee.ssn = Department.Mgr\_ssn} \text{Department}$

$R_2 \leftarrow \rho(Mgr2\_ssn \rightarrow SSN, Mgr_2\_start\_date \rightarrow Mgr\_start\_date) R_1$

$R_3 \leftarrow \pi_{ssn, Mgrssn, Mgr\_start\_date, Mgr2\_start\_date}(R_1 \times R_2)$

$R_4 \leftarrow \sigma_{Mgr\_start\_date < Mgr_2\_start\_date}(R_3)$

$R_5 \leftarrow \pi_{Mgr2\_ssn}(R_4)$

$R_6 \leftarrow \pi_{ssn}(R_1) - R_5$

$\pi_{Lname, salary}(R_1 \bowtie_{R_1.ssn = R_6.ssn} R_6)$

h) $R_1 \leftarrow \text{Employee} \bowtie_{Employee.super\_ssn = Employee.ssn} \text{Employee}$

$R_2 \leftarrow \rho(superssn \rightarrow SSN, supFname \rightarrow Fname, supLname \rightarrow Lname, supBdate \rightarrow Bdate)(R_1)$

$\pi_{supEname, supLname}(\sigma_{Bdate < supBdate}(R_2))$