Consider following relations:

R1: | A | B | C | D
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>a</td>
<td>b</td>
<td>f</td>
</tr>
<tr>
<td>c</td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>c</td>
<td>g</td>
<td>f</td>
<td>a</td>
</tr>
<tr>
<td>c</td>
<td>b</td>
<td>f</td>
<td>a</td>
</tr>
<tr>
<td>b</td>
<td>g</td>
<td>b</td>
<td>a</td>
</tr>
<tr>
<td>g</td>
<td>a</td>
<td>f</td>
<td>c</td>
</tr>
</tbody>
</table>

R2: | A | B | C | D
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>f</td>
<td>f</td>
<td>a</td>
</tr>
<tr>
<td>g</td>
<td>a</td>
<td>f</td>
<td>c</td>
</tr>
<tr>
<td>b</td>
<td>f</td>
<td>f</td>
<td>c</td>
</tr>
</tbody>
</table>

R3: | A | D
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>a</td>
</tr>
<tr>
<td>c</td>
<td>a</td>
</tr>
</tbody>
</table>

R4: | A | C | E
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>g</td>
</tr>
<tr>
<td>c</td>
<td>g</td>
<td>b</td>
</tr>
<tr>
<td>c</td>
<td>f</td>
<td>b</td>
</tr>
<tr>
<td>g</td>
<td>b</td>
<td>g</td>
</tr>
</tbody>
</table>

1. Construct $R1 \bowtie R4$, or state why can't.

2. Construct $R2 \cup R4$, or state why can't.

3. Construct $\sigma_{C=E \land D=A} R4$, or state why can't.

4. Construct $\pi_{C,D}(\sigma_{A=B} R1)$, or state why can't.

5. Construct $R1 - R3$, or state why can't.

6. Construct $\pi_{A,B}(R1) \times \pi_{C,D}(R2)$, or state why can't.

Extra credit. Construct $(\pi_{A,B,D}(R1)) \div R3$, or state why can't.
Consider following Database:

cREATE TABLE book(
    author VARCHAR2(25),
    title VARCHAR2(25),
    year NUMBER(4,0) CHECK (year > 1950),
    isbn VARCHAR2(13),
    PRIMARY KEY (isbn)
);

CREATE TABLE instructor(
    ssn NUMBER(9,0) CHECK (ssn > 0),
    fname VARCHAR2(25) NOT NULL,
    lname VARCHAR2(25) NOT NULL,
    department VARCHAR2(4) NOT NULL,
    PRIMARY KEY (ssn),
    UNIQUE (lname, fname, department)
);

CREATE TABLE assign(
    ssn NUMBER(9,0),
    department VARCHAR2(4),
    crscode CHAR(3),
    classcode CHAR(4),
    semester CHAR(2),
    year CHAR(4),
    isbn VARCHAR2(13),
    PRIMARY KEY (isbn, ssn, department, classcode, crscode, semester, year),
    FOREIGN KEY (department, classcode, semester, year) REFERENCES class,
    FOREIGN KEY (ssn) REFERENCES instructor,
    FOREIGN KEY (isbn) REFERENCES book
);

Write DDL of following relational schema that in the same database

Class(department, crscode, crsname, classcode, semester, year)
year is between 1970 and 2021, semester is either 'SU', 'SP' or 'FA'
classcode is 4 characters of digit, crscode is 3 characters of digit
Write following in relational algebra.
1. Find ISBN numbers of all books assigned by the instructor whose teaching csci331 this semester. (spring 2019)

2. Find course name which the class has been assigned any books with author's name starts with G.

3. Find authors and titles of all books that has assigned by the instructor whose last name is 'DIFFICULT' and the course name contains 'DATABASE'.

Extra Credit:

Write following in domain relational calculus.

Find the titles of the books which published before 2000