Practice questions

Question 1: One of the following four expressions of relational algebra is not equivalent to the other three. They are all based on the relations *R(A,B)* and *S(B,C)*. Indicate which is not equivalent to the others.

(a) $\pi_{AB}\ (R \bowtie S)$

(b) $R \bowtie \pi_B(S)$

(c) $R \cap (\pi_A(R) \times \pi_B(S))$

(d) $\pi_{A,R.B}(R \times S)$

Question 2: Of the following three equivalence's between expressions of relational algebra, each involving relations *R(A,B)* and *S(C,D)* (note the schema of *S* is different from that of the question above), which is true?

(a) $\pi_{A,B}(R \times S) = R$

(b) $R - \rho_{T(A,B)}(S) = \rho_{T(A,B)}(S - \rho_{U(C,D)}(R))$

(c) $\pi_{A,B,D}(R \underset{B=C}{\bowtie} S) = R \bowtie \rho_{T(B,D)}(S)$

(d) none of the above (i.e., they are all false)

Question 3:
Consider the following relation:

```
Family(parent, child, childDOB)
```

The intent is that a tuple (*p,c,d*) means that parent *p* has child *c*, who was born on date *d*. You may assume that parents do not have two children of the same name, and that there are no twins; i.e., no parent has two or more children born on the same day. Here are three queries we might ask about this data:

I. Find for each parent, the youngest child, i.e., the set of (*p,c*) such that *p* has child *c*, and no other child of *p* has a smaller date of birth than *c* does.

II. Find the set of great grandparents of "Amy."

III. Find all the descendants of "Mike."

Which of the above queries are expressible in relational algebra?

(a) **I** only.

(b) **I** and **II** only.

(c) **III** only.

(d) **I, II** and **III**.

Question 4: Consider the following SQL query on the relation R(A,B) that has no NULL's.

```
Select rr.A, rr.B, ss.A, ss.B
From R as rr, R as ss
Where rr.A = ss.A and rr.B = ss.B
```

Suppose that *R* has n tuples (not necessarily all distinct). Which of the above conditions is the most restrictive correct limitation on m, the number of tuples (again not necessarily all distinct) in the result?

(a) $n \leq m \leq n*n$

(b) $n \leq m \leq 2n$

(c) $0 \leq m \leq n$

(d) $m = n$

Question 5:

Suppose now that R(A,B) and S(A,B) are two relations with r and s tuples, respectively (again, not necessarily distinct). If m is the number of (not necessarily distinct) tuples in the result of the SQL query:

```
R intersect S;
```

Then which of the following is the most restrictive, correct condition on the value of m?

(a) $m = \min(r,s)$
(b) $0 \leq m \leq r + s$
(c) $\min(r,s) \leq m \leq \max(r,s)$
(d) $0 \leq m \leq \min(r,s)$

Question 6:

In this and the following questions you shall write queries in SQL and relational algebra over the following example database:

```
Beer(name, manf)
Bars(name, addr, license)
Drinkers(name, addr, phone)
Likes(drinker, beer)
Sells(bar, beer, price)
Frequents(drinker, bar)
```

This question is devoted to SQL queries, database modifications, and declarations. Write the following in SQL, being as succinct as possible.

a) Find the name and address of all drinkers who frequent Joe's Bar and like some Beer that Joe's Bar sells. Do not print any drinker more than once.

b) Delete from Drinkers table all drinkers in the 650 area code. You may assume that phone numbers are represented by character strings of the form '(xxx) yyy-zzzz', where xxx corresponds to the area code.

c) Find for each price (that appears in Sells) the number of bars that serve at least one beer at that price.

Question 7:
Using the same beer schema as in Problem above:

```
Beer(name, manf)
Bars(name, addr, license)
Drinkers(name, addr, phone)
Likes(drinker, beer)
Sells(bar, beer, price)
Frequents(drinker, bar)
```

Write the following in relational algebra. You may, if you wish, break complex expressions into steps by defining temporary relations.

a) Find all pairs of drinkers (i.e., their names) that have the same address. Produce the pair in only one order; e.g., if you produce (*a,b*), do not also produce (*b,a*). (4 points)

b) Find all the bars mentioned in both Sells and Frequents, but not in Bars. (4 points)

c) Find all the bars that serve only beers that drinker "Sally" likes. (4 points)