1. Suppose relation R(A,B,C) has the tuples: (8 pts)

|  |  |  |
| --- | --- | --- |
| **A** | **B** | **C** |
| 1 | 2 | 3 |
| 1 | 2 | 3 |
| 2 | 3 | 1 |
| 3 | 1 | 2 |
| 2 | 2 | 3 |
| 2 | 3 | 3 |

Using **bag** projection and intersection, compute PROJA,B(R) INTERSECT RENAMES(A,B)(PROJB,C(R)). Note that the renaming is only to give the two projections the same schema.

1. Let R(A,B,C) and S(A,B,C) be two relations, and no attributes can have null value. Determine whether each of the following equations **always** holds in which R, S, and all operations are interpreted to be sets and set-operations.

What if R, S, and all operations are bags and bag-operations? Please **explain** your answer in detail. (20 pts)

a). (R INTERSECT S) = (R JOIN S)

b). (((R - S) UNION (S - R)) INTERSECT (R INTERSECT S)) = EMPTYSET

c). DELTA(R) = GAMMA\_{A,B,C}(R)

d). (R UNION S) = R

1. The database contains the following relations: (18 pts)

Person ( ID, name, age, gender) // ID is a key

(e.g., (1, Gary, 30, M), (2, Mary, 21, F)…)

Shop\_list (ID, item) // (ID, item) is the key

(e.g., (1, 1), (1, 2), (2, 2), (2,3)…)

Sell (supermarket, item, price) // (supermarket, item) is the key

(e.g., (Walmart, 1, 3.0), (Walmart, 2, 2.50), (Costco, 3, 50.0), (Costco, 1, 2.50)…)

Write relational algebra expressions to answer the following queries, using Project operation to project the result tuples onto only the column(s)/attribute(s) requested:

1. Find all the items on the shop\_list of at least one person over the age of 18. (5pts)
2. Find the names of all males who have at least one item in their shop\_list sold at Walmart. (6 pts)
3. Find for **each** person, the lowest price of items on his/her shop\_list. (Hint: Gamma operation) (7 pts)