GATE

CS & DA

Database Management System

DPP: 1

Query Languages

Q1 Consider the following statements:

S_1: $\pi_{\text{List N}}(\pi_{\text{List N-1}} \ldots\ldots(\pi_{\text{List 1}}(R)) \equiv \pi_{\text{List 1}}(\pi_{\text{List 2}} \ldots\ldots(\pi_{\text{List N}}(R))$

S_2: $\sigma_{C_N}(\sigma_{C_{N-1}} \ldots\ldots (\sigma_{C_1}(R))) \equiv \sigma_{C_1}(\sigma_{C_2} \ldots\ldots (\sigma_{C_N}(R)))$

Which of the following is correct?

(A) S_1 only

(B) S_2 only

(C) Both S_1 and S_2 only

(D) Neither S_1 nor S_2

Q2 Consider the following table

I(pq)

p	q
0	1
4	5
8	9

J(qr)

q	r
1	2
5	2
5	6
5	10
13	10

K(rs)

r	s
2	3
6	7
10	11
10	3

The number of tuples in ($I \bowtie J \bowtie K$) where $\bowtie$ is the natural join is

(A) 5 (B) 8

(C) 10 (D) 11

Q3 Consider the following relations:

Enroll (Sid, Papercode), Paper(Papercode, Desc)

Which of the following relational algebra displays the Sid who only enrolled for Papercode having description (Desc) as "CS"?

(A) π_{Sid} (Enroll $\bowtie$ $\sigma_{Desc = \text{'CS'}}$ Paper)

(B) π_{Sid} (Enroll) – π_{Sid} (Enroll $\bowtie$ $\sigma_{Desc = \text{'CS'}}$ (Paper))

(C) π_{Sid} (Enroll) – π_{Sid}(Enroll $\bowtie$ $\sigma_{Desc <> \text{'CS'}}$ (Paper))

(D) None of the above

Q4 Consider a relation, work (<u>EmpID, ProjectID</u>)

The suitable relational algebra expression that projects the employee ids who work in exactly one project is

(A) π_{EmpID} (work) – π_{EmpID}(work $\bowtie_{(EmpID = E \wedge ProjectID = P)}$ $\rho_{E,P}$(work))

(B) π_{EmpID}(work $\bowtie_{(EmpID = E \wedge ProjectID \neq P)}$ $\rho_{E,P}$(work))

(C) π_{EmpID} (work) – π_{EmpID}(work $\bowtie_{(EmpID = E \wedge ProjectID \neq P)}$ $\rho_{E,P}$(work))

(D) None of the above

Q5 Consider the relation R(ABCD). Which of the following relational algebra expression returns the lowest value of B? (R1 and R2 are renames of R)

I. $\Pi_{R2.B}$(R1 $\bowtie_{(R1.B < R2.B)}$ R2)

II. Π_B(R) – $\Pi_{R1.B}$(R1 $\bowtie_{(R1.B > R2.B)}$ R2)

III. Π_B(R) – $\Pi_{R1.B}$(R1 $\bowtie_{(R1.B < R2.B)}$ R2)

IV. Π_B(R)

(A) I (B) II

(C) III (D) IV

Q6 Consider the following expression:

P: π_{sid} (student) – π_{sid} (student $\bowtie_{(Marks < M \wedge Gender = G)}$ $\rho_{(I, G, M)}$ (student)) on a relation student(sid, Gender, Marks)

The above query displays

(A) The sid of the students who obtained the maximum marks.

(B) The sids of the male and female students who obtained the maximum marks in their respective gender.

(C) The sids of male students who scored higher than all the female students.

(D) None of the above

Q7 Consider the relation:

Works (<u>Eid</u> , <u>Pid</u>), Project (<u>Pid</u>, Name)

The relational algebra expression that displays the Eids who work in every project with Name = 'M' is/are

GATE

(A) $\pi_{Eid, Pid}$ (Works)/ π_{Pid} ($\sigma_{Name = 'M'}$ (Project))

(B) π_{Eid} (Works) - π_{Eid}[(π_{Eid} (Works) × π_{Pid} ($\sigma_{Name = 'M'}$ (Project))) - $\pi_{Eid, Pid}$ (Works)]

(C) π_{Eid} (Works) - π_{Eid}[(π_{Eid} (Works) × π_{Pid} ($\sigma_{Name <> 'M'}$ (Project))) - $\pi_{Eid, Pid}$ (Works)]

(D) None of the above

Q8 Consider the two relations R_1 and R_2 such that they have no attributes in common.

S_1: $R_1 \bowtie R_2 = R_1 \times R_2$

S_2: $R_1 \bowtie R_2 = \varphi$

Which of the following is correct?

(A) S_1 only

(B) S_2 only

(C) Both S_1 and S_2 only

(D) Neither S_1 nor S_2

Q9 Suppose that two relations R (A, B) and S (A, B) have exactly the same schema. Which of the following is/are always true?

(A) R ∩ S = R - (R - S)

(B) R ∩ S = R - (S - R)

(C) R ∩ S = R ⋈ S

(D) $R \cap S = \sigma_{\mathrm{R.A=S.A \wedge R.B=S.B}} (\mathrm{R} \times \mathrm{S})$

Q10 Consider two relations R(A,B) and S(B,C) and the following relational algebra expression S: $\pi_{R.A,\ S.B}\ (\sigma_{R.B=S.B}\ (R \times S))$.

Which of the following relational algebra expression(s) are guaranteed to produce same result as S?

(A) $\pi_{A,B}$ (R⋈S)

(B) R ⋈ π_B (S)

(C) R ∩ (π_A (R) × π_B (S))

(D) $\pi_{A,\ R.B}$ (R × S)

Q11 Consider the following relational schemas Supplier(<u>Sid</u>. Sname), Parts(<u>Pid</u>, Pname), Catalog(<u>Sid</u>, <u>Pid</u>, Cost) and following two queries.

Q1: π_{Sid} [Catalog - [$\pi_{C1.Sid,\ C1.Pid,\ C1.cost}$($\sigma_{(C1.cost < C2.cost)}$($\rho_{C1}$(Catalog) x ρ_{C2}(Catalog)))]]

Q2: π_{Sid} [Catalog] - π_{Sid}[$\pi_{C1.Sid,\ C1.Pid,\ C1.cost}$($\sigma_{(C1.cost < C2.cost)}$($\rho_{C1}$(Catalog) x ρ_{C2}(Catalog)))]

Which of the following option is correct?

(A) Both Q1 and Q2 always produces the same output.

(B) Output produced by Q1 is always different for output produced by Q2.

(C) Output produced by Q1 is subset of output produced by Q2.

(D) Output produced by Q2 is subset of output produced by Q1.

GATE

Answer Key

Q1	(B)
Q2	(A)
Q3	(C)
Q4	(C)
Q5	(B)
Q6	(B)
Q7	(A, B)
Q8	(A)
Q9	(A, C)
Q10	(A, B, C)
Q11	(D)

GATE

Hints & Solutions

Q1 Text Solution:

S_1 : Projection is not commutative.
S_2 : Selection is commutative.

Q2 Text Solution:

The expression **I** ⋈ **J** ⋈ **K** will produce the following result:

p	q	r	s
0	1	2	3
4	5	2	3
4	5	6	7
4	5	10	11
4	5	10	3

Q3 Text Solution:

Sid who only enrolled for Papercode having description as “CS” = All enrolled Sid – All Sid who have enrolled in at least one Papercode with a description other than "CS"

Q4 Text Solution:

The employee ids who work in exactly one project = All employee ids who work in some project - All employee ids who work in at least two projects

Q5 Text Solution:

I. Returns all values of B except the smallest one.
II. Returns the smallest value of B.
III. Returns the largest value of B.
IV. Returns all values of B.

Q6 Text Solution:

The join condition (Marks < M ∧ Gender = G) filters out students who have lower marks than someone else of the same gender.
The set difference then removes all students who have marks lower than someone else in their gender.
The remaining sids are those **who have the highest marks within their respective gender**.

Q7 Text Solution:

Option A and option B are equivalent where both of them displays the Eids who work in every project with Name = ‘M’.

Q8 Text Solution:

When no common attributes exist, a natural join behaves like Cartesian product.

Q9 Text Solution:

A) This is a valid set identity. The intersection of two sets can be expressed as the elements of R after removing elements that are not in S.
B) The expression S–R gives elements in S but not in R. Subtracting these from R does not necessarily give R∩S, so this identity does not always hold.
C) Since R and S have the same schema, a natural join between them will return only common tuples, which is precisely R∩S.
D) he result will contain pairs of identical tuples, rather than a single instance of common tuples.

Q10 Text Solution:

R × S creates all possible pairs of tuples.
Projecting A, R.B means we include all possible combinations, not just valid join conditions.
Thus, option D is incorrect.

Q11 Text Solution:

Q1 removes specific (Sid, Pid, Cost) entries, meaning that a supplier could still remain if they have other entries in the catalog.
Q2 removes entire suppliers if they have at least one entry where they are not the cheapest.
Therefore, Q2 removes more suppliers than Q1, making Q2 a subset of Q1.