

Last name, first name:
Group:

1-12. Enter the answers for questions / problems 1-12 in the table below. Each multiple choice question has at least one correct answer.

1. D	2. B	3. A	4. C	5. E	6. D/E?	7. e	8. A																														
9. <table><tr><th>ID</th><th>M</th><th>N</th><th>P</th><th>Q</th><th>O</th></tr><tr><td>1</td><td>1</td><td>4</td><td>1</td><td>A</td><td>B</td></tr><tr><td>2</td><td>2</td><td>3</td><td>2</td><td>A</td><td>B</td></tr><tr><td>3</td><td>3</td><td>2</td><td>3</td><td>C</td><td>D</td></tr><tr><td>4</td><td>4</td><td>1</td><td>4</td><td>C</td><td>D</td></tr></table>		ID	M	N	P	Q	O	1	1	4	1	A	B	2	2	3	2	A	B	3	3	2	3	C	D	4	4	1	4	C	D	10. $\{M, N, P\} \rightarrow \{M\}$ $\{Q, O\} \rightarrow \{Q\}$ $\{10\} \rightarrow \{10\}$ $\{10\} \rightarrow \{M\}$		11. $\pi_{5,A,50,T,E}(\sigma_{6,A>10}(6 * T))$		12. $\alpha \rightarrow p \quad p \rightarrow \delta$ $\rightarrow \alpha \rightarrow \delta$	
ID	M	N	P	Q	O																																
1	1	4	1	A	B																																
2	2	3	2	A	B																																
3	3	2	3	C	D																																
4	4	1	4	C	D																																

1-6. Consider the relational schema $T(\underline{ID}, A, B, C, D, E)$ in SQL Server, with primary key $\{ID\}$, and the CHECK constraint $CHECK(A+B=100)$. T doesn't have any other constraints apart from domain ones. Answer questions 1-6 using the legal instance below.

ID	A	B	C	D	E
1	1	99	A-nceput de ieri să cadă	d1	e1
2	50	50	Câte-un fulg, acum a stat,	d1	e2
3	50	50	Norii s-au mai răzbunat	d1	e2
4	40	60	Spre apus, dar stau grămadă	d2	e1
5	20	80	Peste sat.	d2	e1

1. When executed on the above instance T:

☒ query `SELECT * FROM T WHERE C IS NULL` returns 5 tuples.

☒ query `SELECT * FROM T WHERE B < 50` returns 2 tuples.

☒ query `SELECT * FROM T t1 LEFT OUTER JOIN T t2 ON t1.D = t2.E WHERE t1.ID IS NULL OR t2.ID IS NULL` returns 1 tuple.

☒ query `SELECT * FROM T t1 WHERE (t1.D NOT IN (SELECT t2.E FROM T t2))` returns 5 tuples.

e. none of the above answers is correct.

2. What's the effect of executing the statement:

`ALTER TABLE T
ADD UNIQUE(C)`

☒ an error is generated: a UNIQUE constraint cannot be added on C because T already has a primary key.

☒ the UNIQUE constraint is successfully added to the table.

☒ an error is generated: a UNIQUE constraint cannot be added on C because C doesn't have a DEFAULT constraint.

☒ an error is generated: a UNIQUE constraint cannot be added on C because T has a CHECK constraint using columns A and B.
e. none of the above answers is correct.

3. How many tuples does the following query return:
`SELECT t1.*
FROM T t1 LEFT JOIN T t2 ON t1.D = t2.E
WHERE (t1.ID BETWEEN 1 AND 10 AND t1.A = 50
AND (t1.C = 'Norii s-au mai răzbunat' OR
t1.C = 'Câte-un fulg, acum a stat,')`

- ☒ a. 2
b. 3
c. 4
d. 5

e. none of the above answers is correct.

4. How many rows will have a value of 50 in column B after the execution of the statement below?

`UPDATE T
SET B = 50`

- a. 5
b. 3

☒ c. 2 → since there will be a constraint failure

- d. 0

e. none of the above answers is correct.

5. How many records does the query below return?

`SELECT t1.A, t1.B, MAX(t1.B) MaxB
FROM T t1
GROUP BY t1.A, t1.B
HAVING COUNT(*) > (SELECT MIN(t2.ID)
FROM T t2
WHERE t2.A < 50)`

- a. 1
b. 2
c. 3
d. 4

☒ e. none of the above answers is correct.

6. How many records does the query below return?

SELECT r2.ID, SUM(r1.B) SumB

FROM

(SELECT t1.*

FROM T t1 INNER JOIN T t2 ON t1.C = t2.C) r1

RIGHT JOIN

(SELECT t2.*

FROM T t1 RIGHT JOIN T t2 ON t1.ID = t2.ID) r2

ON r1.ID < r2.ID

WHERE r1.ID NOT BETWEEN 2 AND 4

GROUP BY r2.ID

a. 1

b. 2

c. 3

d. 4

e. none of the above answers is correct.

7. A SELECT query:

~~a.~~ can contain a HAVING clause only if it contains a WHERE clause.

~~b.~~ can contain a WHERE clause only if it contains a HAVING clause.

~~c.~~ can contain a HAVING clause only if it contains an ORDER BY clause.

d. can contain a GROUP BY clause only if it contains a HAVING clause.

e. none of the above answers is correct.

13. A research team of linguists is conducting a study on a group of subjects to determine the impact spoken language has on cognition. The team is using a relational database. A **subject** has a name, date of birth, educational level, occupation, and native language. A **language** has a name and type; the **type** has 2 values, *right-branching* and *left-branching*, each accompanied by a description. As subjects are assessed on a battery of memory tasks, their answers are stored in the database. A **memory task** has a description and includes multiple stimuli. A stimulus is a picture of an animal or object (e.g., a cat, a lamp) and can be part of several memory tasks. For a stimulus, the database retains the file path to the actual picture file and one keyword describing the animal / object in the picture (e.g., cat, lamp); the keyword is unique across all stimuli (e.g., there is at most one picture of a cat). A stimulus has a precise position in a memory task, e.g., memory task T1 includes stimuli S7, S2, and S4 on positions 1, 2, and 3, respectively; when evaluated on task T1, a subject will first be shown S7, then S2, and finally S4. A subject can be assessed on several memory tasks, but only once on a given memory task. Of course, multiple subjects can be evaluated on a given memory task. A subject is evaluated on a memory task on a specific date; the subject is shown all the stimuli in the task on a screen in the order specified by their positions; every stimulus is visible for 3 seconds. Upon seeing all the stimuli, the subject is asked to provide the following answer: he/she must recall all the stimuli in the order in which they were presented, by specifying the keyword corresponding to every stimulus. E.g., the subject is shown the following stimuli in a memory task: position 1 – picture of a cat, position 2 – picture of a lamp, position 3 – picture of a dog; the subject provides the following (incorrect) answer: position 1 – lamp, position 2 – cat, position 3 – dog.

Draw a database diagram (tables with primary key, foreign key and unique constraints) for the above data. The schema must be BCNF.

14. Let A, B, C, D be 4 relations with schemas A[ID, A1, A2, A3], B[B1, B2], C[C1, C2], D[ID, D1], and E an expression in the relational algebra:

$E = (\sigma_{ID=B1 \text{ AND } A2='exam'} \text{ AND } B2='DB' (A \times B)) * (\sigma_{C1=3} (C \times D))$

Optimize E and draw the evaluation tree for the optimized version of the expression.

8. Let R[ID1, ID2, ID3, A, B, C, D, E, F, G] be a relational schema with no repeating attributes. {ID1, ID2, ID3} and {A, B} are the only candidate keys. The following dependencies hold: {ID1, ID2} → {C} and {A} → {G}. R is:

a. 1NF → no repeating attributes

b. 2NF not fully func. dep

c. 3NF

d. BCNF

e. none of the above answers is correct.

9-10. Consider the relational schema T[ID, M, N, P, Q, O], with primary key {ID}.

9. Give an example of a T instance that has at least 4 tuples and satisfies the functional dependency {M, N, P} → {Q, O}.

10. Write 3 trivial functional dependencies on T.

11. Write the SQL query below as a relational algebra expression.

SELECT S.A, S.B, T.C
FROM S NATURAL JOIN T
WHERE S.A > 10

12. State the pseudotransitivity rule for functional dependencies in terms of sets of attributes $\alpha, \beta, \gamma, \delta$.

