Branch : CSE & IT **Batch : hinglish**

Database Management System

ER Model

DPP 01

[MCQ]

1. Which of the following statements about ER model is/are correct?

S_1: Relationship sets can have attributes of their own.

S_2: Many to many relationships cannot be represented in ER diagram.

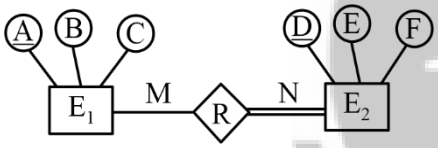
S_3: Multi value attributes and weak entity set allowed in RDMS.

(a) S_1 only (b) S_1 and S_3 only

(c) S_2 and S_3 only (d) S_1, S_2 and S_3

[MCQ]

2. Consider the following ERD:



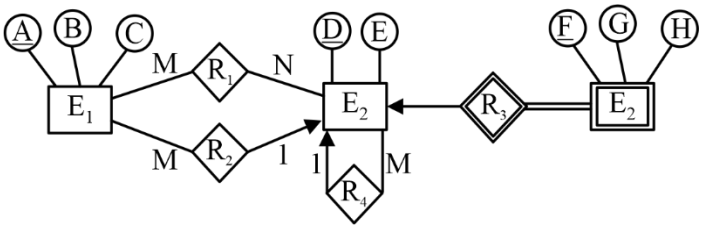
Which of the following is the minimum number of relational table and foreign key required for above ERD?

(a) 3, 2 (b) 1, 1

(c) 2, 1 (d) None of thee

[MCQ]

3. Consider the following ER model:



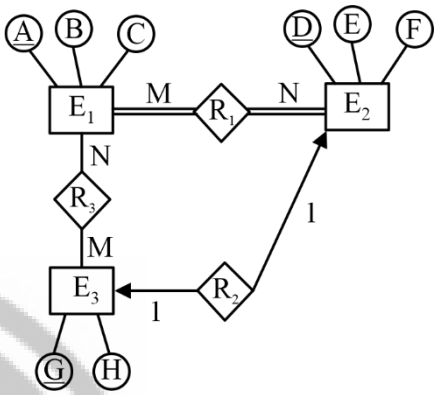
Which of the following is the minimum number of relational tables and minimum number of foreign key required for conversion into relational table?

(a) 6, 4 (b) 4, 5

(c) 5, 4 (d) 4, 6

[NAT]

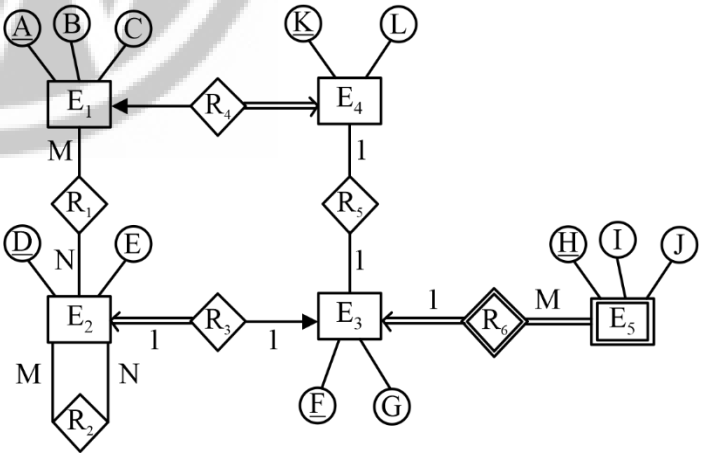
4. Consider the following ER model:



Assume X is the minimum number of tables, Y is the total number of attributes in relational tables and Z is the minimum number of foreign key, then find the value of X + Y + Z?

[MCQ]

5. Consider the following ER diagram:



How many total attributes required for the minimized relations of the above ER diagram?

(a) 14

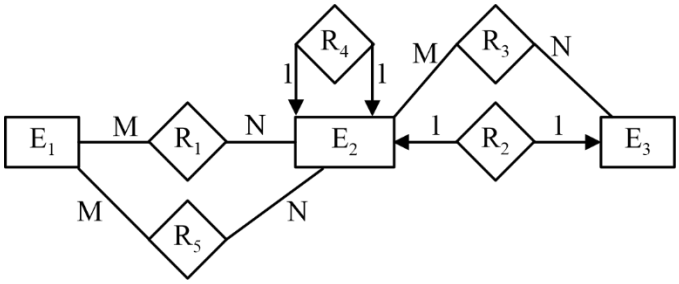
(b) 15

(c) 18

(d) None of these

[NAT]

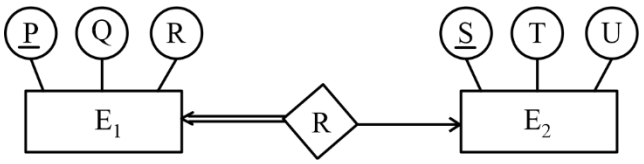
6. Consider the following ER diagram



Total number of RDBMS table in the above diagram?

[MCQ]

7. Consider the following ER model:



If ‘x’ entries in E1 and ‘y’ entries in E2.
How many entries in relation set (R)?

(a) Exactly y

(b) At most x

(c) Exactly x

(d) at least x and at most m

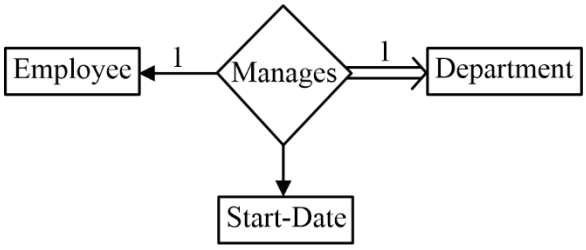
Answer Key

1. **(a)**
2. **(c)**
3. **(b)**
4. **(17)**
5. **(c)**
6. **(6)**
7. **(c)**

Hints & Solutions

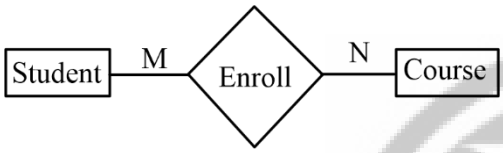
1. (a)

Statement S_1 is correct.



In the above ER diagram "Start-Date" is attribute of relationship set "Manages". It can be associate to either employee or department entity.

Statement S_2 is incorrect.



ER diagram represents many students can enroll many courses.

Statement S_3 is incorrect.

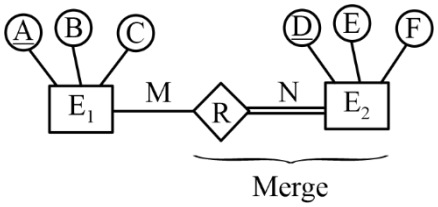
According to R DBMS guidelines every attributes in relational table must atomic and table must have atleast one candidate key (1NF) hence, multivalued attribute and weak entity sets are not allowed in R DBMS.

It only allowed in ER diagram

2. (c)

I. Minimum number of relational tables:

When the relation between entity set is "many to many" and any one side total participation then relationship merge towards total participation.



E_1 (A B C) E_2R (A D E F)

Hence, the minimum number of relations are 2.

II. Minimum number of foreign keys:

Hence, we need minimum 1 foreign key to represent above ERD into relational table

3. (b)

Minimum number of relations tables:

1. E_1 R_2 (A D B C)

In this table A is P.K and D is F.K referring "E_2R_4"

2. E_2 R_4 (D E D_1)

In this table D is P.K and D_1 taken from self-referring relation set "R_4" and D_1 is F.K referring D in the same table.

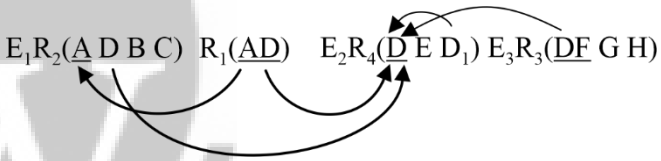
3. R_1 (A D)

In this table "AD" is PK and A and D is FK referring "E_1 R_2" and "E_2 R_4".

4. E_3 R_3 (D F G H)

In this table "DF" is strong key that is PK and 'D' is F.K referring table "E_2R_4".

Hence, for the given ER diagram we need minimum 4 relational table and 5 foreign keys.



4. (17)

Find the minimum number of relation table:

I. The entity between E_1 and E_2 have many to many mappings and both side total participation so, E_1, R_1 and E_2 will be merged into single relation.

E_1 R_1 E_2 (A B C D E F)

In this table A and D both are candidate key of relation E_1 R_1 E_2.

II. Between E_2 and E_3, we have one to one mapping and both side partial participation. Hence, relationship R_2 can be merge either towards E_2 or E_3.

$\therefore$ R_2 E_3 (G H D)

In this table G and D is candidate key and D is FK referring to table E_1 R_1 E_2.

III. Between E_1 and R_3, we have many to many mapping and both side partial participation. Hence, R_3 will have separate table.

$\therefore$ R_3 (A G)

In this table "AG" is candidate key and A and G are FK referring "E_1 R_1 E_2" and "E_3 R_2"

Hence, X value will be 3

Y value will be 11

Z value will be 3

$\therefore$ X + Y + Z = 3 + 11 + 3 = 17

5. (c)

$E_1(\underline{A}BC)$, $R_4(\underline{A}\,\underline{K})$, $E_4(\underline{K}L)$ $\Big\}$ $E_1R_4E_4(\underline{A}BC\underline{K}L)$

$R_1(\underline{AD})$ $\Big\}$ $R_1(\underline{AD})$

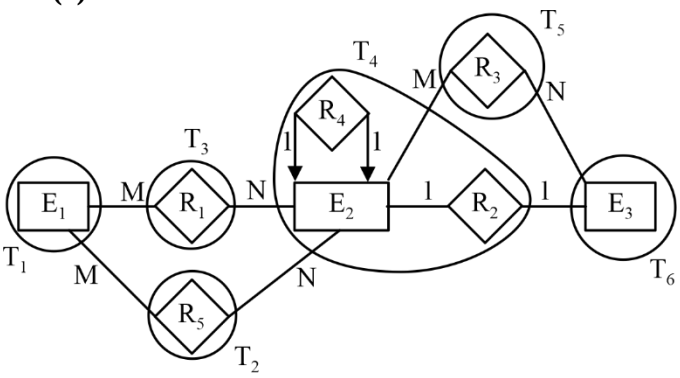
$E_2(\underline{D}\,E)$ $R_3(\underline{D}\,\underline{F})$ $E_3(\underline{F}\,G)$ $E_5(\underline{K}\,F)\}$

E_2 R_3 E_3 R_5 $(\underline{D}\,E\,\underline{F}\,\underline{K}\,G)$

$R_2(\underline{D_1}D_2)\Big\}R_2(\underline{D_1}D_2)$

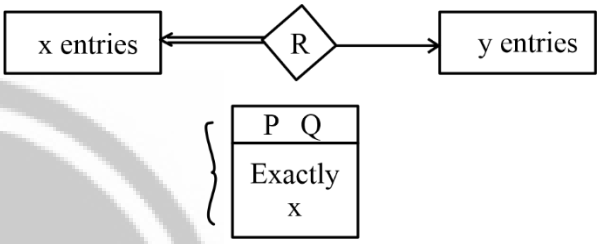
$R_6(\underline{FH})$, $E_5(HIJ)$ $\Big\}$ $E_5R_6(\underline{FH}IJ)$

6. (6)



Total number of tables = 6

7. (c)



Every object of E_1 must be related with exactly one entry of E_2.

Hence, option C is correct.

Branch : CSE & IT Batch : Hinglish

Database Management System

ER Model

DPP 02

[MCQ]

1. Consider the following relation Supervision(EmployeeID, Name, SupervisorID)pertaining to a company's database:

EmployeeID	Name	SupervisorID
1	A	4
2	A	3
3	B	1
4	C	5
5	D	2
6	E	5
7	B	3
8	A	1

The key SupervisorID acts as a Foreign key in the relation Supervision.

The following operations are performed on the relation:

I: Insert a new employee having EmployeeID==‘9’and Name = A and SupervisorID as ‘1’;

II: Set SupervisorID as ‘NULL’ where EmployeeID==2 OR EmployeeID==4;

III: Set SupervisorID as ‘0’ where EmployeeID==1;

Which of the above operation(s) is/are ALLOWED?

(a) I only (b) I and II only

(c) III only (d) I and III only

[MCQ]

2. Consider the following statements:

P: At most one foreign key is possible for a relational schema.

Q: A foreign key declaration can always be replaced by an equivalent check assertion in SQL.

Which of the following is/are INCORRECT?

(a) P only (b) Q only

(c) Both P and Q (d) Neither P nor Q

[MSQ]

3. Consider the relations-

Two relations are given as R_1(PaperCode, NumberofCandidates) and R_2(RollNo, Papercode). Assume that each roll no must have only one papercode but one paper can be chosen by many candidates. Which of the following is/are INCORRECT?

(a) Papercode can either act as a primary key and a foreign key in R_2.

(b) Papercode acts as a foreign key in R_2.

(c) Papercode satisfies UNIQUE and NOT NULL constraint R_2.

(d) Papercode allows NULL values in R_2.

[NAT]

4. Consider the following SQL Query:

```
Create table department
 {
  a integer;
  b integer;
  primary key (a);
  foreign key (b) reference department ON
  DELETE CASCADE
 };
```

The Tuples (a, b) currently in the table department are:

(0, 2) (1, 2) (2, 1) (3, 0) (5, 0) (7, 3) (4, 2) (6, 1)

Consider the following query

Delete from department where a = 0

The number of Tuples that must be additionally deleted to preserve referential integrity is _____.

[NAT]

5. Consider the following relation Supervision (EmployeeID, Name, SupervisorID) pertaining to a company's database:

EmployeeID	Name	SupervisorID
1	A	4
2	A	6
3	B	2
4	C	5
5	D	2
6	E	3
7	B	4
8	A	1

The key SupervisorID acts as a Foreign key in the relation Supervision. The schema follows "On Delete Cascade" constraint. The employee having EmployeeID '5' is deleted from the relation Supervision. The number of tuples remaining in the relation are _____.

[NAT]

6. Consider the following relational schemas:

Catalogue		
sno	**pno**	**cost**
S1	P1	150
S1	P2	50
S1	P3	100
S2	P4	200
S2	P5	250
S3	P1	250
S3	P2	150
S3	P5	300
S3	P4	250

Suppliers		
sno	**sname**	**location**
S1	M/s Royal furniture	Delhi
S2	M/s Balaji furniture	Bangalore
S3	M/s Premium furniture	Chennai

Parts		
pno	**pname**	**part_spec**
P1	Table	Wood
P2	Chair	Wood
P3	Table	Steel
P4	Almirah	Steel
P5	Almirah	Wood

All the items supplied by M/s Balaji Furniture are banned. Moreover, the company no longer sells steel items. The schema follows "On Delete Cascade" constraint. Delete all the records from Catalogue where sno = S2 OR pno = P3 OR pno = P4. The number of tuples deleted from the Catalogue relation is _____.

[MCQ]

7. Consider the following statements:

P: Insertion of tuples into referenced relation may cause foreign key violation.

Q: Insertion of tuples into referencing relation may cause foreign key violation.

Which of the following is/are CORRECT?

(a) P only (b) Q only

(c) Both P and Q (d) Neither P nor Q

[MCQ]

8. Consider the following statements:

P: Updation of tuples into referenced relation may cause foreign key violation.

Q: Updation of tuples into referencing relation may cause foreign key violation.

Which of the following is/are INCORRECT?

(a) P only (b) Q only

(c) Both P and Q (d) Neither P nor Q

Answer Key

1. **(b)**
2. **(c)**
3. **(a, c, d)**
4. **(3)**
5. **(3)**
6. **(4)**
7. **(d)**
8. **(d)**

Hints & Solutions

1. (b)

Since SupervisorID act as a foreign key, the values entered in SupervisorID must be a proper subset of the values in the candidate key EmployeeID.

I: ALLOWED. SupervisorID as '1'. 1 belongs to EmployeeID.

II: ALLOWED. Foreign key allows NULL values.

III: NOT ALLOWED. SupervisorID as '0'. 0 does not belong to EmployeeID.

2. (c)

P: INCORRECT. 0 or more foreign keys are possible for a relational schema.

Q: INCORRECT. A foreign key declaration cannot be replaced by an equivalent check assertion in SQL. Check constraint checks if the value satisfies a given range or not. Foreign keys may have cascade delete which may not be satisfied by check assertion.

3. (a, c, d)

(a) INCORRECT: Papercode can act as a foreign key in R_2.

(b) CORRECT: Papercode can act as a foreign key in R_2.

(c) INCORRECT. Since, one paper can be chosen by many candidates, Papercode CANNOT satisfy UNIQUE constraint.

(d) INCORRECT. Each roll no can opt for only one papercode, so Papercode cannot allow NULL values in R_2.

4. (3)

(0, 2)(1, 2)(2, 1)(3, 0)(5, 0)(7, 3)(4, 2)(6, 1)

Delete A = 0

	A	B
	~~0~~	~~2~~
	1	2
	2	1
①	~~3~~	~~0~~
②	~~5~~	~~0~~
③	~~7~~	~~3~~
	4	2
	6	1

After the Execution of Query (A = 0 Delete) with on Delete Cascade (3, 0) (5, 0) (7, 3) will be additionally deleted. So 3 Tuple additonally deleted.

5. (3)

EmployeeID	Name	SupervisorID
1	A	4
2	A	6
3	B	2
4	C	5
5	D	2
6	E	3
7	B	4
8	A	1

6. (4)

Delete all the records from Catalogue where sno = S2 OR pno = P3 OR pno = P4

7. (b)

P: INCORRECT. Referenced relation is an independent relation. Insertion of tuples into referenced relation can never cause foreign key violation.

Q: CORRECT. Insertion of tuples into referencing relation may cause foreign key violation if the entered value is not a subset of the candidate key in referenced relation.

8. (d)

P: CORRECT. Updation of tuples into referenced relation may cause foreign key violation. If the candidate key in R_1 is updated, then it must be ensured that either all its instances in R_2 is updated or deleted.

Q: CORRECT. Updation of tuples into referencing relation may cause foreign key violation if the entered value is not a subset of the candidate key in referenced relation.

Branch : CSE & IT Batch : Hinglish

DBMS

FD's & Normalization

DPP 01

[MSQ]

1. According to RDBMS rules, choose the correct statement from the following.

(a) A relation in RDBMS can have multiple attributes
(b) A relation in RDBMS is a set of rows and columns
(c) A tuple in a relation can have multiple values for an attribute.
(d) All of the above

[NAT]

2. Consider the student relation shown below with schema stud (Sname, S age, S mail, S marks),

Stud

Sname	Sage	Smail	Smarks
Rohit	28	R@pw.live	68
Kanika	25	K@pw.live	75
Pankaj	25	K@pw.live	75
Rohit	28	R@pw.live	88
Anjali	26	A@pw.live	75

For the above given instance how many 2-set of attributes can determine a row uniquely?

[MSQ]

3. Consider a relation schema R(A, B, C, D, E, F, H) with the given Functional dependency set:

{A → BC, C → AD, DE → F, C → F}

The attribute closure that contains all the attributes of the relation R is?

(a) AE^+
(b) CE^+
(c) AEH^+
(d) All of the above

[NAT]

4. Consider the below relation schema Stud (Rid, name, course, mail, phone) with FD set as:

Rid → {Rid}

Rid → {name, mail}

course → {course, phone}

phone → {phone}

mail → {Rid, course}

name → {phone, mail, course}

The number of non-trivial FD's in the given FD set is/are?

[MCQ]

5. Consider the following set of FD's:

{V → W, W → XZ, X → YZ} for relation R(V, W, X, Y, Z)

Then the attribute closure of YZ^+ contains how many elements?

(a) 0 (b) 1
(c) 2 (d) 3

[MCQ]

6. For the given FD set: {P → QT, Q → SU, V → U} of a relation R (P, Q, T, S, U, V). Find the set of attributes that is Super key but not a Candidate key?

(a) PTQ (b) PV
(c) PQV (d) QV

[MCQ]

7. In a schema with attribute X, Y, Z, W, V, the following set of functional dependencies are given:

{Y → X, Y → Z, ZW → V, X → W, V → X}.

Which of the following FD is not implied by the above set?

(a) YX → ZW
(b) XV → YZ
(c) ZW → V
(d) XV → XW

[MSQ]

8. Choose the correct statement from the following.

(a) The cardinality is defined as the number of attributes in a relation.
(b) Degree of the relation is the number of tuples in the relation.

(c) Relation instance is the set of tuples of a relation at a particular instance of time.

(d) All of the above

Answer Key

1. (a, b)
2. (1)
3. (c)
4. (3)
5. (c)
6. (c)
7. (b)
8. (c)

Hints & Solutions

1. (a, b)

A relation in RDBMS can have multiple attributes/fields/Columns but every tuple should be unique. Thus, according to RDBMS guidelines, A tuple in a relation cannot have multiple values for an attribute.

A relation is a table and a table is a set of rows and columns.

2. (1)

We can clearly observe that none of the attribute can determine a tuple uniquely (Single attribute), if we check for 2-attribute set then only (Sname, Smarks) can determine a row uniquely for the instance. So the answer is 1.

3. (c)

The attribute closure $AE^+ = \{A, B, C, D, E, F\}$.
The attribute closure $CE^+ = \{C, E, A, B, D, F\}$.
But the attribute H is missing from the closure.
The attribute closure $AEH^+ = \{A, B, C, D, E, F, H\}$.
Therefore, C is the correct answer.

4. (3)

Trivial FD's: 2 ie Rid → Rid and phone → phone.

Non-trivial FD's: 3 i.e. Rid → {name, mail}, mail → {Rid, course) and name → {phone, mail, course}.

Semi-non trivial FD's: 1 i.e. course → {course, phone}.

5. (c)

The attribute closure of $YZ^+ = \{Y, Z\}$ no other attribute can be determined by YZ^+. Therefore only 2 elements that is Y and Z are in the YZ^+ closure.

6. (c)

The key for the given FD set.
$\{P \rightarrow QT, Q \rightarrow SU, V \rightarrow U\}$
$PV^+ = \{P, Q, T, V, U, S\}$
$PVQ^+ = \{P, Q, T, V, U, S\}$
$PTQ^+ = \{P, T, Q, S, U\}$
$QV^+ = \{Q, V, S, U\}$
we have PV^+ as the candidate key and also it is the super key. PVQ^+ is the super key but it is not a Candidate Key (not minimal set)

NOTE: A candidate key is minimal set of attributes that determine relational table uniquely. Also, every candidate key is a Super key but every Super key need not be Candidate.

7. (b)

$YX^+ = \{Y, X, Z, W, V\}$
$XV^+ = \{X, V, W\}$
$ZW^+ = \{Z, W, V, X\}$
$XV^+ = \{X, V, W\}$

8. (c)

- Cardinality is defined as the number of tuples in a relation.
- Degree is defined as the number of attributes in a relation.
- Relation instance is the set of tuples of a relation at a particular instance of time.

Branch : CSE & IT **Batch : Hinglish**

DBMS
FD's & Normalization

DPP 02

[MSQ]

1. Choose the correct statement from the following:
(a) There can be many primary keys for a relation.
(b) There can be many alternate keys for a relation.
(c) All the candidate keys are also super keys.
(d) All the super keys are also the candidate keys.

[NAT]

2. Consider the below instance of relation:
Employee:

Emp_rating	Emp_name	Emp_mail	Emp_sal
1	Rohit	p@pw	40000
2	Kanika	c@pw	60000
1	Rohit	Null	50000
3	Pankaj	g@pw	60000

The maximum possible number of alternate keys for the above relational instance is/are _____.

[MCQ]

3. Consider the set of functional dependencies for a relation R(D, N, C, S)
{D→N, D→C, D→S, C→S}
Then choose the correct statement regarding the above set.
(a) {D} is the superkey for the relation.
(b) {DN} is the candidate key for the relation.
(c) {DC} is the candidate key for the relation.
(d) {CN} is the superkey for the relation.

[NAT]

4. Consider the given FD set for relation
R (X, Y, Z, W, U, V)
{X → Y, YZ → W, U → Z, W → X}
Then the number of prime attributes for the relation are?

[MCQ]

5. Choose the incorrect statement from the following
(a) All super keys cannot be primary key.
(b) We choose the minimal candidate key to be a primary key.
(c) The number of super keys are equal to the number of primary keys for a relation.
(d) None of the above.

[NAT]

6. Suppose a relation R has 9 attributes, then the maximum possible number of candidate keys are?

[MSQ]

7. For all given set of FD's find the primary key from the options below, for relation R (A, B, C, D, E, F)
{A → D, C → BDE, B → F, B → C}
(a) AC could be the primary key.
(b) There are two candidate keys AC and AB.
(c) BC is the primary key.
(d) No primary key exists for the relation.

[MCQ]

8. Consider a relation R (A B C D E F), on this relation how many maximum number of candidate keys are possible?
(a) 8 (b) 12
(c) 16 (d) 20

Answer Key

1. **(b, c)**
2. **(3)**
3. **(a)**
4. **(5)**
5. **(c)**
6. **(126)**
7. **(a, b)**
8. **(d)**

Hints & Solutions

1. (b, c)

I. There exists exactly at most one primary key for any relational table while there can be multiple alternate keys for a relation.

II. All the candidate keys are super keys, but it is not compulsory that all super key are candidate keys.

NOTE: A candidate key is minimal set of attributes that determine relational table uniquely. Also, every candidate key is a Super key but every Super key need not be Candidate.

2. (3)

An alternate key is one that is not the primary key. It allows null values. So, the alternate/candidate key for given relation is/are: {Emp_mail} {Emp_rating, Emp_sal}, and {Emp_name, Emp_sal}

3. (a)

{D → N, D → C, D → S, C → S}
the candidate keys of the relation are:
D+ = {D, N, C, S} ✓
C+ = {C, S} ×
S+ = {S} ×
N+ = {N} ×.
{D} is the candidate key as well as the super key.
{DN} and {DC} are the super keys not the candidate key.
{CN} is not any key.

4. (5)

In order to find the prime attributes, we first find the candidate keys for the relation as prime attributes are part of Candidate Key.
The candidate keys are: XUV, YUV, WUV
So the prime attributes are {X, Y, W, U, V}
Non-prime attribute is {z}.

5. (c)

All super keys cannot be primary key. For a relation the number of super keys are more than number of primary keys.

6. (126)

For a relation with n attributes, the maximum number of candidate keys will be ${}^{n}C_{\left\lfloor \frac{n}{2} \right\rfloor}$

n = 9, therefore ${}^{9}C_{\left\lfloor \frac{9}{2} \right\rfloor} \Rightarrow {}^{9}C_{4}$

$\Rightarrow \frac{9\times8\times7\times6\times5!}{4!\times5!} \Rightarrow \frac{9\times3\times7\times6}{4\times3\times2} = 42 \times 3 = 126$

7. (a, b)

There can be at most one primary key for a relation. There exists two candidate keys i.e. AC and AB out of these two only one is selected to be the primary key. So, option (a) and (b) is correct choice.

8. (d)

n = 6

∴ Maximum candidate keys = ${}^{n}C_{\left\lfloor \frac{n}{2} \right\rfloor}$

${}^{6}C_{\left\lfloor \frac{6}{2} \right\rfloor} \Rightarrow {}^{6}C_{3} \Rightarrow \frac{6\times5\times4\times3!}{3!\times3\times2\times1} = 20$

Branch : CSE & IT Batch : Hinglish

DBMS

FD's & Normalization

DPP 03

[MCQ]

1. Consider the relation R (P, Q, R, S, T) and the set of function dependencies F = {P →Q, QR →T, TS→P}. Which of the following is not the candidate key of R?

(a) RST (b) PRS
(c) QRS (d) PQR

[NAT]

2. Assume a relation R (P, Q, R, S, T) with the set of functional dependencies {P→Q, Q→R, R→Q and Q→T}. how many candidate keys are possible in R?

[MCQ]

3. Consider the following statements:

S_1: A key in DBMS is an attribute (or) a set of attributes that help to uniquely identify a tuple (or row) in a relation (or table).

S_2: There should be only one candidate key in relation, which is chosen as the primary key.

(a) Only S_1 is true.
(b) Only S_2 is true.
(c) Both S_1 and S_2 are true.
(d) Neither S_1 nor S_2 is true.

[MSQ]

4. Choose the correct statements from the following:

(a) The minimal set of attributes that can uniquely identify tuple is known as a candidate key.
(b) A super key is a group of single or multiple keys that identifies rows in a table. It supports NULL values.
(c) Primary key is not a unique key.
(d) None of the above.

[MSQ]

5. Consider a schema with attributes A, B, C, D & E following set of functional dependencies are given,

A→B
A→C
CD→E
B→D
E→A

Which of the following functional dependencies is implied by the above set?

(a) CD→AC (b) BC→CD
(c) AC→BC (d) BD→CD

[MCQ]

6. Assume the relation R that has eight attributes ABCDEFGH. Let A = {CH→G, A→BC, B→CFH, E→A, F→EG} is a set of functional dependencies (FD). How many candidates key does the relation R have?

(a) 2 (b) 3
(c) 4 (d) 5

[MCQ]

7. Assume the relation schema R(P, Q, R, S, T, U, V, W, X, Y, Z) and the set of functional dependencies on R: F = {PQ→R, Q→UV, PT→WX, W→Y, X→Z}. Which of the following can be candidate key for R?

(a) PQU (b) PQT
(b) PQTR (d) PQTWX

[MCQ]

8. Consider the following statements:

S_1: Primary key has no duplicate values it has only unique values.

S_2: Primary key are not necessary to be a single column more than one column can also be a primary key for table.

(a) Only S1 is true.
(b) Only S2 is true.
(c) Both S1 & S2 are true.
(d) Neither S1 nor S2 are true.

[MSQ]

9. Choose the correct statements about candidate key.

(a) Candidate key is a super key with maximum attributes.

(b) It must contain unique values.

(c) A table can have multiple CK's but only one primary key.

(d) It is a super key with no repeated data which is called a candidate key.

Answer Key

1. **(d)**
2. **(1)**
3. **(a)**
4. **(a, b)**
5. **(a, b, c)**
6. **(c)**
7. **(b)**
8. **(c)**
9. **(b, c, d)**

Hints & Solutions

1. (d)

RS is not present in RHS of all the FDS therefore RS must be the part of candidate key. So, using option elimination, option (d) is eliminated because PQR does not contain RS therefore it cannot be a candidate key, hence option "d" is the answer.

2. (1)

$P \rightarrow Q$
$Q \rightarrow R$
$R \rightarrow Q$
$Q \rightarrow T$
So $\{PS\}^+ = \{P\ Q\ R\ S\ T\}$ so PS is candidate key.
Only PS is candidate key, hence 1 is the answer.

3. (a)

S1: True: A key in DBMS is an attribute (or) a set of attributes that help to uniquely identify a tuple (or row) in a relation (or table).

S2: False: There can be more than one candidate key in relation out of which one can be chosen as primary key.

4. (a, b)

(a) Candidate key: It is a minimal set of attributes that can uniquely identify a tuple is known as candidate key.

Example: Passport_No, Employee_ID, Roll_No

(b) Super key: super key is an attribute (or set of attributes) that is used to uniquely identify all attributes in a relation.

Note: The difference between superkey and a primary key is as follows:
(i) Super key's attributes can contain NULL.
(ii) Primary key is a minimal super key hence all super keys can't be primary key.

(c) primary key is a unique key.

5. (a, b, c)

Find the closure set of left side of each FD of every option given. If the closure set of left side contains the right side of the FD, then the particular FD is implied by the given set.

(a) Closure of CD = ABCDE, Therefore $CD \rightarrow AC$ can be derived from the given set of FD's.

(b) Closure of BC = ABCDE, therefore $BC \rightarrow CD$ can be derived from the given set of FD's.

(c) Closure of AC = ABCDE, therefore $AC \rightarrow BC$ can be derived from the given set of FD's

(d) Closure of BD = BD, therefore $BD \rightarrow CD$ can't be derived from the given set of FD's.

6. (c)

NOTE: If closure of any attribute includes all the attributes of a table then it is a superkey and minimal superkey is called a candidate key, find closure of each attribute set. D cannot be derived using the left side of FD. hence, D will definitely be part of the candidate key.

$AD^+ = ABCDEFGH$
$BD^+ = ABCDEFGH$
$CD^+ = CD$
$D^+ = D$
$ED^+ = ABCDEFGH$
$FD^+ = ABCDEFGH$
$GD^+ = GD$
$HD^+ = HD$
Thus, there are 4 candidates keys AD, BD, ED and FD.

7. (b)

Simply find the closure of all the options given, as we can see PQT cannot be derived from any of the above FDS which states that P, Q & T must be present in the key. Hence, we need to verify only b, c & d by taking closure set PQT^+ derives all attributes in relation R. so it is candidate key.

NOTE: option (c) & (d) are the super keys, since adding zero or more attributes to C.K generates super key.

8. (c)

- Primary key has no duplicate values it has only unique values. Hence S_1 is true.
- Primary key is not necessarily to be a single column more than one column can also be a primary key for the table. Hence S_2 is true.

9. (b, c, d)

(a) candidate key is super key with minimal attributes.

Any issue with DPP, please report by clicking here:- https://forms.gle/t2SzQVvQcs638c4r5

For more questions, kindly visit the library section: Link for web: https://smart.link/sdfez8ejd80if

PW Mobile APP: https://smart.link/7wwosivoicgd4

Branch : CSE & IT Batch : Hinglish

Database Management System

FD's & Normalization

DPP 04

[MCQ]

1. Consider the following two sets of functional dependencies

$X = \{P \rightarrow Q, Q \rightarrow R, R \rightarrow P, P \rightarrow R, R \rightarrow Q, Q \rightarrow P\}$

$Y = \{P \rightarrow Q, Q \rightarrow R, R \rightarrow P\}$

Which of the following is true?

(a) $X \subset Y$ (b) $Y \subset X$

(c) $X \equiv Y$ (c) $X \neq Y$

[NAT]

2. Consider a relation with schema R(P, Q, R, S, T) and FD set ($PQ \rightarrow R$, $R \rightarrow S$, $S \rightarrow P$). How many super keys in relation R contains?____.

[NAT]

3. Consider a relation R(P, Q, R, S, T) with the set of functional dependencies {$P \rightarrow QR$, $RS \rightarrow T$, $Q \rightarrow S$, and $T \rightarrow P$}. How many super keys are possible in R? _____.

[MCQ]

4. Consider the relation schema R(P, Q, R, S, T, U, V, W, X, Y) and the set of functional dependencies on R are: $F = \{PQ \rightarrow R, Q \rightarrow TU, PS \rightarrow VW, V \rightarrow X, W \rightarrow Y\}$. Which of the following can be the candidate key for R?

(a) PQT (b) PQS

(c) PQSR (d) PQSVW

[NAT]

5. Let a relation R have attributes {P, Q, R, S, T} and "PQR" is the candidate key, then how many super keys are possible _____?

[MCQ]

6. Consider the following FD sets:

$S_1 = \{P \rightarrow R, PR \rightarrow S, T \rightarrow PS, T \rightarrow U\}$

$S_2 = \{P \rightarrow S, QR \rightarrow PS, R \rightarrow Q, T \rightarrow P, T \rightarrow S, T \rightarrow U\}$

$S_3 = \{P \rightarrow S, R \rightarrow P, R \rightarrow Q, T \rightarrow PU\}$

Which of the following sets is equivalent?

(a) $S_1 \equiv S_2$ (b) $S_2 \equiv S_3$

(c) $S_1 \equiv S_3$ (d) $S_1 \equiv S_2 \equiv S_3$

[NAT]

7. Consider a relation R = {P, Q, R, S, T, U, V, W} with the functional dependency sets S = {$PR \rightarrow V$, $S \rightarrow TV$, $QR \rightarrow S$, $RV \rightarrow QS$, $PRS \rightarrow Q$, $RT \rightarrow PV$}

The minimum numbers of simple functional dependency in the minimal cover of F is _____?

[NAT]

8. Consider a relation R(P, Q, R, S, T) with the following functional dependencies: $PQR \rightarrow ST$ and $S \rightarrow PQ$, then the number of super keys in R is_____?

Answer Key

1. **(c)**
2. **(7)**
3. **(27)**
4. **(b)**
5. **(4)**
6. **(b)**
7. **(6)**
8. **(10)**

Hints & Solutions

1. (c)

To check, find minimal canonical cover of both the FD sets. FD set Y is already a minimal cover. In X, P→Q, Q→R, So P→R is redundant FD (through transitivity), and also Q→R, R→P, So Q→P is also redundant FD. so, we can remove it from F, then after removing it will be X ≡ Y.

2. (7)

Candidate keys: PQT, QST, QRT

Super keys:

PQT: PQT, PQRT, PQST, PQRST

QST: QST, PQST, QRST, PQRST

QRT: QRT, PQRT, QRST, PQRST

Total distinct super keys are PQT, QST, QRT, PQRT, PQST, QRST, PQRST. Therefore, correct answer is 7.

3. (27)

P→QR

RS→T

Q→S

T→P

Candidate key {P, RS, QR, T}

$\{P\}^+ = \{P\ Q\ R\ S\ T\}$

$\{T\}^+ = \{P\ Q\ R\ S\ T\}$

$\{RS\}^+ = \{P\ Q\ R\ S\ T\}$

$\{QR\}^+ = \{Q\ R\ S\ T\ P\}$

So total super key on R for 5 attributes is $2^5 - 1 = 31$

Q, R, S and QS are not super keys

31 – 4 = 27

Hence there are 27 super keys.

4. (b)

firstly, find the closure of all the options given above. As we can see that P, Q, and S cannot be derived from any of the above functional dependencies given which states that P, Q and S should be present in the key. Therefore, we need to check only the closure set of option b, c and d which contains these three. Since PQS^+ derives all the attributes in the relation R, So clearly, it's a candidate key.

Point to be noted that, option (c) & (d) are the super keys, since adding zero or more attributes to candidate key generates super key.

5. (4)

PQR is candidate key, remaining attributes → S, T with S, T four possibilities hence 4 super keys are possible.

6. (b)

Candidate key for S_1 = T, closure of T^+ = {P, Q, R, S, T, U}

Candidate key for S_2 = RT closure of RT^+ = {P, Q, R, S, T, U}

Candidate key for S_3 = RT closure of RT^+ = {P, Q, R, S, T, U}

So, S_2 as S_3 are equivalent.

7. (6)

A FD A→B is a simple FD if B is a single attribute:

Step 1:

Simplify all the given FD's

PR→V

S→T

S→V

QR→S

RV→S

RV→Q

PRS→Q

RT→P

RT→V

Step 2:

Find out extraneous attributes present in FD.

PRS → Q: $(PR)^+$ → PRVQ, So we get Q, S is extraneous and can be safely removed, rewriting the new FD as PR→Q.

PR→V: P^+→P, so can't get V; R is not extraneous,

R^+→ R, so, count set V; P is not extraneous. Hence, keep this FD as it is.

$QR \rightarrow S$: $Q^+ \rightarrow Q$, so can't get S R is not extraneous $R^+ \rightarrow R$, so can't set S, Q is not extraneous keep this FD as it is.

$RV \rightarrow Q$: $R^+ \rightarrow R$, so can't get Q; V is not extraneous

$V^+ \rightarrow V$, so, can't get Q; R is not extraneous keep this FD as it is.

$RV \rightarrow S$; $R^+ \rightarrow R$, so can't get S; V is not extraneous $V+ \rightarrow V$ so can't get S; R is not extraneous so keep this FD as it is.

If we continue the step 2, we will not find any extraneous attribute on LHS of any FD. So, we are done with step 2.

Step 3:

Find Redundant FD's

$(PR)^+ \rightarrow$ PRQSTV; so, we got V from other FDs remove the entire FD from list.

$(RV)^+ \rightarrow$RVSTPQ; So, we get Q from other FD's remove the entire FD from the list.

(RT)+ →RTVS; so, we did not get P from other FDs, so keep this FD in the lists.

(RT)+ →RTPQSV; so we got V from other FDs, hence, remove this FD from the list.

Step 4:

1) $S \rightarrow T$
2) $S \rightarrow V$
3) $QR \rightarrow S$
4) $RV \rightarrow Q$
5) $PR \rightarrow Q$
6) $RT \rightarrow P$

The minimum number of simple FDs in the minimal cover of F is 6.

8. (10)

Consider a relation R have attributes $\{x_1, x_2, x_3....x_n\}$ and the candidates' keys are "x_1x_2", "x_1x_3" then possible number of super keys = super keys of (x_1, x_2) + super keys of (x_1, x_3) – super keys of (x_1, x_2, x_3)

$\Rightarrow 2^{(n-2)} + 2^{(n-2)} - 2^{(n-3)}$

The candidate keys of relation are PQR and SR.

The number of super keys of (PQR) = $2^{(5-3)} = 4$

The number of super keys of (RS) = $2^{(5-2)} = 8$

The number of super keys of (PQRS) = $2^{(5-4)} = 2$

Then possible number of super keys = 4 + 8 – 2 = 10

ie, PQR, PQRS, PQRT, PQRST, RS, PRS, QRS, RST, PRST, QRST.

Branch : CSE & IT Batch : Hinglish

Database Management System
FD's & Normalization

DPP 05

[MCQ]

1. Assume a relation R = (P Q R S T U) and functional dependencies: F = {PQ → RU, RT → Q, U → S}, consider the following two statements:

S_1: The decomposition of R into PQRT and PQSTU is a dependency preserving decomposition.

S_2: The decomposition of R into PQRT and PQSTU is a lossless decomposition.

Which of the statement is/are TRUE?

(a) Only S_1 is true.
(b) Only S_2 is true.
(c) Both S_1 and S_2 are true.
(d) Both S_1 and S_2 are false.

[MCQ]

2. Consider the following two decomposition of R(P Q R S T U) with the set of dependencies

F = {PQ → R, PR → Q, PS → T, Q → S, QR → P, T → U}.

S_1: R_1(PQ), R_2(QR), R_3(PQST), R_4(TU)

S_2: R_1(PQR), R_2(PRST), R_3(PSU)

Which of the statements is are dependency preserving and lossless-join decomposition of R?

(a) S_1 Only (b) S_2 Only
(c) Both S_1 and S_2 (d) None of these

[MCQ]

3. Consider a relation STUDENT (Name, Subject, Location, Marks).

Name	Subject	Location	Marks
Madhav	Operating System	Noida	96
Madhav	DBMS	Noida	100

Student is decomposed into following

1. STU $_{Sub\ 1}$ (Name, Subject, Location) and STU $_{Sub\ 2}$ (Name, Location, Marks).

2. STU $_{Sub\ 1}$ (Name, Location) and STU $_{Sub\ 2}$ (Subject, Marks).

Which of the following is True?

(a) 1 is lossy but 2 is lossless
(b) 1 is lossless but 2 is lossy
(c) Both 1 and 2 are lossless
(d) Both 1 and 2 are lossy

[MCQ]

4. Consider a relation R(P, Q, R, S, T, U, V, W) be a relation schema, in which of the following FD sets are known to hold = {P → Q, P → R, P → S, PT → W, T → S, T → U}. Suppose we decompose the relation into two relations, R_1(PQRS), and R_2(STUVW). The above decomposition is

(a) lossless join and dependency preserving.
(b) lossless join but not dependency preserving.
(c) dependency preserving but not lossless join.
(d) neither dependency preserving nor lossless join.

[MCQ]

5. Let R(P, Q, R, S, T, U) be a relational schema, in which of the following FD' sets are known to hold {PQ → R, PR → Q, PS → T, QR → R, Q → U}

Suppose we decompose the relation R into four relations R_1(PQ), R_2(QR), R_3(PQST) and R_4(TU).

Then the above decomposition is:

(a) dependency preserving and lossless join.
(b) lossless join but not dependency preserving.
(c) dependency preserving but not lossless join.
(d) neither dependency nor lossless join.

[MCQ]

6. Consider the following statements

S_1: The decomposition R_1, R_2 ….. R_n for a relation schema R are said to be lossless if their natural join results in the original relation R.

S_2: The decomposition R_1, R_2 ….. R_n for a relation schema R are said to be lossy if their natural join results into addition of extraneous tuples with the original relation R.

(a) Only S_1 is true
(b) Only S_2 is true
(c) Both S_1 and S_2 are true
(d) Neither S_1 nor S_2 are true

[MCQ]

7. Consider the relation R(P, Q, R, S, T, U, V, W) with the following set of functional dependencies:
F = {P $\rightarrow$ QRS, P $\rightarrow$ T, TUV $\rightarrow$ W and U $\rightarrow$ VW}
Which one of the FD in the F is redundant?
(a) P $\rightarrow$ QRS (b) PS $\rightarrow$ T
(c) TUV $\rightarrow$ W (d) U $\rightarrow$ VW

[MCQ]

8. Which are the major and important properties of FD's?
(a) There should be one to one relationship between attributes in FDs.
(b) FDs must be defined in schema.
(c) FDs should be non-trivial.
(d) All of the above

Answer Key

1. **(c)**
2. **(d)**
3. **(d)**
4. **(d)**
5. **(d)**
6. **(c)**
7. **(c)**
8. **(d)**

Hints & Solutions

1. (c)

S_1: True – PQ → R and RT → Q are preserved in PQSTU.

S_2: True – PQRT ∩ PQSTU = PQT and PQT → PQRT which is the candidate key of PQR T relation.

2. (d)

S_1:

	P	Q	R	S	T	U
R_1	α	α				
R_2		α	α			
R_3	α	α	α	α	α	α
R_4					α	α

This is lossless join decomposition

Now checking for dependency preserving

PQ → R, only trivial FD's hold in R, (PQ) and R_2 (Q, R) and FD holds in R_3 (PQST) = {T → U}. Let it be F_1 and FD holds in R_4 (TU) = {T → U}. Let it be F_2.

Now $F+ = (F_1 \cup F_2)^+$

$(PQ)^+$ = PQR but $(F_1 \cup F_2)^+$ will not contain R. So this is not dependency preserving.

S_2:

	P	Q	R	S	T	U
R_1	α	α	α			
R_2	α	α	α	α	α	α
R_3		α	α	α	α	α
R_4	α			α	α	α

This is lossless join decomposition

Now checking for dependency preserving check for FD Q → S

$F^+ = (Q)^+ = \{Q, S\}$ this will no be preserved in any relation as $(F_1 \cup F_2)^+$ will not contain U.

3. (d)

A decomposition is lossy if after joining, relation contains extra tuple, divide the table according to decomposed relation and then perform joining operation again if there is extra tuples then that decomposition is lossy.

STU_{Sub1}		
Name	**Subject**	**Location**
Madhav	OS	Noida
Madhav	DBMS	Noida

STU_{Sub2}		
Name	**Location**	**Marks**
Madhav	Noida	96
Madhav	Noida	100

$STU_{Sub1} \bowtie STU_{Sub1}$			
Name	**Subject**	**Location**	**Marks**
Madhav	OS	Noida	96
Madhav	DBMS	Noida	100
Madhav	OS	Noida	96
Madhav	DBMS	Noida	100

Lossy because we have extra tuples in the relation.

4. (d)

{P → Q, P → R, P → S, PT → W, T → S, T → U}

	P	Q	R	S	T	U	V	W
R_1	α	α	α	α				
R_2				α	α	α	α	α

PT → W is not preserved

Therefore, its neither dependency preserving not lossless

5. (d)

	P	Q	R	S	T	U
R_1	α	α				
R_2		α	α			
R_3	α	α		α	α	
R_4					α	α

Neither lossless nor dependency preserving

∴ (d) is correct option.

6. (c)

S_1 (True): The decomposition R_1, R_2 …. R_n for a relation schema R are said to be lossless if their natural join results the original relation R.

S_2 (True): The decomposition R_1, R_2 …. R_n for a relation schema R are said to be lossy if their natural join results into addition of extraneous tuples with the original relation R.

7. (c)

(a) $P \rightarrow QRS$ $\{P \rightarrow Q, P \rightarrow R, P \rightarrow S\}$

(b) $PS \rightarrow T$, now closure of P has S so S is extraneous attribute. So remove S then resultant FD is $P \rightarrow T$

(c) $\{US\}^+ = VW$, so remaining T and V from FD So resultant FD is $U \rightarrow W$

(d) $U \rightarrow VW = \{U \rightarrow V, U \rightarrow W\}$
So, $U \rightarrow W$ is redundant because it can be derived from FD $U \rightarrow VW$.

8. (d)

(a) There should be one to one relationship between attribute in FD's.

(b) FD's must be defined in schema

(c) FD's should be non-trivial

Hence, option (d) is correct.

Branch : CSE & IT Batch : Hinglish

Database Management System
FD's & Normalization

DPP 06

[MCQ]

1. Assume a relation R(P, Q, R, S, T) with the following functional dependencies
{PQ → RST, P → R, Q → S}. which of the following decomposition of R satisfies BCNF?

(a) R_1 (P, R), R_2(Q, S), R_3(P, Q, R, S, T)
(b) R_1(P, R), R_2(Q, S), R_3(P, Q, R, T)
(c) R_1(P, R), R_2(Q, S), R_3(P, Q, S, T)
(c) R_1(P, R), R_2(Q, S), R_3(P, Q, T)

[MCQ]

2. Assume a relation R = (P, Q, R, S) and a set F of functional dependencies:
F = {PR → S, S → P, S → Q, S → R}, Highest normal form satisfied by the relation R is?

(a) 2NF (b) 3NF
(c) BCNF (d) 1NF

[MCQ]

3. Assume the relation R(P, Q, R, S, T) with candidate key PQ is in atleast 3NF. which of the following functional dependencies given in option are invalid?

(a) PQ → R (b) ST → Q
(c) PQ → S (d) RS → T

[MSQ]

4. State which of the following statements is/are true?

(a) Normal forms are used to eliminate or reduce redundancy in database tables.
(b) A relation is in first normal form if every attribute in that relation is singled valued attribute or No Multivalued Attribute.
(c) A relation is in 2NF if every candidate key is simple candidate key.
(d) A relation R is in BCNF, if R is in 3rd normal form and for every functional dependency, LHS is super key. A relation is in BCNF iff in eveiy non-trivial functional dependency P -> Q, where P is a super key.

[MSQ]

5. Consider the following relation R(P, Q, R, S) and functional dependencies F that hold over the relation F = {P → QS, RS → Q, R → S, Q → PS}. The relation R is in which of the following normal form?

(a) 1NF (b) 2NF
(c) 3NF (d) BCNF

[MCQ]

6. Consider a relation which contains two different true multivalued dependencies then which of the following normal form is violated automatically.

(a) 2NF (b) 3NF
(c) BCNF (d) 4 NF

[MCQ]

7. Assume a relation R(P, Q, R, S, T, U) with the following dependencies
1. PQ → RS 2. T → R 3. Q → TU
Given the functional dependencies as shown above which among the options shows the decomposition of relation R is normalized to 3NF?

(a) R_1(P, Q, R, S, T, U) R_2(T, R) R_3(Q, T, U)
(b) R_1(P, Q, R, S) R_2(R, T) R_3(T, U, Q)
(c) R_1(P, Q, R, S) R_2(R, T) R_3(Q, T, U)
(d) R_1(P, Q, S), R_2(T, R) R_3(Q, T, U)

[MCQ]

8. Given the relation 'R' with attributes PQRST with set of functional dependencies {P → P Q R S T, Q → R} which of the following is / are true?

(a) R_1(PRST) R_2(QR) are both in BCNF and preserves lossless join.
(b) R_1(PQST), R_2(QR) are both in BCNF and preserves lossless join
(c) R_1(PST), R_2(QR) are both in BCNF and preserves lossless join.
(d) None of the above.

Answer Key

1. **(d)**
2. **(c)**
3. **(d)**
4. **(a, b, c, d)**
5. **(a, b)**
6. **(d)**
7. **(d)**
8. **(b)**

Hints & Solutions

1. (d)

If decomposition is lossless and every individual relation satisfy BCNF, then decomposition satisfy BCNF.

(a) The Decomposition $R_1(P, R)$, $R_2(Q, S)$, $R_3(P, Q, R, S, T)$ is lossless, but individual relation R_3 does not satisfy BCNF because of FD $P \rightarrow R$ and $Q \rightarrow S$.

(b) The Decomposition $R_1(P, R)$, $R_2(Q, S)$, $R_3(P, Q, R, T)$ is lossless, but individual relation R_3 does not satisfy BCNF because of FD $P \rightarrow R$.

(c) The Decomposition $R_1(P, R)$, $R_2(Q, S)$, $R_3(P, Q, S, T)$ is lossless, but individual relation R_3 does not satisfy BCNF because of FD $Q \rightarrow S$.

(d) The Decomposition $R_1(P, R)$, $R_2(Q, S)$, $R_3(P, Q, T)$ is lossless, and individual relation R_3 also satisfy BCNF. Therefore, this decomposition is in BCNF.

NOTE: If a relation has only two attributes then it is in BCNF. Therefore R_1 and R_2 is in BCNF in all the options given above.

2. (c)

PR and S are the super key of the relating. LHS of each FD is super key therefore highest normal form satisfied by R is BCNF.

3. (d)

Given, PQ is a composite candidate key. hence prime attributes are P and Q. A relation is said to be in 3NF, if it is in 2NF and if there exists FD $\alpha \rightarrow \beta$, then either α is a super key or β is prime attribute. In functional dependency $RS \rightarrow T$, neither α is super key nor β is prime attribute. Hence this functional dependency is invalid.

4. (a, b, c, d)

a: true: Normal forms are used to eliminate or reduce redundancy in database tables.

b: true: A relation is in first normal form if every attribute in that relation is singled valued attribute.

c: true: A relation is in 2NF if every candidate key is a simple candidate key.

d: true: A relation R is in BCNF, if R is in 3rd normal form and for every functional dependency, LHS is super key. A relation is in BCNF iff in every non-trivial functional dependency $P \rightarrow Q$, where P is a super key.

5. (a, b)

The candidate key of relation is R, therefore relation does not contain violation of 2NF.

Hence, highest normal form is satisfied by the relation is 2NF, so it is also satisfies 1NF.

6. (d)

If there consist a true / real multivalued dependencies in a relation then that relation automatically violates 4NF.(we need not check MVD's in 1NF, 2NF, 3NF and BCNF)

7. (d)

For the given FD set, the minimal cover will be:

$PQ \rightarrow R$

$PQ \rightarrow S$

$T \rightarrow R$

$Q \rightarrow T$

$Q \rightarrow U$

Minimal cover:

$PQ \rightarrow S$

$T \rightarrow R$

$Q \rightarrow T$

$Q \rightarrow U$

Candidate key = {P, Q}

$PQ \rightarrow S$ Satisfy 3NF

$T \rightarrow R$ does not satisfy 3NF

$Q \rightarrow T$ does not satisfy 3NF

$Q \rightarrow U$ does not satisfy 3NF

$\therefore$ Those which have same left-hand side will make relation.

$R_1(P, Q, S)$ $R_2(T, R)$, $R_3(Q, T, U)$

8. (b)

For BCNF decomposition, the relation is created for those FD which violates BCNF property. So relation is made for QR and remove R from relation and create two relation $R_1(PQST)$, $R_2(QR)$ and this decomposition is lossless.

Branch : CSE & IT Batch : Hinglish

Database Management System

File Org & Indexing

DPP 01

[MCQ]

1. Assume a relational database system that holds relation: C(colleges) with the following characteristics

- Records are stored as fixed length, fixed format records, length is 256 bytes.
- There are 16384 records.
- Records contains key attribute CollegeNumber (C.N), length 22 bytes and other fields.
- Unspanned organization is used to store the information or record.

Let's suppose we want to build a sparse primary index on C.N then how many numbers of 4096-byte blocks are needed to store the primary index when block pointer size is 10 bytes _____?

(a) 7 (b) 8

(c) 9 (d) 10

[NAT]

2. Assume a relational database system that holds relation: Product (P) with the following characteristics

- Records are stored as fixed length, fixed format records, with the length of 256 bytes.
- There are 262144 records.
- Records contain attribute P.I (The identifier of the product involved), with the length 24 bytes, and an attribute P.C (the cost of product), with the length 32 bytes and other fields.
- Unspanned organization is used to store the record.

Assume that we want to build a dense secondary index on P.C, then how many numbers of 4096-byte blocks needed to store the dense secondary index. When record pointer size is 32 bytes? _____.

[MCQ]

3. Consider a SQL statement SELECT P_1, P_2, P_3 from Q WHERE P_2 = 'Pavan' is frequently executed, which column(s) should be considered for indexing based only on the statement itself?

(a) P_1 only

(b) P_2 only

(c) P_3 only

(d) P_1, P_2 and P_3

[MCQ]

4. Consider the following specification of system-

Disk block size = 2048 bytes

Block pointer size = 16 bytes

Record pointer size = 20 bytes long

file contains 30,000 records.

Each record of the file has the following fields:

Fields	Size (in Bytes)
EmpName	5
EmpNum	10
DeptNum	9
Addr	20
PhNum	9
DOB	1
Sex	1
Job	3
Sal	5

An extra/additional byte is used per record to represent end of the record.

What is the block factor of the database file assuming unspanned file organization?

(a) 16 (b) 32

(c) 48 (d) 64

[MSQ]

5. Which one of the following statements is/are True regarding indexing?

(a) A database file can contain multiple clustered indexes.

(b) A database file can consist of only one clustered index with multiple secondary indexes.

(c) A database file can consist of multiple primary indexes.

(d) A database file can consist of both primary and clustered index.

[NAT]

6. Consider a database of fixed-length records stored as an ordered file. The database has 25,000 records with each records being 100 bytes, of which the non-key attribute on which clustering index is formed occupies 10 bytes. The data file is completely block aligned.

Suppose, block size, of the file system is 512 bytes and a pointer to the block occupy 5 bytes. You may assume that a binary search on an index file of b block may take $\lceil \log_2 b \rceil$ accesses in worst case.

Given that a cluster consumes 2 blocks, the number of block accesses required to identify the desired data in the worst case is _____.

[MCQ]

7. Consider the following statements-

S_1: If the records of a relation X are physically ordered over a non-key field P and an index is build over the key-field of relation X, then the index is necessarily a secondary index over key attribute.

S_2: More than one secondary indexes are possible.

Which of the given statement(s) is/are CORRECT?

(a) S_1 only

(b) S_2 only

(c) Both S_1 and S_2

(d) Neither S_1 nor S_2

Answer Key

1. **(b)**
2. **(4096)**
3. **(b)**
4. **(b)**
5. **(b)**
6. **(9)**
7. **(c)**

Hints & Solutions

1. (b)

In the primary index, number of entries in the index block equals to number of blocks of relation.

Number of database records in a single block B = 4096/256 = 16

Number of blocks of relation C = 16384/16 = 1024

Size of indexes = size of key field

+ size of block pointer

= 22 + 10 = 32 bytes

Number of indexes records present in single block = 4096/32 = 128

$\therefore$ Total number of blocks required to store primary index = 1024/128 = 8.

2. (4096)

In dense secondary index, number of entries in the index blocks equals to number of records of relation.

- Number of records in the relation P = 262144

  Size of index = size of key field

  + size of record pointer

  = 32 + 32 = 64 bytes

- Number of index entry in single block

  = 4096/64 = 64

  So, the total number of blocks required to store primary index = 262144/64 = 4096.

3. (b)

The column on which condition gets applied should be considered for indexing.

$\therefore P_2$ is the answer.

4. (b)

Blocking factor (i.e number of records per block)

$= \dfrac{\text{Block size}}{\text{record size}}$

Record size of file = Sum of all field + additional bytes = 63 + 1 = 64

$\therefore$ Number of records per block = $\dfrac{2048}{64} = 32$

5. (b)

(a) **False:** A database file can contain one clustered index because the database is sorted on one field only.

(b) **True:** A database file can consist of one clustered index and multiple secondary index.

(c) **False:** The index on a unique field on which database is sorted is primary index and there can be only one primary index.

(d) **False:** A database file can consist of either a primary or clustered index but not both.

6. (9)

Block factor of database file = $\left\lfloor \dfrac{512}{100} \right\rfloor$

= 5 records/block

Number of blocks required to store 25,000 records

$= \left\lceil \dfrac{25000}{5} \right\rceil$

= 5000 blocks

Each cluster consumer 2 blocks

Number of entries in index file = $\dfrac{5000}{2} = 2500$

Block factor of index file = $\left\lfloor \dfrac{512}{15} \right\rfloor = 34$ entries/block

Number of blocks in index file = $\left\lceil \dfrac{2500}{34} \right\rceil = 74$

The number of block accesses in worst case

$= \lceil \log_2 74 \rceil + 1 + 1$

- $\lceil \log_2 74 \rceil$: for index file search
- 1: Accessing 1st block of cluster
- 1: Accessing 2nd block of cluster

= 7 + 1 + 1 = 9 blocks access required

7. (c)

S_1: Records are ordered over non-key field. It is unordered over key field.

Hence, secondary index if formed over unordered key-field. Hence, its CORRECT.

S_2: CORRECT. More than one secondary index is possible.

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Database Management System

File Org & Indexing

DPP 02

[NAT]

1. Consider the following specification of system with disk block size 2048 bytes, block pointer size 14 bytes, record pointer size 18 bytes long and file size 60,000 records. Each record of file is 256 bytes long and record of the size is sorted on the key field. If the primary index (sparse) is built on the key field (ESN) which is 18 bytes long. What is the Index blocking factors (That is number of indexes per block) Assuming unspanned file organization _____.

[NAT]

2. **Common data for next two Questions:**
Consider a disk blocking size B = 1024 bytes. A block pointer (BP) = 12 bytes long and a record pointer (RP) = 7 bytes long. A file has r = 60,000 patient records of fixed length. The size of record is 230 bytes. Suppose the file is not ordered by the key field PSN (18 bytes) and we want to construct a secondary index on key attributes (PSN).

The number of first level index entries are x and number of second level index entries are y then find the value of x + y?

[MCQ]

3. The number of first level index blocks are x and number of second level index blocks are y then x +y_____?
(a) 1600 (b) 1500
(c) 45 (d) 1545

[NAT]

4. Consider a file of r = 40,000 records, each record is R = 100 bytes long and its key field is of size v = 20 bytes. The file is ordered on a key field, and the file organization is unspanned. The file is stored in a file system with block size B = 2000 bytes, and size of block pointer is 20 bytes. If the primary index is built on the key field of the file and multilevel index scheme is used to store the primary index, then the total number of blocks required by the multilevel index is_____.

[MCQ]

5. Assume that we have an ordered file with r = 60,000 records stored on a disk with block size B = 2048 bytes. File record are of fixed size & are unspanned with record length R = 200 bytes. Now assume that the ordering key field of the file is V= 18 bytes long, a block pointer P = 12 bytes long, and we have construed a primary index for the file. Let p and q be the number of blocks required to access a record in case of without index and with primary index using binary search respectively, Then the values of p + q is _____.
(a) 18 (b) 19
(c) 20 (d) 21

[MCQ]

6. Consider an unordered file of 10^6 records with records size of 200 bytes stored on blocks of 8KB with a spanned records organization. We will assume that no system related information is stored within a block, then how many blocks would it be need to store this file?
(a) 24400 (b) 24405
(c) 24410 (d) 24415

[MCQ]

7. Consider the following statements:
S_1: For any given data file, it is possible to create two different sparse first level indexes on various keys.
S_2: For any given data file, it is possible to create two different denes first level indexes on various keys.
Select the correct statements.
(a) Only S_1 correct
(b) Only S_2 correct
(c) Both S_1 and S_2 is correct
(d) Neither is S_1 nor S_2 is correct.

[MCQ]

8. Which of the following is NOT a benefit of using Indexes in a database?
(a) Improved query performance
(b) reduced disk I/O
(c) Increased storage space
(d) Faster data retrieval

[MCQ]

9. Which of the following best describes an index in a database.
(a) A column that stores unique identifiers for each row in a table.

(b) A data structure that allows for fast searching and retrieval of data, based on certain criteria.
(c) A set of constraints that enforce rules for data integrity
(d) None of the above.

Answer Key

1. **(64)**
2. **(61500)**
3. **(d)**
4. **(41)**
5. **(21)**
6. **(d)**
7. **(b)**
8. **(c)**
9. **(b)**

Hints & Solutions

1. (64)

Number of indexes per blocks = $\left\lfloor \frac{2048}{14+18} \right\rfloor = 64$

2. (61500)

Number of first level index entries r_1 = Number of files records r = 60,000.

So, x will be 60000.

Now, block factor of the first level index = $\left\lfloor \frac{1024}{18+7} \right\rfloor = 40$ index entries per block.

∴ Number of index block at first level (that is entries for second level = y) = $\left\lceil \frac{60000}{40} \right\rceil = 1500$ blocks

∴ x + y = 60000 + 1500 = 61500

3. (d)

Now, block factor of the first level index = $\left\lfloor \frac{1024}{18+7} \right\rfloor = 40$ index entries per block.

∴ Number of index block at first level (that is entries for second level = x) = $\left\lceil \frac{60000}{40} \right\rceil = 1500$ blocks

Now, block factor of the second level index = $\left\lfloor \frac{1024}{18+12} \right\rfloor = 34$ index entries per block.

∴ Number of index block at second level (that is entries for second level = y) = $\left\lceil \frac{1500}{34} \right\rceil = 45$ blocks

∴ x + y = 1500 + 45 = 1545

4. (41)

File blocking factor bfr = $\lfloor (B/R) \rfloor$

= $\lfloor 2000/100 \rfloor$

= 20 records per block

Number of blocks needed for file = $\lceil r/bfr \rceil$

= $\left\lceil \frac{40,000}{20} \right\rceil$ = 2000 database blocks

Index records size R_i = (V + P) = (20 + 20) = 40 bytes

Index blocking factors $bfr_i = \lfloor B/R_i \rfloor$ =

$\left\lfloor \frac{2000}{40} \right\rfloor$ = 50 index records per block

Number for first level index entries (r_i) will be equal to number of file blocks b = 2000 entries

Number of 1st Level index blocks $b_1 = \lceil r_1 / bfr_i \rceil$

= $\left\lceil \frac{2,000}{50} \right\rceil = 40$

Number of 2nd level index entries r_2 = number of 1st level block b_1 = 40 entries.

Number of 2nd level index $b_2 = \lceil r_2 / bfr_i \rceil = \lceil 40/50 \rceil = 1$

Since the 2nd level has only 1 block, it is the top index level. Hence, the index has 2 levels.

The total Number of blocks required by the multilevel index (b_i) = $b_1 + b_2$ = 40 + 1 = 41 blocks.

5. (d)

The blocking factor for the file will be bfr = $\lfloor (B/R) \rfloor$

= $\lfloor 2048/200 \rfloor$ = 10 records per block.

The number of blocks needed for the file is b = $\lceil (r/bfr) \rceil = \lceil (60,000/10) \rceil = 6000$ blocks.

A binary search on the data file would need approximately $\lceil \log_2 b \rceil = \lceil \log_2 6000 \rceil$ = 13 block accesses.

The size of each index entry is R_i = (18 + 12) = 30 bytes.

So, the blocking factors for the index is bfr_i = $\lfloor (B/R_i) \rfloor$

= $\left\lfloor \left(\frac{2048}{30} \right) \right\rfloor$ = 68 entries per block

The total number of index entries r_i is equal to number of blocks in the data file, which is 6000 blocks.

Hence, the number of index blocks is $b_i = \lceil (r_i / bfr_i) \rceil$

= $\left\lceil \frac{6000}{68} \right\rceil$ = 89 blocks.

To perform a binary search on the index file it would it need $\lceil (\log_2 / b_i) \rceil = \lceil \log_2 (89) \rceil = 7$ blocks access.

To search for a record using the index, we need one additional block access to data file which makes total of(q) 7 + 1 = 8 = blocks access, an improvement over binary search on data file which required 13 block access.

∴ p + q = 13 + 8 = 21

6. (d)

Blocks size = 8 KB
Records size = 200 bytes

The number of records in a block = $\frac{8192}{200}$ = 40.96 records (Spanned Organization).
As it is spanned hence it takes whole as 40.96
1 block contains 40.96 records.

$\therefore$ The number of file blocks = $\left\lceil \frac{10^6}{40.96} \right\rceil$ = 24415 blocks.

7. (b)

S_1: (false): It is not possible because the requirement of sparse indexing is that the database must be stored and as we know that database is sorted only on one column.

S_2:(True): Any number of dense indexes is possible to construct. In the dense indexing we have index entries for each file records.

8. (c)

The correct answer is 'c'.
'Increase storage space'. This is because adding indexes to a database can actually increase the amount of storage space required as the index data structure needs to be stored alongside the data. The other answer choices are all benefits of using indexes.

9. (b)

Indexing in a database is a data structure that allows for fast searching and retrieval of data based on certain criteria.

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Database Management System

File Org & Indexing

DPP 03

[MCQ]

1. The order of a leaf node in a B^+ tree is the maximum number of (value, data record pointer) pairs it can hold. Given that the block size is 1K bytes, data record pointer is 8 bytes long, the value field is 10 bytes long and a block pointer is 6 bytes, then what is the order of the leaf node?

(a) 53 (b) 54
(c) 55 (d) 56

[NAT]

2. The order of a node in B^+ tree is defined as the number of pointers it can hold. What is the maximum number of keys that a B^+ tree of order 4 and height 4 can have ? _____

(Assume that the height of a root node is 1)

[MCQ]

3. Given a block can hold either 3 records or 10 key pointers. A database contains P records, then how many blocks do we need to hold the data file and the dense index?

(a) $\frac{P}{30}$ (b) $\frac{P}{3}$
(c) $\frac{13P}{30}$ (d) $\frac{P}{10}$

[NAT]

4. The order of an internal node in B^+ tree index is the maximum number of children it can have. Assume that a child pointer takes 6 bytes, the search field value takes 34 bytes and the blocks size is 2048 bytes. The order of the internal node is _____.

[NAT]

5. Assume a disk with block size B = 1024 Bytes, A block pointer is P_B = 12 bytes long and a record pointer is P_R = 18 bytes long. A file has 1,00,000 patients records of size 100 bytes. Suppose the file is ordered by the key field PID and we want to construct a secondary (dense) index on non-key field DeptID (14 bytes), then minimum of how many blocks are required to store index file assuming an unspanned organisation?

(a) 3000 (b) 3100
(c) 3125 (d) None of the above

[NAT]

6. The order of a node in B tree is the maximum number of block pointers it can hold. Given that the block size is 2K bytes, data record pointer is 8 bytes long, the search key is 9 bytes long and a block pointer is 5 bytes long. The best possible order of B tree node is_____.

[NAT]

7. The order of a leaf node (P) in a B^+ tree is the maximum number of (value, data record pointer) pairs it can hold. Given that P=36, data record pointer is 8 bytes long, the search field is 6 bytes long and a block pointer is 8 bytes long. The permissible block size is_____.

[NAT]

8. **(**Assume that the level of root node is1)

The order of different nodes in B^+ tree/B tree are given as-

2 to P block pointers in root node.

$\left\lceil \frac{P}{2} \right\rceil$ to P block pointers in internal node.

$\left\lceil \frac{P}{2} \right\rceil$ –1 to (P–1) keys in leaf node.

Let a and b be
The minimum number of keys in
B tree and B^+ tree node of order
P = 5 and level = 5. The value of (a + b) is_____.

[NAT]

9. **(**Assume that the level of root node is1)

The order of different nodes in B^+ tree/B tree are given as-

2 to P block pointers in root node.

$\left\lceil \frac{P}{2} \right\rceil$ to P block pointer is internal node.

$\left\lceil \frac{P}{2} \right\rceil$ –1 to (P–1) keys in leaf node.

Let a and b be the maximum number of keys in B tree and B^+ tree node of order P = 5 and level = 5. The value of (a +b) is_____.

[NAT]

10. Consider the keys (1– 5000) are going to be interested into a B^+ tree. Assume, all the order are available before insertion. The orders P for B^+ tree node is defined as-

2 to P pointer for root

$\left\lceil \frac{P}{2} \right\rceil$ to P pointer for another node.

The maximum possible levels in a B^+ tree index for P = 9 is_____.

(Assume that level of the root node is 1)

[MCQ]

11. Consider the following statements:

S_1: In a B^+ tree, data pointers are stored only at the leaf nodes of the tree.

S_2: The leaf node has an entry for every value of the search field, along with the data pointer to the record.

Choose the correct statements.

(a) Only S_1 is true
(b) Only S_2 is true
(c) Both S_1 and S_2 are true
(d) Neither S_1 nor S_2 is true

[MSQ]

12. Which of the following is/are true reading B^+ tree?

(a) Records can be fetched in equal number of disk access.
(b) Height of the tree remains balanced and less as compared to B tree.
(c) Keys are used for indexing
(d) Faster search queries as the data is stored only on the leaf nodes.

[NAT]

13. Consider the keys (1– 5000) are going to be interested into a B^+ tree. Assume, all the order are available before insertion. The orders P for B^+ tree node is defined as-

2 to P pointer for root

$\left\lceil \frac{P}{2} \right\rceil$ to P pointer for another node.

The minimum possible levels in a B^+ tree index for P = 9 is_____.

(Assume that level of the root node is 1)

Answer Key

1. **(d)**
2. **(255)**
3. **(c)**
4. **(52)**
5. **(c)**
6. **(93)**
7. **(512)**
8. **(269)**
9. **(5624)**
10. **(6)**
11. **(c)**
12. **(a, b, c, d)**
13. **(4)**

Hints & Solutions

1. (d)

Disk block

Given data,
Disk block size = 1K byte = 2^{10} bytes = 1024 bytes
Block pointer (B) = 6 bytes
Key field (K) = 10 bytes
Record/ data pointer (R) = 8 bytes
Order of leaf node= P
$B + (P)(K + R) \leq D$
$6 + (P)(10 + 8) \leq 1024$
$18\,P \leq 1024 - 6$

$$P = \left\lfloor \frac{1018}{18} \right\rfloor$$

$\therefore$ P = 56
Maximum number of (value, data record pointer) Pairs = 56
The order of the leaf node is 56.

2. (255)

A B^+ tree of order n and height h can have at most $n^h - 1$ keys. Therefore, maximum number of keys-
$= 4^4 - 1 = 255$.

3. (c)

For storing the records, numbers of blocks required = $\frac{P}{3}$ and for storing the keys in dense index number of blocks required = $\frac{P}{10}$.

So, total blocks required are $\frac{P}{3} + \frac{P}{10} = \frac{13P}{30}$

4. (52)

Size of child pointer = 6 bytes
Size of search field value = 34 bytes
Block size = 2048.
Order of internal node = P
($\therefore$ Number of blocks pointer in any node)
$(P - 1)34 + P \times 6 \leq 2048$
$34P + 6P \leq 2048 + 34$
$40P \leq 2082$

$$P \leq \frac{2082}{40}$$

$= \lfloor 52.05 \rfloor \simeq 52$

5. (c)

Blocking factor, bfr = $\lfloor 1024/100 \rfloor$
= 10 records per block
Number of blocks needs for file = $\lceil r/bfr \rceil$
= $\lceil 100000/10 \rceil$ = 10000
Index records size R_i= (Non – Key DeptID + P_R))
= 14 + 18 = 32 bytes
Index blocking factors bfri = $\lfloor B/R_i \rfloor = \lfloor 1024/32 \rfloor$
= 32
Number of 1st level index entries r_1 = number of – records in the file = 100000 entries.
Number of first level index blocks $b_1 = \lceil r_1/bfri \rceil$
= $\lceil 100000/32 \rceil$ = 3125 blocks

6. (93)

Order P: maximum blocks pointers per node.
Block size $\geq$ P × (Block size pointer) + (P –1) × (size of keys + size of record pointers)
Block size $\geq$ P ×5 + (P – 1) × (9 + 8)
$2048 \geq 5P + 17P - 17$
$22P \leq 2065$

$$P = \left\lfloor \frac{2065}{22} \right\rfloor = 93$$

7. (512)

Order P: maximum number of (value, data record pointer) pairs
Block size $\geq$ P × (keys size + Record pointer size) + 1× (Block pointer size)
Block size $\geq$ P × (6 + 8) + 1 × (8)
Block size $\geq$ 14 * 36 + 8
Block Size = 512 bytes

8. (269)

Level	Minimum Number of Nodes	Minimum number of Blocks pointer	Minimum number of keys
1	1	2	1
2	2	$2 \times \left\lceil \frac{5}{2} \right\rceil = 6$	2 × 2
3	6	6 × 3 = 18	6 × 2
4	18	18 × 3 = 54	18 × 2
5	54	54 × 3 = 162	54 × 2

a = minimum number of keys in B tree $\rightarrow$ 161
For a B^+ tree, keys are present in last level only b = 108
$\therefore$ a + b = 161 + 108 = 269

9. (5624)

Level	Max. No. of nodes	Max. No. of Blocks pointer	Max. No. of keys
1	1	5	4
2	5	5 × 5	5 × 4
3	25	25 × 5	25 × 4
4	125	125 × 5	125 × 4
5	625	625 × 5	625 × 4

a = maximum number of keys in B tree → 3124

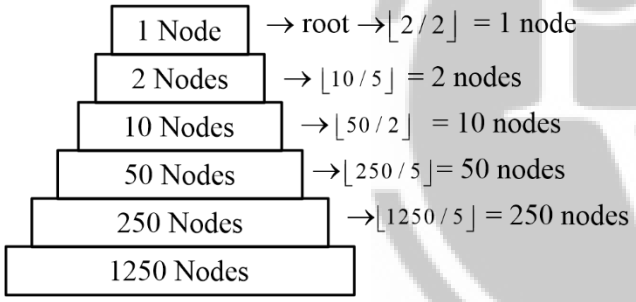
For a B^+ tree, keys are present in last level only b = 2500.

10. (6)

For maximum possible levels, minimum number of keys should be present in an index node.

Number of nodes in the last level = $\left\lfloor \frac{5000}{4} \right\rfloor = 1250$

[Minimum $\left(\left\lceil \frac{9}{2} \right\rceil - 1\right)$ keys for other node]



11. (c)

S_1(True): In a B^+ tree, data pointers are stored only at the leaf nodes of the tree.

S_2(True): the leaf nodes have an entry for every value of the search field, along with the data pointer to the record.

12. (a, b, c, d)

True: Records can be fetched in equal number of accesses

True: Height of the tree remains balanced and less as compared to B tree.

True: We can access the data stored in a B^+ tree sequentially as well.

True: Faster search queries as the data is stored only on the leaf node.

13. (4)

For minimum possible levels, maximum number of keys should be present in index node.

$= \left\lceil \frac{5000}{8} \right\rceil = 625$

$= \left\lceil \frac{625}{9} \right\rceil = 70$

$= \left\lceil \frac{70}{9} \right\rceil = 8$ Minimum number of level = 4

$= \left\lceil \frac{8}{9} \right\rceil = 1$ node

Branch : CSE & IT Batch : Hinglish

Database Management System
Query Language

DPP 01

[MCQ]

1. Consider the following statements:

S_1: $\pi_{List\ N}(\pi_{List\ N-1}.....(\pi_{List\ 1}(R))$

$\equiv \pi_{List\ 1}(\pi_{List\ 2}.....(\pi_{List\ N}(R))$

S_2: $\sigma_{c_n}\left(\sigma_{c_{n-1}}.....\left(\sigma_{c_1}(R)\right)\right) \equiv \sigma_{c_1}\left(\sigma_{c_2}....\left(\sigma_{C_N}(C)\right)\right)$

Which of the following statement(s) is/are correct?

(a) S_1 only

(b) S_2 only

(c) Both S_1 and S_2 only

(d) Neither S_1 nor S_2

[NAT]

2. Consider the following relations-

Enroll (CandidateID, Papercode) with 5000 tuples and Count(Papercode, Number_of_appearing_candidates) with 29 tuples.

Assume, one candidate can enroll for multiple Papercode. Let p and q be the maximum and minimum number of records in Count ⋈ Enroll then the value of p + q is _____.

[MCQ]

3. Let R_1 and R_2 be two relations which are union compatible with the same set of attributes.

S_1: $R_1 \cap R_2 = T_1 \bowtie T_2$

S_2: $R_1 \cup R_2 = T_1 \bowtie T_2$

Which of the above statement(s) are INCORRECT?

(a) S_1 only

(b) S_2 only

(c) Both S_1 and S_2 only

(d) Neither S_1 nor S_2

[MSQ]

4. Consider the following relations:

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

Which of the following relational algebra displays the sid's who only enrolled for Papercode having descriptions (Desc) as "CS"?

(a) $\pi_{sid}(\text{Enroll} \underset{\text{Desc = CS}}{\bowtie} \text{Paper})$

(b) $\pi_{sid}(\text{Enroll}) - \pi_{sid}((\text{Enroll} \bowtie \underset{\text{Desc = CS}}{\sigma}(\text{Paper}))$

(c) $\pi_{sid}(\text{Enroll}) - \pi_{sid}((\text{Enroll} \bowtie \underset{\text{Desc < > CS}}{\sigma}(\text{Paper}))$

(d) None

[MCQ]

5. Consider a relations work (EmpiD, Project ID)

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

(a) $\pi_{Empid}(\text{Work}) - \pi_{Empid}(\text{Work} \underset{\substack{\text{Empid = E} \\ \wedge \\ \text{Project Id = P}}}{\bowtie} \rho_{E,P}(\text{work}))$

(b) $\pi_{Empid}(\text{Work} \underset{\substack{\text{Empid = E} \\ \wedge \\ \text{Project ID} \neq \text{P}}}{\bowtie} \rho_{E,P}(\text{work}))$

(c) $\pi_{Empid}(\text{work}) - \pi_{Empid}(\text{work} \underset{\substack{\text{Empid = E} \\ \wedge \\ \text{Project ID} \neq \text{P}}}{\bowtie} \rho_{E,P}(\text{work}))$

(d) None

[MCQ]

6. Consider two relations R and S with *x* and *y* number of distinct record. Let p and q be the minimum and maximum number of records in the resultant R/S, then-

(a) p = 0, q = x + 1 (b) p = 0, q = $\left\lfloor \frac{x}{y} \right\rfloor$

(c) $p = x, q = y$ (d) $p = x, q = \left\lfloor \frac{x}{y} \right\rfloor$

[MCQ]

7. Let R_1 and R_2 be two relations with n and m tuples.

S_1: The maximum number of records in $R_1 - R_2$ is n.

S_2: The minimum number of records in $R_1 \cup R_2$ is max (n, m)

(a) S_1 only
(b) S_2 only
(c) Both S_1 and S_2
(d) Neither S_1 nor S_2

[MCQ]

8. Consider the following RA expression-

P: $\pi_{sid}(\text{student}) - \pi_{sid}(\text{student} \bowtie \rho_{\substack{I, G, M \\ \text{Marks} < M \\ \wedge\ \text{Gender} = G}}(\text{Student}))$

On a relation student (sid, Gender, Marks) and $\rho_{I = sid}$, $\rho_{G = Gender}$, $\rho_{M = Marks}$.

The above R.A displays?

(a) The sid of the student 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 student who scored higher than all the female students
(d) None

[MSQ]

9. Consider the relation-

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

The relational algebra expression that displays the Eids who work in every project Name = 'M____.

(a) $\pi_{Eid, Pid}(\text{works}) / \pi_{Pid}(\sigma_{Name = M}(\text{Project}))$

(b) $\pi_{Eid}(\text{Work}) - \pi_{Eid}\left[\pi_{Eid}(\text{Work}) \times \pi_{pid}\left(\sigma_{Name = m}(\text{Project})\right) - \pi_{Eid\ Pid}(\text{works})\right]$

(c) $\pi_{Eid}(\text{Work}) - \left[\pi_{Eid}(\text{Work}) \times \pi_{pid}\left(\sigma_{Name <> m}(\text{Project})\right) - \pi_{Eid\ Pid}(\text{works})\right]$

(d) None

[MCQ]

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

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

S_2: $R_1 \bowtie R_2 = \phi$

Which of the given statement(s) is/are correct?

(a) S_1 only
(b) S_2 only
(c) Both S_1 and S_2
(d) Neither S_1 nor S_2

Answer Key

1. **(b)**
2. **(10000)**
3. **(b)**
4. **(a, c)**
5. **(c)**
6. **(b)**
7. **(c)**
8. **(b)**
9. **(a, b)**
10. **(a)**

Hints & Solutions

1. (b)

Selection is commutative whereas projection is not commutative.

Consider the following relation R

A	B	C
3	2	0
1	2	5
2	3	4

I. Statement S_1: Incorrect

$\pi_B(\pi_{B,C}(R))$ $\quad$ $\pi_{B,C}(\pi_B(R))$

$\pi_B\begin{bmatrix} B & C \\ 2 & 0 \\ 2 & 5 \\ 3 & 4 \end{bmatrix}$ $\quad$ $\pi_{B,C}\begin{bmatrix} 2 \\ 2 \\ 3 \end{bmatrix} \rightarrow$ Not Possible

II. Statement S_2: Correct

$\sigma_{B=2}(\sigma_{c>0}(R)) = [1 \quad 2 \quad 5]$

$\sigma_{c>0}(\sigma_{B=2}(R)) = [1 \quad 2 \quad 5]$

2. (10000)

$\therefore$ Papercode is candidate key in Count with 29 records and a foreign key in Enroll. Papercode can also not Contain NULL values in Enroll as it is the candidate.

Maximum number of records in Count $\bowtie$ Enroll (P) = maximum (5000, 29) = 5000

Now as we know that FK always store subset value of its parent key attribute.

Minimum number of records Counts $\bowtie$ Enroll (q) = maximum (5000, 29) = 5000

$\therefore$ p + q = 5000 + 5000 = 10000

3. (b)

R_1 and R_2 are union compatible means they have the same number of attributes and the domains of the attributes also the same.

4. (a, c)

Side who enrolled for only 'CS' Papercode-

= All sids – Sid who enrolled for some non CS Courses/ Papers

$= \pi_{sid}(\text{Enroll}) - \pi_{sid}(\text{Enroll} \bowtie \underset{\text{Desc} < >\text{cs}}{\sigma}(\text{Paper}))$

$\therefore$ Option a and c is correct.

5. (c)

Retrieve employee ID's work exactly in one project

= All emp IDs – Emp IDs who work in at least two projects etc.

$= \text{All emp IDs} - \pi_{\text{Empid}}(\text{Work} \bowtie \underset{\substack{\text{Empid} = E \\ \wedge \\ \text{Project ID} \neq P}}{\rho_{E,P}}(\text{work}))$

6. (b)

The minimum number of records in R/S is 0.

The maximum number of records in R/S is at most *x*, if y = 0

But it will be $\left\lfloor \frac{x}{y} \right\rfloor$ if y > 0.

7. (c)

S_1: R_1 with n tuples

R_2 with m tuples

When m = 0, then $R_1 - R_2 = n$

So, Statement S1 is true.

S_2: Let *x* be the tuple set of R, and *y* be the tuple set of R_2

If $x \cap y \neq \phi$, then min m number of tuples in $R_1 \cup R_2$ is max (n, m). Hence, statement S2 is also true.

8. (b)

$R : \pi_{sid}(\text{Student} \bowtie \underset{\substack{\text{Marks} < m \\ \wedge \\ \text{Gender} = G}}{\rho_{I,G,M}}(\text{Student}))$

The R will results: The sids of student of the same gender who scored less marks than the same student of the same gender

π_{sid} (Student) – R ≡ The sids of the students who scored maximum marks in a particular gender category.

$\therefore$ Hence, b is correct.

9. (a, b)

Relative Eid who works in every project having name = 'M' is equivalent to division operation in relational algebra.

So, (a) is correct.

(b)

Works (Eid, Pid)		Project (Pid, Name)	
A	1	1	M
B	2	2	P
A	2	3	M
C	3		
C	2		
C	1		
A	3		

$$P: \pi_{Eid}(works) \times \pi_{Pid}\left(\underset{Name = M}{\sigma}(Project)\right)$$

$$\begin{bmatrix} A \\ B \\ C \end{bmatrix} \qquad \begin{bmatrix} 1 \\ 3 \end{bmatrix}$$

P:		
	A	1
	A	3
	B	1
	B	3
	C	1
	C	3

$$\underbrace{\pi_{Eid}\left[P - \pi_{EidPid}(Works)\right]}_{Q} = \begin{bmatrix} A & 1 \\ A & 3 \\ B & 1 \\ B & 3 \\ C & 1 \\ C & 3 \end{bmatrix} - \begin{bmatrix} A & 1 \\ B & 2 \\ A & 2 \\ C & 3 \\ C & 2 \\ C & 1 \\ A & 3 \end{bmatrix}$$

$$\text{Gives Eid who dose not} \leftarrow = \underset{Eid}{\pi}\begin{bmatrix} B & 1 \\ B & 3 \end{bmatrix} = [B]$$

$$\pi_{Eid}\ (Works) - Q = \begin{bmatrix} A \\ B \\ C \end{bmatrix} - [B] = \begin{bmatrix} A \\ B \end{bmatrix} \leftarrow \text{Eids who}$$

works in all 'M' projects

10. (a)

If the relations R_1 and R_2 have no attributes in common, the result of natural join is equal to the cross product of R_1 and R_2.

The condition of equijoin is not inaccessibility between two same attributes. So, S1 is CORRECT.

Branch : CSE & IT **Batch : Hinglish**

Database Management System

Query Language

DPP 02

[MCQ]

1. Consider the following keywords.

A. SELECT
B. TOP
C. DISTINCT
D. FROM
E. WHERE
F. GROUP BY
G. HAVING H. ORDER BY

The above keywords are used in the given SQL query below.

```
SLECT TOP NumberOfRows DISTINCT Col1, Col2
FROM TableNameX, TableNameY
GROUP BY ColumnName
HAVING expression
ORDER BY ColumnName;
```

Which of the following is the correct query execution order according to SQL Standard?

(a) D E F G A H B C
(b) D E F G A C H B
(c) D E F G A B C H
(d) A D E F G H C B

[MSQ]

2. Consider the following employee table

Employees (EMPID, EmpName, Sal, DeptID, ManagerID) assume that EMPID is primary key of relation. which of the following SELECT statements is/are invalid?

(a) SELECT ManagerID, DeptID FROM employees;
(b) SELECT ManagerID, DISTINCT DeptID FROM employees;
(c) SELECT DISTINCT ManagerID, DISTINCT DeptID FROM employees;
(d) SELECT DISTINCT ManagerID, DeptID FROM employees;

[MSQ]

3. Consider the following product relation

Products (PID,PName, Cost)

Assume that PID is a primary key of relation. Which SELECT statement should we used to limit the display of product information to the product having price/cost less than 50?

(a) SELECT PID, PName FROM Products WHERE Cost < 50;
(b) SELECT PID, PName FROM Products WHERE Cost< = 50;
(c) SELECT PID, PName FROM Products WHERE PID IN (SELECT PID FROM Products WHERE Cost <50);
(d) SELECT PID, PName FROM Products GROUP BY PID Having Cost < 50;

[MCQ]

4. The Employees table contains these columns

empID	NUMBERS (4)
LastName	VARCHAR (25)
JobID	VARCHAR (10)

Suppose that, you want to search for string that contains 'Negi' in the LastName column which SQL statement will be used?

(a) SELECT empID, LastName, JobID FROM employees WHERE LastName LIKE '%Negi';
(b) SELECT empID, lastName, JobID FROM employees WHERE LastName = 'Negi_%';
(c) SELECT empID, lastName, JobID FROM employees WHERE LastName LIKE 'Negi';
(d) None of these

[NAT]

5. Consider a relation A(P,Q) currently has tuples {(1, 2), (1, 3), (3, 4) } and relation B(Q, R) currently has {(2, 5), (4, 6), (7, 8)}. Then the number of tuples in the result of the SQL query: SELECT * FROM A NATURAL OUTER JOIN B; is_____?

[MSQ]

6. Which of the following statement is/are true about constraints?

(a) The constraints is applied only to INSERT operation into table.

(b) A foreign key can't contain NULL values.

(c) A column with the unique constraint can store NULLS.

(d) We can have more than one column in a table as a part of primary key.

[MCQ]

7. Consider the following statements

S_1: An INSERT statement can add multiple rows per execution to a table.

S_2: An UPDATE Statement can modify multiple rows based on multiple condition on a table.

Choose the correct statements.

(a) Only S_1 is true

(b) Only S_2 is true

(c) Both S_1 is S_2 are true

(d) Both S_1 and S_2 are false

[MCQ]

8. Consider the following statements.

S1: A DELETE statement can remove rows based on a single condition on a table

S2: An INSERT statement can add a single row based on multiple condition on a table.

Choose the correct statements

(a) Only S_1 is true

(b) Only S_2 is true

(c) Both S_1 and S_2 are true

(d) Both S_1 and S_2 are false

[MSQ]

9. Which of the below statement are true regarding the WHERE and HAVING clause in a SQL statement?

(a) WHERE and HAVHIG clause can't be used together in SQL Statement.

(b) The HAVING clause condition can have aggregate function.

(c) The WHERE clause is used to exclude rows before the grouping of data.

(d) The HAVING clause is used to exclude one or more aggregated results after grouping data.

[MCQ]

10. Given the database schema A(P,Q,R) which of the following SQL query can be used to test whether the functional dependency P→R holds on relation A?

(a) Select P from A group by P having count (distinct R) >1

(b) Selects P from A group by A having count (distinct R) >1

(c) Select R from A group by P having count (distinct R) >1

(d) None of the above

Answer Key

1. **(b)**
2. **(b, c)**
3. **(a, c)**
4. **(c)**
5. **(4)**
6. **(c, d)**
7. **(c)**
8. **(c)**
9. **(b, c, d)**
10. **(a)**

Hints & Solutions

1. (b)

The correct query execution order.

FROM	→	D
WHERE	→	E
GROUP BY	→	F
HAVING	→	G
SELECT	→	A
DISTINCT	→	C
ORDER BY	→	H
TOP	→	B

So, correct order of execution is DEFGACHB i.e… option (b).

2. (b, c)

Option b & c are having invalid SELECT statement, because we cannot apply DISTINCT keyword on attribute basis, DISTINCT keyword chooses a distinct row.

3. (a & c)

Option (a) is correct because this SQL statement displays the product information of product with cost less than 50.

Option (b) is incorrect because it will return product information of product with cost equal to 50.

Option (c) is correct SQL statement because in this we used nested SQL query.

First, we find PID of product whose cost is less than 50, and then we compare PID with the result of inner query.

Option (d) is incorrect SQL statement because it cannot select non aggregate column PName in SELECT clause.

4. (c)

The LIKE command is used in a WHERE clause to search for a specified pattern in a column.

You can use two wildcards with LIKE:

- % Represents zero, one, or multiple characters
- _ -Represents a single character

Option (a)

The following SQL selects all Lastname ending with "Negi".

Option (b):

The following SQL selects all Lastname starting with "Negi".

Option (c):

The following SQL selects all Lastname contains with "Negi".

Or

The equivalent SQL query:

SELECT empID, lastName, JobID FROM employees WHERE LastName LIKE '%Negi%';

5. (4)

A		B		A⋈B		
P	Q	Q	R	P	Q	R
1	2	2	5	1	2	5
1	3	4	6	3	4	6
3	4	7	8	1	3	-
				-	7	8

Therefore the number of tuples in the results are 4.

6. (c, d)

(a) **False;** we can also apply for an update operation into table.

(b) **False;** A foreign key can contain NULL values as well

(c) **True;** A column with the UNIQUE constraint can store NULL values but not duplicate value.

(d) **True;** a primary key can also be a composite key.

7. (c)

S_1: True; An INSERT statement can add multiple, rows per execution to a table by using the following SQL query.

INSERT INTO table 2 (col1, col2, col3, ….) SELECT col1, col2, col3,…

S_2: True; An UPDATE statement can modify multiple rows based on multiple conditions on table.

8. (c)

S_1: True; DELETE statement can remove rows based no/single/multiple condition on a table.

S_2: True; An insert statement can add a single row based on multiple conditions on a table.

9. (b, c, d)

(a) False; A query can have both WHERE and HAVING clauses.

(b) True; The HAVING clause condition can have aggregate function.

(c) True; WHERE clause is used to exclude rows before the grouping of data.

(d) True; The HAVING clause is used to exclude aggregated results after grouping data.

10. (a)

If the query in option a returns non null output, then the dependency does not hold. Hence (a) option is correct.

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Database Management System

Query Language

DPP 03

[MCQ]

1. Consider the following relational algebra query on relations A (p, q, r) and B (q, r):

$\pi_p(A) - \pi_p((\pi_p(A) \times \pi_{q,r}(B) - \pi_{p,q,r}(A))$

The above query is equivalent to?

(a) $A \cap B$
(b) $A \cup B$
(c) $A - B$
(d) $A \div B$

[MCQ]

2. Consider the following SQL query.

SELECT DISITNCT $P_1, P_2, P_3 \ldots P_n$
FROM $R_1, R_2, R_3 \ldots R_m$
WHERE Q

Which of the following relational algebra query is equivalent to above SQL query?

(a) $\pi_{P1, P2, P3 \ldots Pn}(\sigma_Q (R_1 \bowtie R_2 \bowtie R_3 \bowtie \ldots\ldots \bowtie R_m))$
(b) $\pi_{P1, P2, P3 \ldots Pn}((R_1 \times R_2 \times R_3 \times \ldots\ldots \times R_m)$
(c) $\sigma_{P1, P2, P3 \ldots Pn}(\pi_Q (R_1 \bowtie R_2 \bowtie R_3 \bowtie \ldots\ldots \bowtie R_m))$
(d) $\pi_{P1, P2, P3 \ldots Pn}(\sigma_Q (R_1 \times R_2 \times R_3 \times \ldots\ldots \times R_m))$

[MCQ]

3. Consider the following equivalencies between expressions of relational algebra, each involving relations A (P, Q) and B (R, S). Assume that there is no foreign key, A attribute to table can be NULL, all attributes are of integer types which of the following equivalencies is/are TRUE?

(a) $\pi_{P, Q}(A \times B) = A$
(b) $A - \rho_{T(P, Q)}(B) = \rho_{T(P, Q)}(B - (\rho_{T(R, S)}(A)))$
(c) $\pi_{P, Q, S}(A \bowtie_{Q=R} B) = A \bowtie (\rho_{T(Q, S)}(B))$
(d) None of the above

[MCQ]

4. Let A = (P, Q, R) and a_1 and a_2 both be relations on schema A. Give on expression in the domain relation calculus List- I, match the List-I expression to its equivalent relational algebra query in List-II.

List-I	List-II
1. $a_1 \cup a_2$	(a) $\{<p, q, r> \mid < p, q, r> \in a_1 \vee <p, q, r> \in a_2\}$
2. $a_1 \cap a_2$	(b) $\{<p, q, r> \mid <p, q, r> \in a_1 \wedge < p, q, r> \in a_2\}$
3. $a_1 - a_2$	(c) $\{<p, q, r> \mid < p,q,r, > \mid \in a_1 \wedge <p, q ,r> \notin a_2\}$

(a) 1– (a), 2 – (b), 3 – (c)
(b) 1– (b), 2 – (c), 3 – (a)
(c) 1– (a), 2 – (c), 3 – (b)
(d) 1– (b), 2 – (a), 3 – (c)

[NAT]

5. Consider the table which contains the data shown below.

Sailors (SailID, SailName, Rating, Age)
Reserves (SailID, BoatID, Date)
Boats (BoatID, BoatName, Color)

Sailors

SailID	SailName	Rating	Age
1	Ram	5	35
2	Shaym	9	22
3	Ramesh	10	19
4	Suresh	3	NULL
5	Akhil	NULL	35

Reserves

SailID	BoatID	Date
1	4	2017-03-15
1	5	2017-04-15
3	2	2014-04-15
4	4	2018-01-01
5	1	2017-12-25

Boats

BoatID	BoatName	Color
1	Lake	Red
2	Fish	Yellow
3	Clipper	Green
4	Yatch	Green
5	Fish	Yellow
6	Clipper	red

and the following relational algebra query.

$\pi_{BoatID}\ (\sigma_{Age\ =\ 35\ \wedge\ rating\ \geq\ 5}\ (sailors)\ \bowtie\ Reserves)\ \cap \pi_{BoatID}\ (\sigma_{Rating\ <\ 5}\ (Sailors) \bowtie Reserves)$

The number of rows returned by the above query is_____.

[MCQ]

6. Consider the relation schemas w(P, Q, R), *x* (S, P, T) y(P, Q, R, S, T) and z (R, S, T). A query that uses additional operators of relational algebra:

$((w \times x) \cap y) \div z$.

What will be the result set if we write this query using only the basic operators of relational algebra?

(a) Result set of the basic operator's query will be greater than the result set of given query.
(b) Result set will only consist of attributes P and Q.
(c) Some of the operations in query cannot be performed due to incompatible relation schemas
(d) Query cannot be written by only using basic operations.

[MSQ]

7. Consider the following relational table A

A				
P	Q	R	S	T
p_1	q_1	r_1	s_1	t_1
p_2	q_2	r_2	s_2	t_2

Also, consider the decomposition of the relation A into relations A_1 = (P, Q, R) and A_2 = (R, S, T) which of the following is/are correct based on the above relations.

(a) $\pi_{A1}\ (A) \bowtie \pi_{A2}\ (A) = A$
(b) $\pi_{A1}\ (A) \bowtie \pi_{A2}\ (A) \neq A$
(c) PQ $\rightarrow$T is true in the table $\pi_{A1}\ (A) \bowtie \pi_{A2}\ (A)$
(d) None of the above

[MSQ]

8. Which of the following relational algebra expression is/are always holds correct?

(a) $(X \bowtie Y) \bowtie Z = (Z \bowtie X) \bowtie Y$
(b) $\sigma_A\ (\sigma_B\ (X)) = \sigma_B\ (\sigma_A\ (X)$
(c) $\pi_A\ (\pi_B\ (X)) = \pi_B\ (\pi_A\ (X)$
(d) None of the above

[MSQ]

9. Consider the following Database

Tool (TooID, Brand, Price)

Jobsite (Location, compensation, Task)

ToolBox(ToolBoxID, location)$\rightarrow$location is a foreign key to jobsite.

Holds(ToolBoxID, ToolID) $\rightarrow$ToolBoxID is a foreign key to ToolBox. ToolID is a foreign key to Tool.

And consider the following SQL query.

SELECT DISTINCT T. ToolID
FROM Tool T, Holds H, ToolBox B, Jobsite J
WHERE T. ToolID = H.ToolId AND H.ToolBoxID = B. ToolBoxID AND B. location = J. location AND J. Task = 'welding'

Which of the following would be an equivalent relational algebra query?

(a) π_{ToolID} (Tool $\bowtie$ Holds $\bowtie$ ToolBox $\bowtie$ $\sigma_{task\ =\ 'welding'}$(jobsite))
(b) $\pi_{ToolID}\ (\sigma_{task\ =\ 'welding'}$ (Tool $\bowtie$ (Holds $\bowtie$ Tool Box) $\bowtie$ Jobsite)
(c) $\sigma_{task\ =\ 'welding'}\ (\pi_{ToolID}$ (Tool) $\bowtie$ Holds $\bowtie$ Tool Box $\bowtie$ Jobsite)
(d) None of the above

[MSQ]

10. Consider the following two relations A (P, Q) and B (R, S). Which of the following statement is/are TRUE?

(a) The cardinality of $(A \bowtie_{P\ =\ R} B)$ is always larger than or equal to the size of $(A \bowtie_{P\ =\ R\ and\ Q=S} B)$.
(b) The cardinality of $(A \bowtie_{P\ =\ R\ and\ Q\ \neq\ S} B)$ is always larger than or equal to the size of $(A \bowtie_{P\ =\ R\ and\ Q\ =\ S} B)$.
(c) These two-expression $(\sigma_{P\ =\ 5}\ (A \bowtie_{Q=R} B))$ and $(\sigma_{P\ =\ 5}\ (A) \bowtie_{Q=R} B)$ are always equivalent.
(d) These two expressions $(A \times B) - (A \bowtie_{Q\ =\ R} B)$ and $(A \bowtie_{Q\ \neq\ R} B)$ are always equivalent.

Answer Key

1. **(d)**
2. **(d)**
3. **(c)**
4. **(a)**
5. **(1)**
6. **(c)**
7. **(a, c)**
8. **(a, b)**
9. **(a, b)**
10. **(a, c, d)**

Hints & Solutions

1. (d)

In relational algebra A ÷ B is defined as $\pi_P(A) - \pi_P((\pi_P(A) \times \pi_{qr}(B) - \pi_{p,q,r}(A))$

A÷ B is used when we wish to express queries with "all".

2. (d)

SELECT DISTINCT $P_1, P_2, P_3 \ldots. P_n$

FROM $R_1, R_2, R_3 \ldots.. R_m$

WHERE Q

So, from $R_1, R_2, R_3 \ldots. R_m$

Here, there is no join condition, so it will perform cartesian product, then select σ_Q and perform projection.

$\pi_{P1, P2, P3 \ldots. Pn}(\sigma_Q(R_1 \times R_2 \times R_3 \times \ldots.. \times R_m))$

3. (c)

(a) When B = ϕ, then result of A × B =ϕ then it is not equivalent to A. So, this equivalence is false.

(b) It is clearly seen that it is false / not equivalence as difference is not commutative.

(c) Both expressions are equivalent. In expression $A \bowtie_{\rho T(Q, S)} (B)$, first we are performing rename operation on attribute of relation B and then performing natural join on common column Q.

4. (a)

$a_1 \cup a_2 = \{< p, q, r > | < p,q,r > \in a_1 \vee < p, q, r > \in a_2\}$

$a_1 \cap a_2 = \{< p, q, r > | < p,q,r > \in a_1 \wedge < p, q, r > \in a_2\}$

$a_1 - a_2 = \{< p, q, r > | < p,q,r > \in a_1 \wedge < p, q, r > \notin a_2\}$

5. (1)

Let $\sigma_{age = 35 \wedge rating \geq 5}$ (sailors) as T

T:	1	Ram	5	35

is selected.

(5, Akhil, Null, 35) is not selected as rating contains NULL value and NULL cannot be compared to '5'.

NOTE: Null compared with value result will be undefined.

S: T ⋈ Reserves

Sail ID	Sail Name	Rating	Age	Boat ID	Date
1	Ram	5	35	4	2017-03-15
2	Ram	5	35	5	2017-04-15

U: $\sigma_{rating<5}$ (Sailors) ⋈ Reserves

4	Suresh	3	NULL	4	2018-01-01

$\pi_{BoatID}(S) \cap \pi_{BoatID}(u) = \{4, 5\} \cap \{4\} = \{4\}$

6. (c)

Given:

w (P, Q, R), *x* (S, P, T) y(P, Q, R, S, T) and z (R, S, T) (w × x) contains 6 attributes whereas y contains 5 attributes. So, they aren't union-compatible. Hence intersection operation can't be performed.

NOTE: If number of attributes in Relation A is n and number of attributes in relation B is m then number of attributes "A x B" will be "n + m".

7. (a, c)

(a) TRUE

A				
P	Q	R	S	T
p_1	q_1	r_1	s_1	t_1
p_2	q_2	r_2	s_2	t_2

$\pi_{A1}(A)$			$\pi_{A2}(A)$		
P	Q	R	R	S	T
p_1	q_1	r_1	r_1	s_1	t_1
p_2	q_2	r_2	r_2	s_2	t_2

$\pi_{A1}(A) \bowtie \pi_{A2}(A)$				
P	Q	R	S	T
p_1	q_1	r_1	s_1	t_1
p_2	q_2	r_2	s_2	t_2

$\therefore \pi_{A1}(A) \bowtie \pi_{A2}(A) = A$

(b) FALSE since $\pi_{A1}(A) \bowtie \pi_{A2}(A) = A$

(c) TRUE. PQ→T holds in $\pi_{A1}(A) \bowtie \pi_{A2}(A)$. An FD PQ→T holds if and only iff- for same values of PQ, the T value must be same.

8. (a, b)

(a) Natural join is commutative and Associative so it is always true.

(b) Selection is commutative.

(c) Projection is not commutative.

Hence, a and b are correct.

9. (a, b)

(a) σ_{Task} = 'welding' (Jobsite)
From this we will get all row of jobsite having task welding.
Tool ⋈ holds ⋈ Tool Box ⋈ Jobsite
Natural join is done and with $\pi_{ToolID\rightarrow}$ ToolID column gets displayed.

(b) same explanation as (A)

(c) incorrect because after projecting ToolID we cannot apply condition on task.
Hence corrects option is a and b.

10. (a, c, d)

(a) True, because $(A \bowtie_{P=R \text{ and } Q=S} B)$ is more restrictive than $(A \bowtie_{P=R} B)$, it will also filter out the row in which Q is not equal to S therefore the cardinality (Number of rows) of $(A \bowtie_{P=R} B)$ is always larger than or equal to the size of $(A \bowtie_{P=R \text{ and } Q=S} B)$.

(b) False, the cardinality of $(A \bowtie_{P=R \text{ and } Q \neq S} B)$ is always larger than or equal to the size of $(A \bowtie_{P=R \text{ and } Q=S} B)$.

(c) True, because the results of both $(\sigma_{P=5} (A \bowtie_{Q=R} B))$ and $(\sigma_{P=5} (A) \bowtie_{Q=R} B)$ are always equivalent.

(d) True because the result $(A \times B) - (A \bowtie_{Q=R} B)$ and $(A \bowtie_{Q \neq R} B)$ are always equivalent.

Hence, correct answer is a, c and d.

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Database Management System

Transaction & Concurrency Control

DPP 03

[NAT]

1. Consider the following schedule

S: $w_1(X)$; $w_1(Y)$; $r_2(X)$; $w_2(Y)$; $r_3(X)$; $w_3(Y)$

How many schedules are conflict equivalent to given schedule (S) _____?

[NAT]

2. Consider the following schedule

S = $r_1(P)$; $r_3(S)$; $w_1(Q)$; $r_2(Q)$ $r_4(Q)$, $w_2(R)$ $r_5(R)$; $w_4(T)$; $r_5(T)$; $w_5(Q)$

How many serial schedules conflict equal to schedules(S)? _____.

[NAT]

3. Consider the following schedule

S = $r_1(P)$; $r_3(S)$; $w_1(Q)$; $r_2(Q)$ $r_4(Q)$, $w_2(R)$; $r_5(R)$; $w_4(T)$; $r_5(T)$; $w_5(Q)$

How many serial schedules view equal to schedule(S)_____?

[MCQ]

4. Consider the following transactions

T_1: $r_1(P)$; $w_1(P)$; $r_1(Q)$; $w_1(Q)$

T_2: $r_2(P)$; $r_2(Q)$

T_3: $w_3(P)$; $w_3(Q)$

How many concurrent schedules between T_1, T_2 and T_3 transactions _____?

(a) 400

(b) 410

(c) 420

(d) None

[NAT]

5. How many views equivalent serial schedules are possible for the given schedules below _____

S: $w_1(P)$ $r_2(P)$ $w_3(P)$ $r_4(P)w_5(P)$ $r_6(P)$

[MCQ]

6. The goal of concurrency control on database system is to

(a) Only allow concurrent execution of transaction that correspond to serial execution of some of the transactions.

(b) Allow only transactions that don't access common relationship to run concurrently.

(c) Execute transactions serially.

(d) None of the above.

[MCQ]

7. What problem can occur when a DBMS executes multiple transactions concurrently?

(a) Lost update problem.

(b) Dirty read problem.

(c) Incorrect summary problem.

(d) All of the above.

[MCQ]

8. Consider the following statements

S_1: Every view serializable schedule is conflict serializable.

S_2: Some view serializable schedules are conflict serializable.

(a) Only S_1 is true.

(b) Only S_2 is true

(c) Both S_1 & S_2 are true

(s) Neither S_1 nor S_2 is true

[MCQ]

9. Consider the following schedule involving two transactions

S_1: $r_1(A)$; $r_2(A)$; $w_2(A)$; $r_3(A)$; $w_1(A)$; $w_2(B)$; $r_3(B)$, c_2, $w_3(A)$; c_1, c_3

S_2: $r_2(A)$; $r_1(A)$; $w_1(A)$; $w_2(A)$; $w_2(A)$; $r_3(A)$; $w_3(A)$, $r_2(B)$; c_1, c_3; c_2

Which one of the following statements is TRUE?

(a) S_1 is recoverable and S_2 is not recoverable.

(b) S_1 is not recoverable and S_2 is recoverable.

(c) Both S_1 and S_2 are recoverable.

(d) Both S_1 and S_2 are not recoverable.

[MCQ]

10. Consider the following schedule:

S: $r_1(A)$; $r_2(C)$; $w_1(A)$; $r_3(A)$ $r_2(B)$; $w_2(B)$, $w_3(A)$; $r_3(B)$; $r_2(A)$

for the schedule S given above two orderings of commits (c_i) operations are specified.

I. c_1; c_3; c_2

II. c_1; c_2; c_3

Which of the above ordering ensures recoverability of schedule S?

(a) Only I

(b) Both I and II

(c) Only II

(d) None of these

[MCQ]

11. Consider the following partial schedule 'S' involving two transaction T_1 and T_2

Time	T_1	T_2
t_0	read(P);	
t_1	write(P);	
t_2		read(R);
t_3		write(R);
t_4		read(Q);
t_5		write(Q);
t_6		read(P);
t_7		commit;
t_8	read(Q);	

Suppose that the transaction T_1 fails immediately after time instance 8. Which one of the following is correct?

S_1: Schedule S is non recoverable and cannot ensure transaction atomicity

S_2: Only T_2 should be aborted and then restarted to ensure truncation atomicity

(a) Only S_1 is true

(b) Only S_2 is true

(c) Both S_1 and S_2 are true

(d) Both S_1 and S_2 are false

Answer Key

1. **(8)**
2. **(10)**
3. **(10)**
4. **(c)**
5. **(2)**
6. **(a)**
7. **(d)**
8. **(b)**
9. **(a)**
10. **(d)**
11. **(a)**

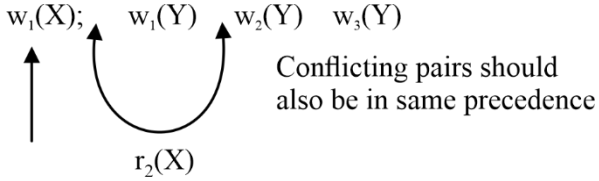
Hints & Solutions

1. (8)

Given schedule

S: $w_1(X)$; $w_1(Y)$; $r_2(X)$; $w_2(Y)$;$r_3(X)$;$w_3(Y)$

Conflict equivalent schedules to above schedules.



Transaction T_1 operations must be in same order

There are 2 ways $r_2(X)$ placed such that it must be before $w_2(Y)$ and conflicting pairs should be in precedence.

Hence 2 possibilities to place $r_2(x)$ to avoid conflict equivalence in above schedule.

$S = w_1(X)\ r_2(X)\ w_1(Y)\ w_2(Y)\ w_3(Y)$

$r_3(X)$

4 ways

$S = w_1(X);\ w_1(Y)\ r_2(X)\ w_2(Y)\ w_3(Y)$

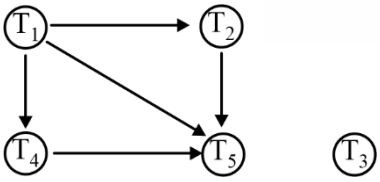
$r_3(X)$

4 ways

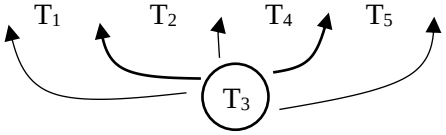
Total 8 conflict equal schedules to the given schedule.

2. (10)

Constructing the precedence graph

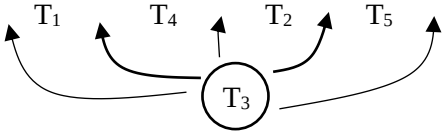


Topological orders



5 ways

Topological orders



5 ways

Total 10 topological orders.

As we know that number of serial schedule conflict 'S' is equal to number of topological orders.

3. (10)

Final write Q: $T_1\ T_5$

Initial Reads

Data item	Initial reads	Writes
P	T_1	-
Q	-	$T_1\ T_5$
R	-	T_2
S	T_3	-
T	-	T_4

Updated reads

$w_1(Q) \rightarrow r_2(Q)$

$r_4(Q)$

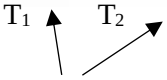
T_5 also writes Q

$w_2(R) \rightarrow r_5(Q)$

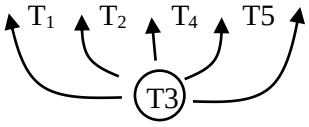
$w_4(T) \rightarrow r_5(T)$

T_1	T_5
-	
$T_1 \rightarrow T2$	
$T1 \rightarrow T4$	
$T2 \rightarrow T5$	
$T4 \rightarrow T5$	

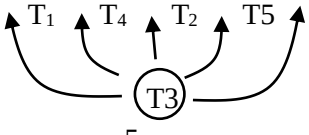
view equal serial orders



T_4 can be placed in two ways

1) 

5 ways

2) 

5 ways

$\therefore$ There are 10 serial orders.

4. (c)

$$\frac{8!}{4! * 2! * 2!} = 420$$

5. (2)

S: $w_1(P)r_2(P)$ $w_3(P)r_4(P)$ $w_5(P)r_6(P)$

Final write

- Can exchange
- without violation view equal conditions

View equal serial schedules are

T_1 T_2 T_3 T_4 T_5 T_6

T_3 T_4 T_1 T_2 T_5 T_6

6. (a)

only allow concurrent execution of transaction that correspond to serial execution of some of the transactions.

7. (d)

All the problems mentioned in option are potential when a DBMS executes multiple transactions concurrently.

8. (b)

Every conflict serializable schedules are view serializable but vice versa is not true. However, some view serializable schedules are conflict serializable.

9. (a)

S_1:

T_1	T_2	T_3
$r_1(A)$		
	$r_2(A)$	
	$w_2(A)$	
		$r_3(A)$
$w_1(A)$		
	$w_2(B)$	
		$r_3(B)$
	c_2	
		$w_3(A)$
c_1		
		c_3

Here the transaction reads the changes of uncommitted transaction but commits itself. So schedule is recoverable.

S_2:

T_1	T_2	T_3
	$r_2(A)$	
$r_1(A)$		
$w_1(A)$		
	$w_2(A)$	
	$w_2(B)$	
		$r_3(A)$
		$w_3(A)$
		$r_3(B)$
c_1		
		c_3
	c_2	

Here T_3 reads the changes of T_2 but T_3 commits before T_2. So it is not recoverable schedule. Hence, correct option is (a).

10. (d)

T_1	T_2	T_3
$r_1(A)$		
	$r_2(c)$	
$w_1(A)$		
		$r_3(A)$
	$r_2(B)$	
	$w_2(B)$	
		$w_3(A)$
		$r_3(B)$
	$r_2(A)$	
c_1		
		c_3
	c_2	

T_3 reads the changes of T_2 corresponding to B and commits itself before T_2. So this schedule is not recoverable

T_1	T_2	T_3
$r_1(A)$		
	$r_2(c)$	
$w_1(A)$		
		$r_3(A)$
	$r_2(B)$	
	$w_2(B)$	
		$w_3(A)$
		$r_3(B)$
	$r_2(A)$	
c_1		
	c_2	
		c_3

T_2 reads the changes of T_3 Corresponding to A and commits itself before committing of T_3. So this schedule is also not recoverable. Hence answer is option (d).

11. (a)

T_1 gets faild after t_8, as T_1 is uncommitted at t_1 time and write (P) and T_2 reads P at t_6 and gets committed. Hence uncommitted transaction changes are got read by other transaction and then gets committed itself hence it is non recoverable.

T_1 gets failed hence not atomic. Hence correct option is a.

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Database Management System
Transaction and Concurrency Control

DPP-01

[NAT]

1. Two operations are called conflicting operations, if they satisfy which of the below conditions:

I: They work on same data item.

II: Both the operations belong to different transactions.

III: There exists at most one write operation.

The number of conditions satisfied for conflicting operations is/are _____.

[MSQ]

2. Consider the following schedule S:

T_1	T_2	T_3
R(x)		
	W(x)	
		R(x)
W(x)		
		W(x)

Choose the correct statements from the following for above schedule S.

(a) S is a conflict serializable schedule.

(b) S is a view serializable schedule.

(c) S is a serializable schedule.

(d) None of the above.

[NAT]

3. For the given schedule S below, the number of conflict pairs is/are:

S:

T_1	T_2	T_3
R(x)		
	R(x)	
		R(x)
W(y)		
	W(y)	
		W(y)

[MCQ]

4. Suppose many concurrent transactions are made to run over the same data set and the 2nd transaction updates the database before the 1st transaction is finished or completed its execution then which one among the following property is violated and the database is no longer consistent.

(a) Durability (b) Isolation

(c) Atomicity (d) Consistency

[MCQ]

5. Consider the following T_1 and T_2 transactions:

P = 0 and Q = 0;

T_1: Read(P);
Read(Q);
If P = 0 then Q = Q + 10;
write (B);

T_2: Read(Q);
Read(P);
If P = 0 then P = P + 15;
write (P);

The non-serial interleaving of T_1 and T_2 for concurrent execution leads to

(a) Serializable Schedule

(b) Schedule which is not conflict serializable schedule.

(c) A conflict serializable.

(d) None of these.

[MCQ]

6. Consider the following statements:

S_1: If a schedule is view serializable then it may not be conflict serializable.

S_2: If a schedule is conflict serializable then it is also view serializable schedule.

(a) Only S_1 is true

(b) Only S_2 is true

(c) Both S_1 & S_2 are true

(c) Neither S_1 nor S_2 is true

[MCQ]

7. Consider the following log which consists of transactions T_1, T_2 and T_3:

Step	Details of log
1	<T_1 Start>
2	<T_1, A, 200, 300>
3	<T_1, A, 600, 500>
4	<T_2 start>
5	<T_1 commit>
6	<T_2, B, 600, 400>
7	<T_2 commit>
8	<T_3 start>
9	<T_3, A, 600, 100>

If a crash occurs just after step 9. Which of the following is the correct way for recovery?

(a) Undo (T_3) then Undo (T_1) then Redo (T_2)
(b) Redo (T_3) then Undo (T_1) then Undo (T_2)
(c) Undo (T_3) then Redo (T_1) then Redo (T_2)
(d) None of these.

[NAT]

8. Consider the following schedule

S: $R_1(A)$, $R_3(D)$, $W_1(B)$, $R_2(B)$, $R_4(B)$, $W_2(C)$, $R_5(C)$, $W_4(E)$, $R_3(E)$, $W_5(B)$

How many serial schedules are possible which will be view equal to S? _____.

Answer Key

1. **(2)**
2. **(b, c)**
3. **(3)**
4. **(b)**
5. **(b)**
6. **(c)**
7. **(c)**
8. **(10)**

Hints & Solutions

1. (2)

Two operations are called conflicting if the below conditions:

I: They work on same data item.

II: Both the operations belong to different transactions.

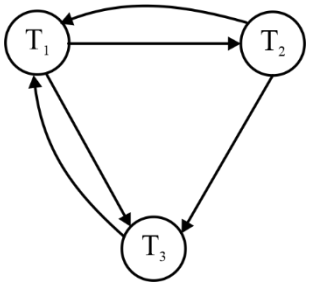
III: There exists one write operation.

Therefore, only two statements are correct.

2. (b, c)

If a schedule S is either conflict serializable or view serializable or both then it is serializable.

I: Checking conflict serializability using precedence graph.



Cycle exists in the precedence graph; therefore, the schedule is not conflict serializable.

II: Checking for view serializability.

Since there is a cycle in the precedence graph and also there exists a blind write by transaction T2 on data item x, so it may or may not be view serializable.

Case 1: Initial read on data item x: $T_1 \rightarrow T_3$

Case 2: Updated write on data item x: $T_2 \rightarrow T_3$

Case 3: Final write on data item x: T_3

By above three cases we can say the serial order:

$T_1 \rightarrow T_2 \rightarrow T_3$

Thus, the schedule S is view serializable and hence serializable.

3. (3)

The conflicting pairs are:

$w_1(y) \rightarrow w_2(y)$

$w_1(y) \rightarrow w_3(y)$

$w_2(y) \rightarrow w_3(y)$

only 3 conflict pairs exist in the given schedule.

4. (b)

Isolation allows the multiple transaction to occur at the same time without impacting each other's execution. The property which first violated is Isolation that result in loss of consistency or result will be incorrect.

5. (b)

T_1:	R(A)	T_2:	R(B)
	R(B)		R(A)
	W(B)		W(A)

$T_1 \rightarrow T_2$: ..... W(B) R(B).....

$T_2 \rightarrow T_1$: ..... W(A) R(A) .....

- There is no possibility of non-serial schedule which becomes serializable by T_2 followed by T_1 and T_1 followed by T_2
- A serial schedule is always serializable but it is asking about the non-serial schedule.

Hence, option (b) is correct.

6. (c)

S_1(true): If a schedule is view serializable then it may not be conflict serializable.

S_2(true): If a schedule is conflict serializable then it is also view serializable schedule

7. (c)

- T_1 and T_2 are committed. So, T_1 and T_2 will perform Redo.
- T_3 is not committed. So, T_3 will Perform Undo.

Hence, option (c) is correct.

8. (10)

<table>
<tr><th>Given schedule</th><th>View Equal</th></tr>
<tr><td>Final Write:
B $\Rightarrow T_1$ T_5
C $\Rightarrow T_2$</td><td>$T_1 \rightarrow T_5$
No restriction</td></tr>
<tr><td>Initial Read:
<table><tr><th>Data item</th><th>IR</th><th>Write</th></tr><tr><td>A</td><td>T_1</td><td>-</td></tr></table></td><td>-
-</td></tr>
</table>

D	T_3	-	
Updated Read: $W_1(B) \rightarrow R_2(B)$ $W_1(B) \rightarrow R_4(B)$ $W_2(C) \rightarrow R_5(C)$ $W_4(E) \rightarrow R_5(E)$			$T_1 \rightarrow T_2$ $T_1 \rightarrow T_4$ $T_2 \rightarrow T_5$ $T_4 \rightarrow T_5$

$T_1 \rightarrow T_2 \rightarrow T_5$

T_4 must be before T_5 and T_1 must be before T_4

- $T_1\ T_4\ T_2\ T_5$
- $T_1\ T_2\ T_4\ T_5$

T_3 can be anywhere there is no any restriction.

Total possibilities = 5 + 5 = 10

Hence, (10) is correct.

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Database Management System

Transaction & Concurrency Control

DPP 02

[MCQ]

1. Consider the following schedule S of transaction T_1, T_2 and T_3.

S: $r_1(x); r_2(x); r_3(y); w_1(x); r_2(z); r_2(y); w_2(y); w_1(z);$

Which one of the schedule below is the correct serialization of the above.

(a) $T_2 \rightarrow T_1 \rightarrow T_3$

(b) $T_3 \rightarrow T_2 \rightarrow T_1$

(c) $T_3 \rightarrow T_1 \rightarrow T_2$

(d) $T_2 \rightarrow T_3 \rightarrow T_1$

[MCQ]

2. Consider the transactions T_1, T_2 and T_3 and the schedules S_1 and S_2 given below.

T_1: $r_1(A); r_1(C); w_1(A); w_1(C)$

T_2: $r_2(B); r_2(C); w_2(C)$

T_3: $r_3(B); r_3(A); w_3(B)$

S_1: $r_1(A); r_3(B); r_3(A); r_2(B); r_2(C); w_3(B); w_2(C); r_1(C); w_1(A); w_1(C)$

S_2: $r_1(A); r_3(B); r_2(B); r_3(A); r_1(C); r_2(C); w_3(B); w_1(A); w_2(C); w_1(C)$

Which one of the following statements about the schedule is TRUE?

(a) Only S_1 is conflict serializable.

(b) Only S_2 is conflict serializable.

(c) Both S_1 and S_2 are conflict serializable.

(d) Neither S_1 nor S_2 is conflict serializable.

[MCQ]

3. Which of the following schedule is view serializable but not conflict serializable.

(a) $r_1(P); r_2(P); w_1(P); r_2(Q)$

(b) $r_1(P); w_1(P); r_2(P); w_2(Q)$

(c) $w_1(P); w_2(P); w_1(P); w_2(P); w_1(P)$

(d) None of these.

[MCQ]

4. Consider the following transactions T_1 and T_2:

T_1	T_2
Read(A);	Read(A);
Update A = A + 100;	
	Update A = A – 50;
Write(A);	
	Write(A);

The above transaction has _____.

(a) Lost update problem

(b) Dirty read problem

(c) Unrepeatable read problem

(d) Incorrect summary problem

[MCQ]

5. Consider the following schedule.

Time	T_1	T_2
t_0	Read Item(A);	
t_1		Read Item(A);
t_2		A = A + X;
t_3		Write Item(A);
t_4	Read Item(A);	

Which of the following concurrency problem exists in the above given schedule?

(a) Dirty read (b) Unrepeatable read

(c) Lost update (d) Both a and b

[MCQ]

6. _____Problem occurs when a transaction reads data from a database, then another transaction reads the same database data, and this particular data is deleted by an operation of the first transaction.

(a) Dirty read

(b) Unrepeatable read problem

(c) Phantom read

(d) Lost update problem

[MCQ]

7. Consider a schedule S:

$r_1(x), r_2(y), w_2(x), w_3(z), r_4(z), r_3(x), w_3(y), r_4(x), w_4(y)$

Choose the correct statements for the above schedule S.

(a) The schedule S is not serializable.

(b) The schedule S is conflict serializable with schedule S as $T_1 \rightarrow T_2 \rightarrow T_3 \rightarrow T_4$.

(c) The schedule S is not view serializable.

(d) None of the above.

[MCQ]

8. Consider the below schedule.

S: $r_1(A), r_2(B), w_2(A), r_3(A), w_1(B) w_3(A)$

choose the correct statement from the following.

(a) S is conflict serializable schedule.

(b) S is not conflict serializable schedule.

(c) S may or may not be view serializable schedule.

(d) None of these

[MSQ]

9. Choose the correct statements from the following.

(a) To test view serializability we make use of precedence graph

(b) To test conflict serializability we make use of precedence graph.

(c) If there exists no blind write and the schedule is not conflict serializable then we can conclude that it is not view serializable.

(d) All of the above.

Answer Key

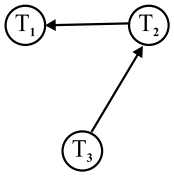
1. **(b)**
2. **(a)**
3. **(c)**
4. **(a)**
5. **(b)**
6. **(c)**
7. **(b)**
8. **(b)**
9. **(b, c)**

Hints & Solutions

1. (b)

Conflict operation are

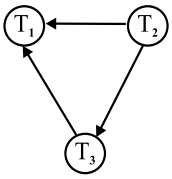
$R_2(X)$; $W_1(X)$; $R_3(Y)$; $W_2(Y)$, $R_2(Z)$; $W_1(Z)$



From precedence graph, the correct serialization order is $T_3 \rightarrow T_2 \rightarrow T_1$

2. (a)

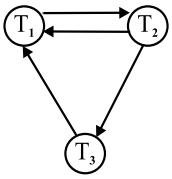
S_1: $r_1(A)$; $r_3(B)$; $r_3(A)$; $r_2(B)$; $r_2(C)$; $w_3(B)$; $w_2(C)$; $r_1(C)$; $w_1(A)$; $w_1(C)$



As there is no cycle is precedence graph

$\therefore$ S_1 is conflict serializable.

S_2: $r_1(A)$; $r_3(B)$; $r_2(B)$; $r_3(A)$; $r_1(C)$; $r_2(C)$; $w_3(B)$; $w_1(A)$; $w_2(C)$; $w_1(C)$

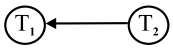


There exists a cycle hence it is not conflict serializable.

Hence, S_1 is conflict serializable but S_2 is not conflict serializable.

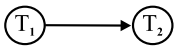
3. (c)

A : False



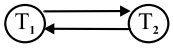
It is conflict serializable, hence it is also view serializable.

B : False



It is conflict serializable, hence it is also view serializable.

C : True



It is not conflict serializable, hence checking for view serializable.

T_1	T_2
W1(P)	
	W2(P)
W1(P)	
	W2(P)
W1(P)	

We check for order of read in view serializability. In order $T_2 \rightarrow T_1$, the schedule is view serializable.

4. (a)

The Transaction T_1 first reads data A from the database then transaction T_2 reads the same data from the database. Then T_1 Performs an operation to add 100 to A. Then transaction T_2 Performs an operation to subtract 50 from the data read by T_2. i.e., A. T_1 performs a write operation to save the value of A according to changes made to T_1. Then T_2 performs a write operation to update the value of A again in the DB. This situation causes changes to A made by T_1 to be lost because T_2 overwrites A again after T_1 update A. you could also say that the update of T_1 is lost.

Hence a is correct option.

5. (b)

In above schedule, T_1 reads value of A and then again reads the value of A. The I^{st} value of A is different from other value in 2^{nd} read.

Hence this is called unrepeatable read.

6. (c)

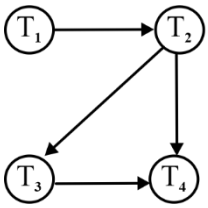
The phantom read problem arises when a transaction reads a variable once but when it tries to read the same variable again which was already deleted by other transaction, this problem known as phantom read problem.

7. (b)

T_1	T_2	T_3	T_4
r(x)			
	r(y)		
	w(x)		
		w(z)	
			r(z)
		r(x)	
		w(y)	
			r(x)
			w(y)

for conflict serializability, we check precedence graph.

Conflict serial schedule $\Rightarrow T_1 \rightarrow T_2 \rightarrow T_3 \rightarrow T_4$

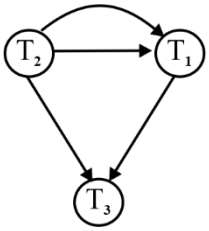


No cycle in precedence graph, therefore it is serializable

8. (b)

T_1	T_2	T_3
r(A)		
	r(B)	
	W(A)	
w(B)		
		r(A)
		w(A)

Precedence graph.



Cycle in the precedence graph, therefore not conflict serializable.

9. (b, c)

For checking conflict serializability we make use of precedence graph. For checking view serializability we check for 3 conditions.

1. Initial read
2. Updated read
3. Final write

If a schedule is not conflict serializable and there exists no blind write then we can conclude the schedule is not view serializable too.