Unit I

Introduction to DBMS

Database is collection of ____.

A.Modules

B.Data

C.None of these

D .Programs

Answer B

Long form of DBA is _____.

A. Database Application
B. None of these
C. Database Admin
D. Database Administrator

Answer D Database Administrator

Q3. Duplication of data at several places is called as _____.

A. Data Inconsistency

B. Data Isolation

C. Atomicity Problem

D. Data Redundancy

Answer D

Q4.If in redundant file common fields are not matching then it results in _____.

A. Data Inconsistency

B. Data Integrity Problem

C. Data Isolation

D. Data Redundancy

Answer A

Q5.A main purpose of DBMS is to provide _____ view of data to user.

A. Abstract

B None of these

C. Complete

D. Partial

Answer A

Q6. _____ means to hide certain details of how data is stored and maintain.

A Data Isolation

B None of these

C Data Integrity

D Data Abstraction

Answer D

Q7 There are _____ levels of data abstraction.

A 4

B 1

C 3

D 2

Answer C

Q8. In data abstraction which is lowest level of abstraction ?

A Physical Level

B None of these

C Conceptual Level

D View Level

Answer A

Q9 _____ of abstraction explains how data is actually stored and describes the Data Structure and Access methods used by database.

A Conceptual Level

B Physical Level

C View Level

Answer B

Q10 Data Model is collection of conceptual tools for describing -

A Data

B Consistency Constaint

C Data Schema

D All of these

Answer D

Q11 Entity Relationship model consists of collection of basic objects called _____ and relationship among these objects.

A functions

B models

C entities

D None of these

Answer C

Q12 Which of the following is example of Object based logical model ?

A Relational Model

B Hierarchical Model

C Network Model

D Entity Relationship Model

Answer D

Q13 Overall design of the database is called as _____.

A Database Abstraction

B Database Schema

C Database Instance

D None of these

Answer B

Q14 Which of the following are valid types of Database Schema's ?

A Partial Schema

B Physical and Practical Schema

C Practical Schema

D Physical and Logical schema

Answer D

Q15 Which of the following schema is present at highest level ?

A Physical Schema

B Sub-Schema

C Logical Schema

D None of these

Answer B

Unit 2

1) Relational Algebra is a ----- query language.

a) Relational
b) Structural
c) Procedural
d) Fundamental
Answer: - c

2) Which of the following is a fundamental operation in relational algebra?
a) Set intersection
b) Natural join
c) Assignment
d) None of the mentioned
Answer: - d

3) Which of the following is a set-oriented operation?
a) Select
b) Difference
c) Project
d) None of the mentioned
Answer: - b

4) Which of the following is used to denote the selection operation in relational algebra?

a) Pi
b) Sigma
c) Lambda
d) Omega
Answer: - b

5) The select operation selects ------that satisfy a given predicate.
a) tuples
b) columns
c) relation
d) All of above
Answer: - a

6) The operation $\sigma_{\text{dept\_name = "Physics"}}$ **(instructor)** selects:

a) Selects all the attributes from instructor relation
b) Selects all the tuples satisfying the condition from the Physics relation
c) Selects all the tuples satisfying the condition from the instructor relation
d) None of above.

Answer: - c

7) Which of the following is used to denote the project operation in relational algebra?
a) Pi
b) Sigma
c) Lambda
d) Omega

Answer: - a

8) The ------ operation, denoted by –(minus), allows us to find tuples that are in one relation but are not in another relation.
a) Union
b) Set-difference
c) Project
d) Intersection

Answer:- b

9) Which is a join condition that contains an equality operator?

a) Equijoin
b) Cartesian
c) Natural
d) None of above

Answer: - a

10) The assignment operator is denoted by -----

a) ->
b) <-
c) =
d) ==

Answer: - b

11) A query in the tuple relational calculus is expressed as:

a) {t|P()|t}
b) {P(t)|t}
c) {t|P(t)}
d) None of the above

Answer: - c

12) The DRC means ----

a) Domain Relational Couple
b) Define Relational Calculus
c) Domain Right-join Calculus
d) Domain Relational calculus

Answer: - d

13) Relational calculus is a ------- query language

a) Relational
b) Structural
c) Procedural
d) Nonprocedural

Answer: - d

14) A set of possible data values is called---.

a) Attribute
b) Degree
c) Domain

d) Tuple

Answer: - c

15) Generalized projection is ------- operation in Relational Algebra.

a. Fundamental Operation
b. Additional Operation
c. Extended Operation
d. None of above

Answer:- c

16) .------ are the types of outer join.

a. left outer join only
b. Right outer join only
c. Full outer join only
d. Left outer join, Right outer join, full outer join

Answer:- d

17) Drawback of inner join is -----.

a. Loss of information
b. Speed is slow
c. Time is high
d. None of above

Answer:- a

18) Full outer join is union of-------.

a. Left outer join and right outer join
b. Inner join and left outer join
c. Inner join and Right outer join
d. None of above

Answer:- a

19) A tuple-relation-calculus formula is built up out of ------.

a. electrons
b. tuples
c. atoms
d. None of above

Answer: - c

20) A Domain Relation Calculus serves as the theoretical basis of------language.

a. SQL
b. QBE
c. MySQL
d. None of above

Answer: - b

21) For select operation the ----- appear in the subscript and the ---- argument appears in the parenthesis after the sigma.

a. Predicates, relation
b. Relation, predicates
c. Operation, predicates
d. Relation, operation

Answer:- a

22) Which of the following relational algebra operations do not require the participating tables to be union-compatible?

a. Union
b. Intersection
c. Join
d. All of above

Answer:- c

23) In SQL the statement select * from R, S is equivalent to-----

a. Select * from R natural join S
b. Select * from R cross join S
c. Select * from R union join S
d. Select * from R inner join S

Answer: - b

24) If two relations R and S are joined, then the non-matching tuples of both R and S are ignored in------.

a. left outer join
b. right outer join
c. full outer join
d. inner join

Answer:- d

25) The common column is eliminated in-------.

a. theta join
b. outer join
c. natural join
d. composed join

Answer:- c

26) Cartesian product in relational algebra is-----

a. Unary operator
b. Binary operator
c. Ternary operator
d. Not defined

Answer:- b

27) In Union operation, duplicate rows are automatically-------.

a. Deleted
b. Added
c. Kept
d. None of the above

Answer:- a

28) Which of the following aggregate function is used for counting tuples in a relation?

a. Avg
b. Count
c. Max
d. Min

Answer:- b

29) Which of the following is not a valid aggregate function ?

a. Avg
b. Compute
c. Count
d. Min

Answer:- b

30) Which of the following operation is used to select some required attributes from a relation while discarding the other attributes?

a. Select
b. Rename
c. Join
d. Project

Answer: - d

31) The natural join operation is-------.

a. Commutative
b. Associative
c. Both a and b
d. None of the above

Answer: - c

32) In relation algebra, the expression $r \leftarrow r - E$ represents

a. deletion
b. insertion
c. modification
d. None of the above

Answer: - a

33) In relation algebra, the Rename operation allows-------.

a. to rename relation only
b. to rename attribute name only
c. to rename the relation or attribute names or both
d. None of the above

Answer: - c

Unit IIISQL

Q1. Here which of the following displays the unique values of the column?

SELECT _____ dept_name FROM instructor;

a) All

b) From

c) Distinct

d) Name

Answer: c

Q2.The _____ clause allows us to select only those rows in the result relation of the ____ clause that satisfy a specified predicate.

a) Where, from

b) From, select

c) Select, from

d) From, where

Answer: a

Q3.The _____ clause is used to list the attributes desired in the result of a query.

a) Where

b) Select

c) From

d) Distinct

View Answer

Answer: b

Q4. In the given query which of the keyword has to be inserted?

INSERT INTO employee _____ (1002,Joey,2000);

a) Table

b) Values

c) Relation

d) Field

Answer: b

Q5. The union operation automatically _____ unlike the select clause.

a) Adds tuples

b) Eliminates unique tuples

c) Adds common tuples

d) Eliminates duplicate

Answer: d

Q6. If we want to retain all duplicates, we must write _____ in place of union.

a) Union all

b) Union some

c) Intersect all

d) Intersect some

Answer: a

Q7.The _____ is essentially used to search for patterns in target string.

a) Like Predicate

b) Null Predicate

c) In Predicate

d) Out Predicate

Answer: a

Q8 A _____ indicates an absent value that may exist but be unknown or that may not exist at all.

a) Empty tuple

b) New value

c) Null value

d) Old value

Answer: c

Q9 The primary key must be

a) Unique

b) Not null

c) Both Unique and Not null

d) Either Unique or Not null

Answer: c

Q10.Aggregate functions are functions that take a _____ as input and return a single value.

a) Collection of values

b) Single value

c) Aggregate value

d) Both Collection of values & Single value

Answer: a

Q11The phrase “greater than at least one” is represented in SQL by _____

a) < all

b) < some

c) > all

d) > some

Answer: d

Q12All aggregate functions except _____ ignore null values in their input collection.

a) Count(attribute)

b) Count(*)

c) Avg

d) Sum

Answer: b

Q13.If we do want to eliminate duplicates, we use the keyword _____in the aggregate expression.

a) Distinct

b) Count

c) Avg

d) Primary key

Answer: a

Q14.

SELECT _____ FROM instructor WHERE dept name= ’Comp. Sci.’;

Which of the following should be used to find the average of the salary ?

a) Mean(salary)

b) Avg(salary)

c) Sum(salary)

d) Count(salary)

Answer: b

Explanation: Avg() is used to find the mean of the values.

Q15 Using which language can a user request information from a database?

a) Query

b) Relational

c) Structural

d) Compiler

Answer: a

Q16. Which one of the following is used to define the structure of the relation, deleting relations and relating schemas?

a) DML(Data Manipulation Langauge)

b) DDL(Data Definition Langauge)

c) Query

d) Relational Schema

Answer: b

Q17. To remove a relation from an SQL database, we use the _____ command.

a) Delete

b) Purge

c) Remove

d) Drop table

Answer: d

Q18. DELETE FROM r; //r - relation

This command performs which of the following action?

a) Remove relation

b) Clear relation entries

c) Delete fields

d) Delete rows

Answer: b

Explanation: Delete command removes the entries in the table

Q19. Updates that violate _____ are disallowed.

a) Integrity constraints

b) Transaction control

c) Authorization

d) DDL constraints

Answer: a

Relational database

Q1. A relational database consists of a collection of

a) Tables

b) Fields

c) Records

d) Keys

Answer: a

Q2. The term _____ is used to refer to a row.

a) Attribute

b) Tuple

c) Field

d) Instance

Answer: b

Q3.The term attribute refers to a _____ of a table.

a) Record

b) Column

c) Tuple

d) Key

Answer: b

Q4.For each attribute of a relation, there is a set of permitted values, called the _____ of that attribute.

a) Domain

b) Relation

c) Set

d) Schema

Answer: a

Q5. Database _____ which is the logical design of the database, and the database _____ which is a snapshot of the data in the database at a given instant in time.

a) Instance, Schema

b) Relation, Schema

c) Relation, Domain

d) Schema, Instance

Answer: d

Q6. The subset of a super key is a candidate key under what condition?

a) No proper subset is a super key

b) All subsets are super keys

c) Subset is a super key

d) Each subset is a super key

Answer: a

Q7. A _____ is a property of the entire relation, rather than of the individual tuples in which each tuple is unique.

a) Rows

b) Key

c) Attribute

d) Fields

Answer: b

Q8. Which one of the following attribute can be taken as a primary key?

a) Name

b) Street

c) Id

d) Department

Answer: c

Q9. An attribute in a relation is a foreign key if the _____ key from one relation is used as an attribute in that relation.

a) Candidate

b) Primary

c) Super

d) Sub

Answer: b

Q10. The relation with the attribute which is the primary key is referenced in another relation. The relation which has the attribute as a primary key is called _____

a) Referential relation

b) Referencing relation

c) Referenced relation

d) Referred relation

Answer: c

Q11. The _____ is the one in which the primary key of one relation is used as a normal attribute in another relation.

a) Referential relation

b) Referencing relation

c) Referenced relation

d) Referred relation

Answer: c

Q12. A _____ is a pictorial depiction of the schema of a database that shows the relations in the database, their attributes, and primary keys and foreign keys.

a) Schema diagram

b) Relational algebra

c) Database diagram

d) Schema flow

Answer: a

UNIT V MCQ

1) The additional structure ------- provide efficient access to the file records.

a. Index
b. Circuit
c. Graph
d. None of above

Answer: - a

2) Ordered indices are based on-------.

a. unsorted ordering of the values
b. sorted ordering of the values
c. sorted and unsorted both
d. None of Above

Answer: - b

3) An -------- consists of a search-key value and pointers to one or more records with that value as their search-key value.

a) Index hash
b) Index entry
c) Index cluster
d) Index map

Answer: - b

4) The type of indexes that include an entry for each value of the indexing attribute is known as ----------.

a. Secondary index
b. Sparse index
c. Dense index
d. None of above

Answer: - c

5) Hash indices uses-----for uniform distribution of values across a range of buckets.

a. Random Value
b. Hash Function
c. Some constant value
d. None of above

Answer: - b

6) Sparse Index is also called as----

a. Non dense index
b. Dense index
c. Dense and non-dense index
d. None of above

Answer: - a

7) In the indices techniques, deletion time is a time required to delete an item and time required to -------

a. insert the index structure
b. copy the index structure
c. delete the index structure
d. update the index structure

Answer: - d

8) The index consists of-----.

a. a list of keys
b. pointers to the master list
c. both (a) and (b)
d. All of the above

Answer: (c)

9) Does index take space in the disk?

a. It stores only in memory
b. Yes, Indexes are stored on disk
c. Indexes are never stored on disk
d. Indexes take no space at all.

Answer: - b

10) With respect to B^+ tree which of following Statement is true?

a. All paths from root to leaf are of the same length
b. All paths from root to leaf are of the different length
c. All paths from root to leaf can be of the same length or different length
d. None of Above

Answer: - a

11) If there are large number of indices, then------

a. Single level indexing is used.
b. Multiple indexing is used.
c. Sequential indexing is used.
d. Multilevel indexing is used.

Answer: - d

12) Which of the following is correct DROP INDEX Command?

a. DROP INDEX table_name;
b. DROP INDEX index_name;
c. DROP INDEX view_name ;
d. DELETE INDEX index_name;

Answer: - b

13) The first record of a block in a data file is called------.

a. first anchor.
b. main record.
c. block anchor
d. none of the above

Answer: - c

14) Decomposition is the process of-------.

a. Combining of given two or more relations
b. Union of given two or more relation
c. Both A & B
d. Breaking down given relation into two or more relations

Answer: - d

15) The ------- is a process of organizing the data in database to avoid data redundancy, insertion anomaly, update anomaly & deletion anomaly.

a. Decomposition
b. Normalization
c. Merging
d. None of above

Answer: - b

16) The attribute on the left-hand side of the arrow in a functional dependency is called as ------.

a. Candidate key
b. Determinant
c. Foreign key
d. Primary key

Answer: - b

17) Which of the following are anomalies that can be caused by redundancy in tables?

a. Insertion
b. Deletion
c. Modification
d. All

Answer: - d

18) A functional dependency is a relationship between or among----.

a. Entities
b. Rows
c. Attributes
d. Tables

Answer: - c

19) Considering relational database, functional dependency A determines B is represented like -----.

a. A->B
b. B->A
c. AB->R
d. R->AB

Answer: - a

20) We create an index in SQL using _____ command

a) Create index
b) New index
c) Create new index
d) Develop index

Answer: - a

21) A relation that contains minimal redundancy and allows easy use is called---.

a. Clean
b. Simple
c. Complex
d. Well-structured

Answer: - d

22) In the -----normal form, a multi-valued attribute is converted to an atomic value.

a) First
b) Second
c) Third
d) Fourth

Answer: - a

23) When the determinant contains two attributes, then----.

a. The first attribute determines the dependent attribute.
b. The second attribute determines the dependent attribute.
c. Both attributes determine the dependent attribute.
d. Either the first or second attribute determines the dependent attribute.

Answer: - c

24) Atomic value means-----.

a. Divisible
b. Indivisible
c. All of Above
d. None of Above

Answer:- b

25) The normalization process generally-----.

a. Reduces the number of relations.
b. Increases the number of relations.
c. Increases the number of functional dependencies.
d. All of Above

Answer:- b

26) Third normal form is based on the concept of -----.

a. Transitive Dependency
b. Closure Dependency
c. Normal Dependency
d. Functional Dependency

Answer: - a

27) What is the highest normal form a relation is in if every determinant is a candidate key?

a. First
b. Second
c. Third
d. BCNF

Answer: - d

28) A relation is in this form, if it is in BCNF and has no multi-value dependency.

a. Second
b. Third
c. Fourth
d. Domain normal form

Answer: - c

29) A partial Functional Dependency (FD) means that ----.

a. Some attributes of an entity are not known.
b. Not all attributes on right-hand side of FD are necessary.
c. No dependency exists in the entity.
d. Not all of the attributes on the left-hand side of FD are necessary.

Answer: - d

30) If a relation is in BCNF, then it is also in-----.

a. 1 NF
b. 2 NF
c. 3 NF
d. All of the above

Answer: - d

31) The database designer would like to avoid --------.

a. Lossless decomposition.
b. Lossy decomposition.
c. Any type decomposition.
d. None of Above

Answer:- b

Unit V ISE III Questions

Q1. A **transaction is ----------**

a. The collection of hardware that form a single logical unit of work
b. The collection of operations that form a single logical unit of work
c.All of above
d. None of Above

Answer b

The collection of operations that form a single logical unit of work

Q2 A database system must ensure proper execution of transactions despite failures **either ----------**

a) The entire transaction executes,
b) None of it does.
c) The entire transaction executes or none of it does
d) None of Above

Answer c

The entire transaction executes or none of it does

3 The "all-or-none" property is referred to as----------

a) Atomicity
b) Consistency
c) Isolation
d) Durability

Answer a

Atomicity

4 A transaction that completes its execution successfully is said to be --------

a) Committed.
b) Abort
c) Failure
d) None of above

Answer a
committed

Q 5 In State Transition Diagram of a transaction the initial state is ----------

a) Committed state
b) Active State
c) Abort
d) Failure

Answer b
Active state

Q6 Strict two-phase locking does not ensure----

A) Cascadelessness
b) Freedom from deadlock
c) Serializability
d) None of these

Ans: b

Q 7 When the transaction leaves the system, it enters into the ---------state

a) Terminated state
b) Active state
c) Committed State
d) None of above

Answer a
Terminated state

8 A variable associated with each data item that indicates whether a read or write operation can be applied to the data item is called as ----------

a) Timestamp
b) lock

c) Query
d) None of Above

Answe b
lock

Q9 Shared lock is also called as ----------

a) Read lock.
b) Write lock
c) Read and write lock
d) None of Above

Answer a
Read Lock

Q10. If a transaction T has acquired ------lock on data item D, no other transaction is allowed to access D until T releases its lock on D.

A) Shared
b) Random
c) Exclusive
d) All of the above

Ans: c

Q 11 In Growing phase of two-phase locking protocol ----------

a) A transaction may obtain locks, but may not release any lock
b) A transaction may release locks
c) All of above
d) None of Above

Answer a
transaction may obtain locks, but may not release any lock

12 Growing phase of two-phase locking protocol is called as ----------

a) Expanding phase
b) Shrinking phase
c) Expanding and Shrinking phase
d) None of Above

Answer a
Expanding phase

Q13 In strict two-phase locking protocol ----------

a) A transaction does not release any of its exclusive locks until it commits or aborts.
b) A transaction release any of its exclusive locks before commit
c) A transaction never release any of its exclusive locks
d) None of above

Answer A
transaction does not release any of its exclusive locks until it commits or aborts.

Q 14The timestamp-ordering protocol ensures that ----------

a) Any conflicting read and write operations are executed in any order.
b) Any conflicting read and write operations are executed in timestamp order
c) All of above
d) None of Above

Answer b
Any conflicting read and write operations are executed in timestamp order.

15An integral part of a database system is ----------

a) A Failure System
b) A recovery scheme
c) All of Above
d) None of Above

Answer b
recovery scheme

Q 16 For Transaction failure:- There are two types of errors that may cause a transaction to fail: ---------

a) Logical error and general error
b) System error and General error
c) Logical error and System error
d) None of Above

Answer c
Logical error and System error

Q17 Divide by zero is ----------

a) Logical error

b) System error
c) Both Logical error and System error
d) None of Above

Answer a
Logical error

Q18. All sites in a distributed database commit at exactly the same instant.

a) True

b) False

c) Neutral

d) None of these

Ans:- b

Q. 19 : Uniprocessor computing devices is called_____.

A. Grid computing
B. Centralized computing
c . Distributed computing
d. None of these

Ans:- b

Q 20 Any undesirable state of the system such as deadlock is ---------- error

a) Logical error
b) System error
c) Both Logical error and System error
d) None of Above

Answer b
System Error

Q21 The log-based recovery techniques are classified into two types

a) Deferred-modification technique an immediate -modification technique
b) Deferred-modification technique an interconnected -modification technique
c) All of Above
d) None of Above

Answer a

Deferred-modification technique an immediate -modification technique

Q 22In deferred-modification technique ----------

a) It records all update operations of the transactions in the log, but postpones the execution of all the update operations until the transaction enter into the committed state
b) It does not records all update operations of the transactions in the log,
c) It records all update operations of the transactions in the log, but preponds ones the execution of all the update operations until the transaction enter into the committed state
d) None of above

Answer a

It records all update operations of the transactions in the log, but postpones the execution of all the update operations until the transaction enter into the committed state

Q23 Deferred-modification technique is also called as----------

a) NO-UNDO/REDO technique
b) DO-UNDO/REDO technique
c) UNDO technique
d) REDO technique

Answer a

NO-UNDO/REDO technique

Q 24 ---------- are types of Parallel Database Architecture

a) Shared memory only
b) Shared memory, Shared disk
c) Shared memory, Shared disk, Shared nothing
d) Shared memory, Shared disk, Shared nothing , Hierarchical

Answer d
Shared memory, Shared disk, Shared nothing , Hierarchical

Q25 In a distributed database system, ----------

a. The database is stored on several computers.
b. The database is stored on local computer only
c. All of Above
d. None of Above

Answer a
The database is stored on several computers.

Q 26 A transaction that accesses data in the single site at which the transaction was initiated is called ---------

a) Local Transaction
b) Global Transaction
c) Local Transaction and Global Transaction
d) None of Above

Answer a
Local Transaction

Q 27 Transaction that either accesses data in a site different from the one at which the transaction was initiated or accesses data in several different sites is called as ----------.

a) Local Transaction
b) Global Transaction
c) Local Transaction and Global Transaction
d) None of Above

Answer b
Global Transaction

Q 28 Which of these terms is not included in DBMS recovery terminology?

A) Steal
b) No-force
c) Force
d) None of these
Ans: d

Q29 The important metric(s) for measuring the efficiency of a parallel database system is ------

A) Speedup
b) Scaleup
c) Both A and B
d) None of these

Ans: c

Q30 With regards to transaction processing, any DBMS should be capable of:

A) Ensuring that transactions are free from interference from other users.
B) Parts of a transaction are not lost due to a failure.
c) Transactions do not make the database inconsistent
d) All of the above.

Ans: d

Q. 31 :- :- Centralized database systems is ----------

a) Centralized database systems run on a single computer system and do not interact with other computer systems
b) Centralized database systems run on a multiple computer system
c) Centralized database systems run on a multiple computer system and interact with other computer systems
d) None of Above

Answer a

Q. 32 :- Which of the following is a type of environmental disaster ?

A) Earthquake b) Integer overflow
c) Logical error d) None of these

Ans: a

Q. 33 What is ACID properties of Transactions?

a) Atomicity, Consistency, Isolation, Database

b) Atomicity, Consistency, Isolation, Durability

c) Atomicity, Consistency, Inconsistent, Durability

` d) Automatically, Concurrency, Isolation, Durability

Ans: b

Q. 34 :- Data not found is ----------

a) Logical error
b) System error
c) Both Logical error and System error
d) None of Above

Answer Logical error

Q. 35 :- Resource limit exceeded is ----------

a) Logical error
b) System error
c) Both Logical error and System error
d) None of Above

Answer a
Logical error

Q. 36 :- W-timestamp(Q) denotes?
a) The largest timestamp of any transaction that can execute write(Q) successfully
b) The largest timestamp of any transaction that can execute read(Q) successfully
c) The smallest timestamp of any transaction that can execute write(Q) successfully
d) The smallest timestamp of any transaction that can execute read(Q) successfully
Answer: a
Explanation: W-timestamp(Q) denotes The largest timestamp of any transaction that can execute write(Q) successfully.

Q30 R-timestamp(Q) denotes?
a) The largest timestamp of any transaction that can execute write(Q) successfully
b) The largest timestamp of any transaction that can execute read(Q) successfully
c) The smallest timestamp of any transaction that can execute write(Q) successfully

d) The smallest timestamp of any transaction that can execute read(Q) successfully

Answer: b