1. In the instance of the relation R(A,B,C,D,E) shown below, which of the following functional dependencies hold ?

A	B	C	D	E
1	5	3	8	5
1	4	3	8	5
1	5	4	8	1

I. $AB \rightarrow C$ II. $B \rightarrow D$ III. $DE \rightarrow A$

a. I only
b. II only
c. I and III only
d. II and III only
Ans: d

2. The following questions refer to the relation T(A,B,C,D,E) with the following FD's:

$A \rightarrow BC$, $CD \rightarrow E$, $\boldsymbol{\sigma} \rightarrow D$

The value of $\boldsymbol{\sigma}$ is not known and it should be any non-empty subset of T ' s attributes. $\boldsymbol{\sigma}$ may even contain D itself, which would make $\boldsymbol{\sigma} \rightarrow D$ a trivial dependency. Which of the following must be true regardless of what is inside $\boldsymbol{\sigma}$?

I. If some key T contains E, then some other key must contain D
II. If some key T contains D, then some other key must contain E
a. I only
b. II only
c. Both I and II
d. Neither I nor II
Ans: a

3. Consider the relation schema T = PQRS and the following functional dependencies on T
P ->QRS
Q->R
RS->P
I. T is not in BCNF, but it is in 3NF
II. The decomposition of T into T1 = PQR into T2 = QRS is lossless
III. The decomposition of T into T1 = PQS into T2 = QR is lossless
IV. The decomposition of T into T1 = PQS into T2 = QR is dependency preserving

a. I and II is true

b. I and III is true
c. I and IV is true
d. I, II and III is true
Ans: b

4. The following table satisfies

order_no	cat_no	dept	sales_person	quant	cust_no	cust_name
222-1	1234 3456	hardware	John Wilson	2 2	3333	Joe Smith
444-2	4567	lumber	Tim Gramm	2	4444	Sue Taylor
555-1	5678 6789	garden	David Simon	3 1	3333	Joe Smith
777-2	4567	lumber	Tim Gramm	2	7777	Bob Sponge
888-3	1234	hardware	Ben Sherman	1	4444	Sue Taylor

I. BCNF
II. Second Normal Form
III. First Normal Form
a. I only
b. II only
c. III only
d. None of the above
Ans: d

5. Let A be the set of all attributes in a relation R. Then a set S ⊆ A is a ---------- of R if S → A.
a. Candidate Key
b. Primary Key
c. Super Key
d. Foreign Key
Ans: c

6. Consider the following relation scheme for compact discs
CD (Company, Date, CatalogNum, Composer, Track, Group, Artist, Title, Instrument, Duration) together with the following functional dependencies:
{Artist} -> {Instrument, Group}
{Composer, Title, Company} -> {CatalogNum, Track, Duration}
{CatalogNum} -> {Company, Date}
{CatalogNum, Title} -> {Composer}

Calculate the closure of the attribute set {CatalogNum, Title} with respect to the given functional dependencies.
a. {CatalogNum, Title, Composer, Company, Date}
b. {CatalogNum, Title, Composer, Company, Date, Track, Duration}
c. {CatalogNum, Title, Composer, Company, Date, Instrument}
d. {CatalogNum, Title, Composer, Company, Date, Artist, Instrument, Group}
Ans: b

7. Given the following relation and dependences, state which normal form the relation is in. R (a, b, c, d, e)
   a, b -> c, d, e
   c, d-> a, b, e
   e -> d
   a. 1NF b. 2NF c. 3NF d. BCNF
      Ans: c

8. Which of the following is the highest normal form by which the R relation can be classified?
   R (patient, physician, hospital, address, date, time)
   Given
   patient, physician -> hospital, address, date, time
   hospital -> address
   a. 1NF b. 2NF c. BCNF d. 3NF
      Ans: b

9. Find a minimal cover for the following set of functional dependencies F for the Relation R = (A, B, C, D, E, F)

   F = {A → C
   AC → D
   E → AD
   E → F}

   a. F = {A → CD, E → AF}
   b. F = {A→ C, C→ D, E → AF}
   c. F = {A→ CD, E → AD}
   d. F = {A→ CD, E → AF}
      Ans: a

10. Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values. F = {CH -> G, A -> BC, B -> CFH, E -> A, F -> EG} is a set of functional dependencies (FDs) so that F+ is exactly the set of FDs that hold for R.

    How many candidate keys does the relation R have?

    a. 3
    b. 4
    c. 5
    d. 6
       Ans: b

11. Armstrong's inference rule does not determine
    a. Mutual dependency: If X → Y and Y → X, then X → Y
    b. Transitivity: If X → Y and Y → Z, then X → Z
    c. Reflexivity: If Y ⊆ X then, X → Y. Such FDs are called trivial FDs

d. Augmentation: If X → Y, then XZ → Y Z.

Ans:c

12. Consider the following relational schema:

Suppliers(sid:integer, sname:string, city:string, street:string)
Parts(pid:integer, pname:string, color:string)
Catalog(sid:integer, pid:integer, cost:real)

Assume that, in the suppliers relation above, each supplier and each street within a city has a unique name, and (sname, city) forms a candidate key. No other functional dependencies are implied other than those implied by primary and candidate keys. Which one of the following is TRUE about the above schema?

A. The schema is in BCNF

B. The schema is in 3NF but not in BCNF

C. The schema is in 2NF but not in 3NF

D. The schema is not in 2NF

Ans.A

13. Consider the following table : Faculty (facName, dept, office, rank, dateHired)

FACNAME	DEPT	OFFICE	RANK	DATEHIRED
Ravi	Art	A101	Professor	1975
Murali	Math	M201	Assistant	2000
Narayanan	Art	A101	Associate	1992
Lakshmi	Math	M201	Professor	1982
Mohan	CSC	C101	Professor	1980
Lakshmi	Math	M201	Professor	1982
Sreeni	Math	M203	Associate	1990
Tanuja	CSC	C101	Instructor	2001
Ganesh	CSC	C105	Associate	1995

(Assume that no faculty member within a single department has same name. Each faculty member has only one office identified in *office*). 3NF refers to third normal form and BCNF refers to Boyee-Codd Normal Form Then Faculty is

a. Not in 3NF, in BCNF
b. In 3NF, not in BCNF
c. In 3NF, in BCNF
d. Not in 3NF, not in BCNF
Ans: b

14. The shared lock (or read lock) can be held by several transactions, while an exclusive lock (or write lock) can be held by only one transaction.

• System 1 uses exclusive and shared locks.
• System 2 uses only exclusive locks.
Indicate which statements is false

a. If all transactions are read-only, then on system 1 no transaction ever waits.
b. System 1 may be able to execute more transactions per second than system 2.
c. If all transactions are write-only, then on system 2 no transaction ever waits.
d. There exists schedules that result in a deadlock on system 1 but not in a deadlock on system 2

Ans: c

15. Consider the following transaction schedules. For each schedule, indicate if it is conflict-serializable or not.

I. R1(A), W1(A), R2(B), W2(B), R3(C), W3(C), R2(C), W2(C), R1(B), W1(B)
II. R1(A), R1(B), W1(A), R2(B), W2(D), R3(C), R3(B), R3(D), W2(B), W1(C), W3(D)
III. R1(A),R2(B),R3(C),W1(C),W2(A),W3(B)
IV. R1(A), R1(B), W1(A), R2(B), W2(A), R3(C), R3(B), R3(D), W2(B), W1(C), W3(D)

a. I, II, III are conflict-serializable
b. II, III and IV are conflict serializable
c. I, II, IV are conflict-serializable
d. All are serializable

Ans: c

16. A scheduler uses the strict two-phase locking protocol. In each of the cases below, indicate whether the scheduler may result in a deadlock.

Transaction I	**Transaction II**
T1: W1(A), W1(C), CO1	T1: W1(A), W1(C), CO1
T2: W2(B), W2(D), CO2	T2: W2(B), W2(D), CO2
T3: W3(A), W3(B), CO3	T3: W3(A), W3(B), CO3
T4: W4(B), W4(C), CO4	T4: W4(D), W4(A), CO4
T5: W5(C), W5(D), CO5	

a. Both Transaction I and II, are deadlocked
b. Both Transaction I and II, are not deadlocked
c. Transaction I is deadlocked and Transaction II is not deadlocked
d. Transaction I is not deadlocked and Transaction II is deadlocked

Ans: d

17. At initially the variable X = 500 and there exists two transaction T1 and T2. Transaction T1 wants to update the value of X by adding 10 similarly T2 requires to print the value of X by reducing it 50 %. The constraints of the aforementioned transaction is serializable and isolated. Identify the appropriate schedule to achieve this condition.

    a. R1(X), W1(X), R2(X), W2(X)

    b. R1(X), W1(X), W2(X),R2(X)
    c. R1(X), R2(X), W1(X), W2(X)
    d. None of the above

    Ans: c

18. Consider the following transactions which are executed concurrently:

T_3	T_4
lock-X(B);	lock-S(A);
read (B);	read (A);
B:=B-50;	lock-S(B);
write(B);	read (B);
lock-X(A);	display(A+B)
read (A);	unlock(A);
A:=A+50;	unlock(B);
write(A);	
unlock(B);	
unlock(A);	

The concurrent schedule is

a. Conflict serializable
b. Recoverable
c. Cascadeless
d. None of the above

Ans: A

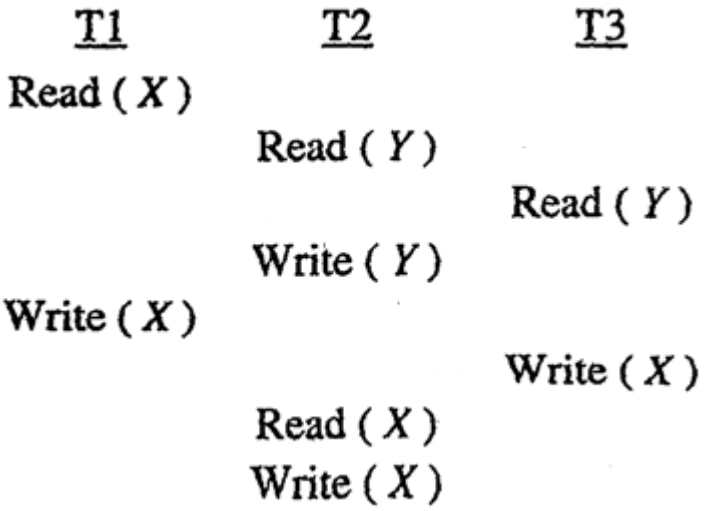
19. The following schedule satisfies:

T_{14}	T_{15}
read (B)	
	read (B)
	$B := B - 50$
	write (B)
read (A)	
	read (A)
display $(A + B)$	
	$A := A + 50$
	write (A)
	display $(A + B)$

a. **Two Phase locking protocol**
b. **Cascadeless schedule**
c. **Recoverable schedule**
d. **Time stamp ordering**

Ans: d

20. Consider the following schedule:



Which is the correct conflict serializability order?

a. **T1, T2, T3**
b. **T1, T3, T2**
c. **T2, T3, T1**
d. **T3, T2, T1**

Ans: B

21. Consider the following schedules:
S: R2(X), W3(X), T3 Commit; W1(X), T1 Commit, W2(Y), R2(Z),T2 Commit, R4(X), R4(Y), T4 Commit.

Which one of the following statements is CORRECT?

(A) S is conflict-serializable but not recoverable
(B) S is not conflict-serializable but is recoverable
(C) S is both conflict-serializable and recoverable
(D) S is neither conflict-serializable nor is it recoverable

Ans: C

22. Consider the following log sequence of two transactions on a bank account, with initial balance 12000, that transfer 2000 to a mortgage payment and then apply a 5% interest.

```
1. T1 start
2. T1 B old=12000 new=10000
3. T1 M old=0 new=2000
4. T1 commit
5. T2 start
6. T2 B old=10000 new=10500
7. T2 commit
```

Suppose the database system crashes just before log record 7 is written. When the system is restarted, which one statement is true of the recovery procedure?

A. We must redo log record 6 to set B to 10500
B. We must undo log record 6 to set B to 10000 and then redo log records 2 and 3.
C. We need not redo log records 2 and 3 because transaction T1 has committed.
D. We can apply redo and undo operations in arbitrary order because they are idempotent

Ans: B

23. Consider a simple checkpointing protocol and the following set of operations in the log.

```
(start, T8); (write, T8, y, 2, 3); (start, T5); (commit, T8);
(write, T5, z, 5, 7);(checkpoint);
(start, T6); (write, T6, x, 1, 9); (commit, T6); (start, T7);
(write, T7, z, 7, 2);
```

If a crash happens now and the system tries to recover using both undo and redo operations, what are the contents of the undo list and the redo list.

a. Undo: T7, T5; Redo: T6, T8
b. Undo: none; Redo: T5, T6, T7; T8
c. Undo: T7, T5; Redo: T6
d. Undo: T7, T5, T8; Redo: T6

Ans: c

24. Consider the following partial Schedule:

Time	Transaction-id	
	$T1$	$T2$
1	$read(A)$	
2	$write(A)$	
3		$read(C)$
4		$write(C)$
5		$read(B)$
6		$write(B)$
7		$read(A)$
8		$commit$
9	$read(B)$	

Suppose that the transaction T1 fails immediately after time instance 9. Which one of the following statements is correct?

(A) T2 must be aborted and then both T1 and T2 must be re-started to ensure transaction atomicity
(B) Schedule S is non-recoverable and cannot ensure transaction atomicity
(C) Only T2 must be aborted and then re-started to ensure transaction atomicity
(D) Schedule S is recoverable and can ensure atomicity and nothing else needs to be done
Ans: (B)

25. Assume that Ti requests a lock held by Tj. The following table summarizes the actions taken for wait-die and wound-wait scheme:

	Wait – die scheme	Wound – wait scheme
Ti is younger than Tj	W	X
Ti is older than Tj	Y	Z

Fill correct status of Ti and Tj at W, X, Y, and Z respectively.

a. Ti dies, Ti waits, Ti waits, and Tj aborts respectively.
b. Ti dies, Ti waits, Ti waits, and Tj aborts respectively.
c. Ti waits, Ti dies, Ti waits, and Tj aborts respectively.
d. None of these

Ans: B