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1. T1 and T2 are 2 concurrent transactions, both active at time t . Choose the correct answer(s):
- a. The following execution describes a *write read* conflict: At time t , T2 is reading a data object previously written by T1.
 - b. The following execution describes a *write read* conflict: At time t , T2 is writing a data object previously read by T1.
 - c. The following execution describes a *read write* conflict: At time t , T2 is reading a data object previously written by T1.
 - d. The following execution describes a *read write* conflict: At time t , T2 is writing a data object previously read by T1.
 - e. none of the above answers is correct.

2. A schedule S:

- a. is conflict serializable if and only if its precedence graph has exactly one cycle.
- b. is conflict serializable if and only if its precedence graph is acyclic.
- c. is conflict serializable if and only if its precedence graph has exactly two cycles.
- d. is conflict serializable if and only if its precedence graph has exactly three cycles.
- e. none of the above answers is correct.

3. In SQL Server, under the READ UNCOMMITTED isolation level:
- a. S locks must be acquired to perform read operations.
 - b. read operations are performed without acquiring S locks.
 - c. X locks must be acquired to perform write operations.
 - d. write operations are performed without acquiring X locks.
 - e. none of the above answers is correct.

4. In horizontal fragmentation:

- a. the reconstruction operator is the natural join.
- b. the union of the horizontal fragments must be equal to the original relation.
- c. fragmentation is performed with projection operators.
- d. fragmentation is performed with selection predicates.
- e. none of the above answers is correct.

5. I is an index with search key $\langle C1, C2, C3, C4 \rangle$.

a. If I is a hash index, I matches condition $C1 > 10 \text{ AND } C2 > 7$.

b. If I is a hash index, I matches condition $C1 = 10 \text{ AND } C2 = 7 \text{ AND } C3 = 1 \text{ AND } C4 = 5$.

c. If I is a B+ tree index, I matches condition $C1 = 10 \text{ AND } C2 = 7$.

d. If I is a B+ tree index, I matches condition $C2 = 7 \text{ AND } C3 = 9$.

e. none of the above answers is correct.

6. Let R be a relation with P pages. The cost of sorting R using *simple two-way merge sort* (i.e., with 3 pages in the buffer pool) is:

- a. π^P
- b. $2P(\lceil \log_4 P \rceil + 1)$
- c. $2P(\lceil \log_2 P \rceil + 1)$
- d. $2P(\lceil \log_3 P \rceil + 1)$
- e. none of the above answers is correct.

7. Consider the query:

SELECT *

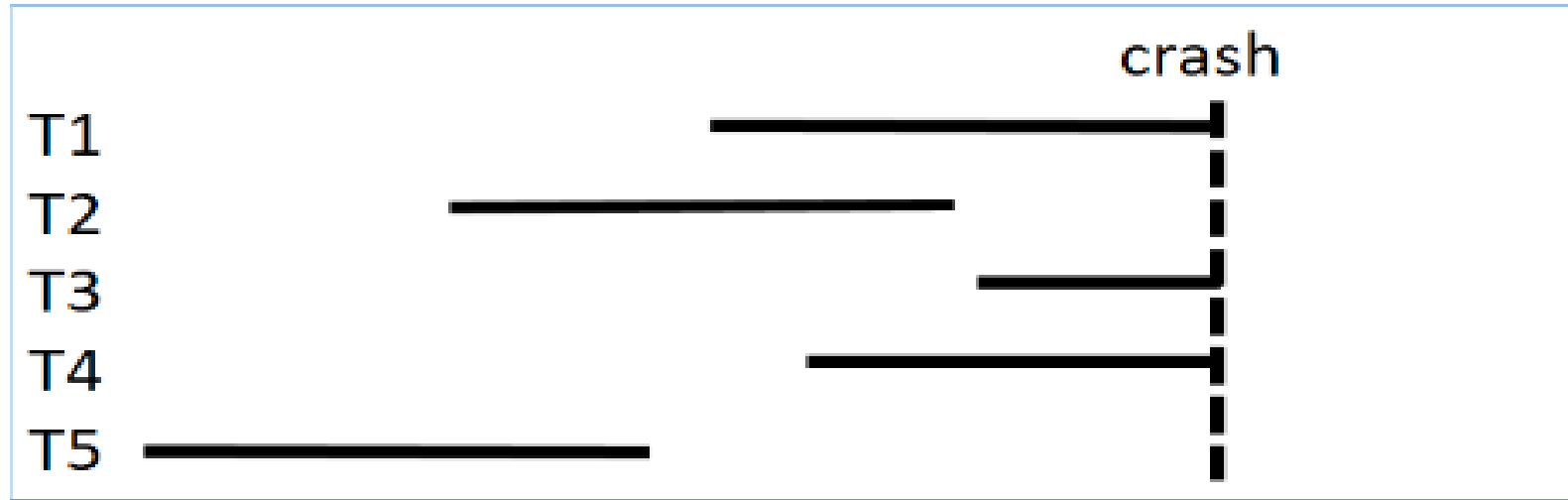
FROM R1, R2, R3

WHERE p1 AND p2 AND p3

The conditions tested by the predicates in the WHERE clause are statistically independent. The cardinality of a relation R is denoted by $|R|$. The reduction factor associated with predicate p is denoted by $RF(p)$. The cardinality of the query's result set can be estimated by:

- a. $\frac{|R1| * |R2| * |R3|}{RF(p1) + RF(p2) + RF(p3)}$
- b. $|R1| * |R2| * |R3| * RF(p1) * RF(p2) * RF(p3)$
- c. $RF(p1) * RF(p2) * RF(p3) - (|R1| + |R2| + |R3|)$
- d. $|R1| + |R2| + |R3| + RF(p1) + RF(p2) + RF(p3)$
- e. none of the above answers is correct.

8. Consider the execution below. When the system comes back up after the crash, it must ensure that:



- a. T1, T3, T4 are durable; T2 and T5 are undone.
- b. T1, T3, T4 are undone; T2 and T5 are durable.
- c. T1 is undone only if T2 and T4 are also undone.
- d. T2 is durable only if T5 is undone.
- e. none of the above answers is correct.

9. In data replication:

- a. *primary site replication* is an asynchronous replication technique.
- b. *primary site replication* is a synchronous replication technique.
- c. *read-any write-all* is a synchronous replication technique.
- d. *read-any write-all* is an asynchronous replication technique.
- e. none of the above answers is correct.

10. A database access request contains:
- a. the requesting user.
 - b. the criminal record of the requesting user.
 - c. the operation the user wants to perform.
 - d. the requested object.
 - e. none of the above answers is correct.

11. Consider schedule S below over transactions T1, T2, T3, T4 (all transactions commit):

T1	T2	T3	T4
W(A)			
			R(C)
	R(B)		
		W(D)	
	R(A)		
R(D)			
			W(B)
R(C)			

- a. S is conflict serializable.
- b. S is not conflict serializable.
- c. (R(T4, C), R(T1, C)) belongs to the conflict relation of S.
- d. (W(T1, A), R(T2, A)) belongs to the conflict relation of S.
- e. none of the above answers is correct.