TRUE OR FALSE

1. Write Ahead Logging describes a protocol where updated pages must be written to disk before a crash
    a. FALSE
2. During a transaction abort, we redo all updates made by the transaction
    a. FALSE
3. When undoing updates of a transaction, CLR record is logged to describe the undoing of a posterior update.
    a. FALSE
4. In ARIES, UPDATE log records contain the information of the previous state of the page
    a. TRUE
5. The recovery manager is responsible for Atomicity and Durability, as defined by the ACID acronym.
    a. TRUE

FORCE and STEAL

We run two transactions, T1 and T2. The transaction table and the dirty page table at the time of the checkpoint are both empty. We know that the system uses page-level locks. We access some system metadata and observe the following:

- On disk, P1 has a pageLSN of 40.
- On disk, P2 has a pageLSN of 50.
- On disk, P3 has a pageLSN of 30.

We also find the following log:

LSN	**Record**
0	BEGIN_CHECKPOINT
10	END_CHECKPOINT
20	UPDATE: T1 writes P2
30	UPDATE: T1 writes P3
40	UPDATE: T2 writes P1
50	UPDATE: T2 writes P2
60	COMMIT: T1
70	COMMIT: T2

1. The system might be use two-phase locking.
a. True
b. False
c. Not enough information
a. At LSN 20, T1 writes an UPDATE log record with P2. Then, T2 writes an UPDATE log record with P2 before T1 writes a COMMIT log record. So, the system cannot be using strict 2PL.

2. The system uses a FORCE policy.
a. True
b. False
c. Not enough information
c. In this particular case, T1 forces P3 to disk before committing, and T2 forces P1 and P2 to disk before committing. We do not know exactly when T2 forces P2 to disk, nor any of the other updates. Given this information, we see that the system could be using a FORCE policy, but we

cannot be certain (it's possible that the writes happened before the commit log record just by good luck).

3. The system doesn't use a STEAL policy.

a. True
b. False
c. Not enough information

c. Not enough information. The pageLSN indicate the last update pushed to disk, but we do not know if the updates were written to disk before or after the commits.

4. The system doesn't use the ARIES recovery algorithm.

a. True
b. False
a. True, because the ARIES we covered uses strict 2PL, and this system does not use strict 2PL, so this system cannot be using ARIES.

Recovery

Consider the following log. Some of the records have been omitted. The system crashes immediately after LSN 100 and begins recovery. During analysis, we recreate the transaction table and dirty page table shown below.

LSN	**Record**
0	BEGIN_CHECKPOINT
10	END_CHECKPOINT
20	UPDATE: T1 writes P1
30	UPDATE: T1 writes P3
40	UPDATE: T2 writes P2
50	ABORT: T1
60	???
70	???
80	END: T1
90	UPDATE: T2 writes P1
100	COMMIT: T2

Transaction Table			**Dirty Page Table**	
Transaction	**lastLSN**	**Status**	**PageID**	**recLSN**
T2	100	Committing	P1	20
			P2	40
			P3	30

5. Which of the following sequences of missing log records (??? in the image above) is correct?

a.

LSN	Record
60	CLR: T1 LSN 50
70	CLR: T1 LSN 30

b.

LSN	Record
60	CLR: T1 LSN 50
70	CLR: T1 LSN 20

c.

LSN	Record
60	CLR: T1 LSN 30
70	CLR: T1 LSN 20

d.

LSN	Record
60	CLR: T1 LSN 20
70	CLR: T1 LSN 30

c. When we abort a transaction, we perform CLR’s in reverse order.

6. Which of the following sequences of actions will occur during the REDO phase? "Orig LSN" denotes the LSN of the original action in the log above, to improve readability. (??? indicates your answer to 5.)

a.

Orig LSN	Record
20	UPDATE: T1 writes P1
30	UPDATE: T1 writes P3
40	UPDATE: T2 writes P2
60	???
70	???
90	UPDATE: T2 writes P1

b.

Orig LSN	Record
20	UPDATE: T1 writes P1
30	UPDATE: T1 writes P3
40	UPDATE: T2 writes P2

c.

Orig LSN	Record
20	UPDATE: T1 writes P1
30	UPDATE: T1 writes P3
40	UPDATE: T2 writes P2
60	???
70	???

d.

Orig LSN	Record
20	UPDATE: T1 writes P1
30	UPDATE: T1 writes P3
40	UPDATE: T2 writes P2
90	UPDATE: T2 writes P1

a. We start redoing actions from the first recLSN in the dirty page table (20). We need to redo all UPDATE log records and CLR log records whose pages are in the dirty page table with recLSN <= LSN.

7. Which of the following sequences of log records will be written during the UNDO phase?

a.

LSN	Record
200	CLR: T2 LSN 100
210	CLR: T2 LSN 30
220	END: T2

b.

LSN	Record
No logs written during UNDO	

c.

LSN	Record
200	CLR: T2 LSN 110
210	CLR: T2 LSN 100
220	CLR: T1 LSN 50
230	CLR: T1 LSN 40
240	CLR: T2 LSN 30
250	END: T2
260	CLR: T1 LSN 20
270	END: T1

d.

LSN	Record
200	CLR: T2 LSN 110
210	CLR: T2 LSN 100
220	CLR: T2 LSN 30
230	END: T2

b. This is a trick question! Since we log a END: T2 during the REDO phase of the previous problem, we actually have no active transactions that we need to UNDO. In this particular case, no log records are written during UNDO!