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 undo all updates made by the transaction
    a. TRUE
3. When undoing updates of a transaction, CLR record is logged to describe the undoing of a prior update.
    a. TRUE
4. In ARIES, UPDATE log records contain no information of the previous state of the page
    a. FALSE
5. The recovery manager is responsible for Atomicity and Consistency, as defined by the ACID acronym.
    a. FALSE

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 uses strict two-phase locking.

a. True
b. False
c. Not enough information

b. 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 uses 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 might be using the ARIES recovery algorithm.

a. True
b. False

b. False, 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 110 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: T2 writes P2
40	UPDATE: T1 writes P3
50	ABORT: T1
60	???
70	???
80	???
90	END: T1
100	UPDATE: T2 writes P1
110	COMMIT: T2

Transaction Table			**Dirty Page Table**	
Transaction	**lastLSN**	**Status**	**PageID**	**recLSN**
T2	110	Committing	P1	20
			P2	30
			P3	40

5. Which of the following sequences of missing log records (??? in the image above) is correct? You do not need to fill in all of the missing LSN's above.

a.

LSN	**Record**
60	CLR: T1 LSN 20

b.

LSN	**Record**
60	CLR: T1 LSN 50

70	CLR: T1 LSN 40
80	CLR: T1 LSN 50

70	CLR: T1 LSN 40
80	CLR: T1 LSN 20

c.

LSN	Record
60	CLR: T1 LSN 20
70	CLR: T1 LSN 40

d.

LSN	Record
60	CLR: T1 LSN 40
70	CLR: T1 LSN 20

d. When we abort a transaction, we perform CLR's in reverse order, ruling out a and c. Each CLR undoes an update, so there is no CLR for LSN 50, ruling out b.

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: T2 writes P2
40	UPDATE: T1 writes P3
100	UPDATE: T2 writes P1

b.

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

c.

Orig LSN	Record
20	UPDATE: T1 writes P1
30	UPDATE: T2 writes P2
40	UPDATE: T1 writes P3
60	???
70	???
80	???
100	UPDATE: T2 writes P1

d.

Orig LSN	Record
20	UPDATE: T1 writes P1
30	UPDATE: T2 writes P2
40	UPDATE: T1 writes P3
60	???
70	???
80	???

c. 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. We can rule out a and b because they are missing the CLR log records from Q4

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

a.

LSN	Record
200	CLR: T2 LSN 100

b.

LSN	Record
200	CLR: T2 LSN 110

210	CLR: T2 LSN 30
220	END: T2

210	CLR: T2 LSN 100
220	CLR: T2 LSN 30
230	END: T2

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**
No logs written during UNDO	

d. 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!