Solution

1.

a) No. Uncommitted data is never written to disk.
b) Yes. Some committed data might have not been written to disk yet.
c) Yes. Some uncommitted might have been written to disk.
d) Yes. We need to repeat history, including looser transactions, before starting the UNDO phase.
e) Begin_checkpoint of the most recent checkpoint
f) Smallest recLSN in dirty page table at the end of Analysis
g) Oldest log record of transactions active at crash

2.

a) Analysis determines that the last begin_checkpoint was at LSN 00 and starts at the corresponding end_checkpoint (LSN 10). Transaction Table records are denoted as (transID, lastLSN, status) and Dirty Page Table records are denoted as (pageID, recLSN) sets.
Analysis phase runs till LSN 70 and does the following:

LSN 20	Adds (T1, 20, U) to TT and (P5, 20) to DPT
LSN 30	Adds (T2, 30, U) to TT and (P3,30) to DPT
LSN 40	Changes (T2, 30, U) to (T2, 40, C)
LSN 50	Deletes entry for T2 from Transaction Table
LSN 60	Adds (T3, 60, U) to TT. Does not change P3 entry in DPT
LSN 70	Adds (P2, 70) to DPT and Changes (T1, 20, U) to (T1, 70, U)
LSN 80	Changes (T1, 70, U) to (T1, 80, A)

The final Transaction Table has two entries: (T1, 80, A), and (T3, 60, U).
The final Dirty Page Table has three entries (P5,20), (P3,30), and (P2, 70).

b)

LSN 20	P5 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (i.e. if pageLSN >= 20), nothing is redone otherwise the changes are redone.
LSN 30	P3 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (i.e. if pageLSN >= 30), nothing is redone otherwise the changes are redone.
LSN 40	No action
LSN 50	No action
LSN 60	P3 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (i.e. if pageLSN >= 60), nothing is redone otherwise the changes are redone.
LSN 70	P2 is retrieved and its pageLSN is checked. If the page had been written to disk before the crash (i.e. if pageLSN >= 70), nothing is redone otherwise the changes are redone.
LSN 80	No action

c) UNDO phase starts at LSN 80 (highest lastLSN in TT). The Loser Set consists of LSNs 80 and 60.

LSN 80 Removes 80 from the Loser Set. Adds LSN 70 to the Loser Set. Loser Set = (70, 60).
LSN 70 Removes 70 from the Loser Set. Undoes the change on P2 and adds a CLR indicating this Undo (LSN 90, undoNextLSN = 20). Loser Set = (60, 20).
LSN 60 Undoes the change on P3 and adds a CLR indicating this Undo (LSN 100, undoNextLSN = null). Loser Set = (20).
LSN 20 Undoes the change on P5 and adds a CLR indicating this Undo (LSN 110, undoNextLSN = null).

3.
3.1

a) Log records {10, 20, 30, 40, 50, 60, 70, 80} **OR**
"records from last complete checkpoint to crash"
b) DPT: { (P1, 10), (P3, 20), (P4, 40), (P2, 50) }
TT: { (T1, 10, U), (T3, 70, U) } **OR**
{ (T1, 30, U), (T3, 70, U) } **OR**
{ (T1, 30, A), (T3, 70, U) }

3.2
a) Log records {10, 20, 30, 40, 50, 60, 70, 80} OR
"records from the earliest recLSN in the DPT"
b) Pages {P1, P3, P4, P2}
c) LSNs {10, 20, 40, 50, 70} are repeated
d) no log records are recorded

3.3
a) Log records {70, 40, 30, 10}
[note, 30 is optional only if TT listed 10 as prevLSN for T1]
b) LSNs {70, 40, 10} are undone
c) LSN 90, Undo LSN 70, undoNextLSN=40
LSN 100, Undo LSN 40, undoNextLSN=null, T3 end
LSN 110, Undo LSN 10, undoNextLSN=null, T1 end
[note, the end log records can recorded with separate LSNs]