Problem 1

Consider a database with the following initial values, and the attached command log:

\[ A = 50, B = 48, C = 0, D = 47 \]

LOG:

\[ \langle T_0, \text{start} \rangle \]
\[ \langle T_0, A, 50, 75 \rangle \]
\[ \langle T_0, A, 75, 100 \rangle \]
\[ \langle T_0, \text{commit} \rangle \]
\[ \langle T_1, \text{start} \rangle \]
\[ \langle T_1, B, 48, 92 \rangle \]

BREAK A
\[ \langle T_1, B, 92, 108 \rangle \]
\[ \langle T_1, \text{commit} \rangle \]
\[ \langle T_2, \text{start} \rangle \]
\[ \langle T_2, C, 0, 33 \rangle \]

BREAK B
\[ \langle T_2, \text{commit} \rangle \]
\[ \langle T_3, \text{start} \rangle \]
\[ \langle T_3, D, 47, 52 \rangle \]
\[ \langle T_3, D, 52, 78 \rangle \]

BREAK C
\[ \langle T_3, D, 78, 103 \rangle \]
\[ \langle T_3, \text{commit} \rangle \]

Assume that the system crashes at the designated break points, before the remaining transactions can commit. Use the recovery protocol for sequentia; transactions to answer the following questions for each break point.

1. List any transactions that will need to be undone or redone for BREAK A.
   List, in order, the set of logged operations to be performed to undo or redo the transactions. (i.e. "Set A to 7", "Set B to 39", etc.)

   Answer:
   REDO: \( T_0 \), SET A to 75, Set A to 100
   UNDO: \( T_1 \), set B to 48

2. List any transactions that will need to be undone or redone for BREAK B.
   List, in order, the set of logged operations to be performed to undo or redo the transactions. (i.e. "Set A to 7", "Set B to 39", etc.)
3. List any transactions that will need to be undone or redone for BREAK C.
   List, in order, the set of logged operations to be performed to undo or redo the transactions. (i.e. "Set A to 7", "Set B to 39", etc.)

Answer:
REDO: $T_0$, SET A to 75, Set A to 100; $T_1$, set B to 92, set B to 108
UNDO: $T_2$, set C to 0

REDO: $T_0$, SET A to 75, Set A to 100; $T_1$, set B to 92, set B to 108; $T_2$, set C to 33
UNDO: $T_3$, set D to 52, set D to 47