**Acceptable States of Database and Log**

Consider a transaction T that performs the following two actions:

\[
\begin{align*}
A &= A + 5 \\
B &= B + 5
\end{align*}
\]

**UNDO Logging**

Assume that UNDO logging is in use and initially A=5 and B=5. For each hypothetical disk state below, state whether it is a possible (legal) state for UNDO logging. If it is not, explain why not.

1. DB(A:5, B:5), LOG(<T,start>)
   - where the notation means that the persistent part of the DB has the value 5 in A and 5 in B.
2. DB(A:10, B:5), LOG(<T,start>)
3. DB(A:10, B:5), LOG(<T,start>, <T,A,5>, <T,B,5>, <T,commit>)
4. DB(A:5, B:10), LOG(<T,start>, <T,A,5>, <T,B,5>)

**REDO Logging**

Assume that REDO logging is in use and initially A=5 and B=5. For each hypothetical disk state below, state whether it is a possible (legal) state for UNDO logging. If it is not, explain why not.

1. DB(A:10, B:5), LOG(<T,start>, <T, A, 10>)
2. DB(A:10, B:5), LOG(<T,start>, <T, A, 10>, <T, B, 10>)
3. DB(A:10, B:5), LOG(<T,start>, <T, A, 10>, <T, B, 10>, <T, commit>)

**UNDO/REDO Logging**

Assume that UNDO/REDO logging is in use and initially A=5 and B=5. For each hypothetical disk state below, state whether it is a possible (legal) state for UNDO/REDO logging. If it is not, explain why not.

1. DB(A:10, B:5), LOG(<T,start>, <T, A, 5>)
2. DB(A:10, B:5), LOG(<T,start>)
3. DB(A:5, B:10), LOG(<T,start>, <T, A, 5>, <T, B, 5>, <T, commit>)
4. DB(A:5, B:10), LOG(<T,start>, <T, A, 5>, <T, B, 5>, <T, commit>)

**Recovery**

A system reboots after a crash and finds the following database and UNDO log state:

DB(A:10, B:10)
LOG(<T1,start>, <T2,start>, <T1, A, 5>, <T1, commit>, <T2, B, 5>, <T2, A, 15>
CRASH)

1. What was the initial state of the system before T1 and T2 began executing?
2. What will be the state after the recovery?
3. Repeat questions (1) and (2) assuming it is a REDO log.