19.2 ① checkpointing is done with log-based recovery schemes to redue the time required for recovery after a crash.

② checkpoints should be reduced if fast recovery is not critical

③ checkpoints don't affect on recovery from a disk crash:
archival dumps are the equivalent of checkpoints for recovery from disk crashes.

19.10 Because some actions may be irrevocable. For an output statement money to a customer. The best way to deal with this is to try to do all output statements at the end of the transaction.

19.21

redo-phase:

undo-List = $T_0$, $T_1$

perform redo

C = 600

$T_1$ is removed from Undo-List

$T_2$ is added to undo-List

A = 400

B = 2000

undo-phase:

Undo-List = $T_0$, $T_2$

Scan the log backwards

A = 500, output <$T_2$, A, 500>

output <$T_2$ abort>

B = 2000; output <$T_0$, B, 2000>

output <$T_0$ abort>

end: A = 500, B = 2000, C = 600

log <$T_2$, A, 500> <$T_2$ abort> <$T_0$, B, 2000> <$T_0$ abort>

19.23 There is no checkpoint in the log. so recovery starts from the beginning of the log, and replays each action that is found in the log. The redo phase would add the following log records

<$T_0$, B, 2050>

<$T_0$, C, 600>

<$T_0$, C, 400>

<$T_0$, C, 500>

At the end of redo phase, the following events happen:

<$T_0$, C, 400>

<$T_1$, C, 600>

<$T_1$, $O_2$, operation_abort

<$T_1$, abort>

<$T_0$, C, 700>

<$T_0$, $O_1$, operation_abort>

<$T_0$, B, 2000>

<$T_0$, abort>

so finally the values of data items B and C would be 2000, and 700.

19.25 a. Redo records prior to the checkpoint record need not be applied to it as it means the page has been flushed to disk and been removed from the DirtyPageTable before the checkpoint. However, the page may have been updated after the checkpoint, which means it will appear in the dirty page table at the end of the analysis pass.

b. The RecLSN is an entry in the DirtyPageTable, which reflects the LSN at the end of the log when the page was added to DirtyPageTable. During the redo pass of the ARIES algorithm, if the LSN of the update log record encountered is less than the RecLSN of the page in Dirty-PageTable, the that record is not redone but skipped.