1) The system has crashed, and the content of the undo log is the following. Show what actions the recovery manager takes during recovery.

<START T1>
<T1, A, a>
<T1, B, b>
<START T2>
<T2 C, c>
<START T3>
<T3 D, d>
<T2,E,e>
<START T4>
<T4,F,f>
<T3,G,g>
<COMMIT T2>
. . . .C.R.R.R.R.A.S.H. . .

2) (Problem 17.2.2 and 17.2.3 in the book, pp. 862)

For each of the sequences of the log records representing the actions of one transaction T, tell all the sequences of events that are legal according to the rules of undo logging, where the events of interest are the log entries and the outputting of records to disk (eg. <OUTPUT A>). You may assume that the log records are written to disk in the order shown: i.e. it is not possible to write one log record to disk while a previous record is not written to disk.

(a). <START T>; <T, A, 10>; <T, B, 20>; <COMMIT T>

(b). <START T>; <T, A, 10>; <T, B, 20>; <T,C,30> <COMMIT T>

(c) The pattern above can be extended to a transaction that writes new values for n database elements. How many legal sequences of events are there for such a transaction, if the undo-logging rules are obeyed ?

3 Consider the two logs below, called LogA and LogB:

	LogA
1	<START T1>
2	<T1, A, a>
3	<T1, B, b>
4	<START T2>
5	<T2 C, c>
6	<START T3>
7	<T3 D, d>
8	<COMMIT T1>
9	<START CKPT(T2,T3)>
10	<T2,E,e>
11	<START T4>
12	<T4,F,f>
13	<T3,G,g>
14	<COMMIT T3>
15	<END CKPT>
16	<COMMIT T2>
17	<COMMIT T4>

	LogB
1	<START T1>
2	<T1, A, a>
3	<T1, B, b>
4	<START T2>
5	<T2 C, c>
6	<START T3>
7	<T3 D, d>
8	<COMMIT T1>
9	<START CKPT(T2,T3)>
10	<T2,E,e>
11	<START T4>
12	<T4,F,f>
13	<T3,G,g>
14	<COMMIT T3>
15	<COMMIT T2>
16	<END CKPT>
17	<COMMIT T4>

(i). One of the logs is a UNDO log, the other is a REDO log. Indicate which one is the UNDO log and which is the REDO log:

The UNDO log is: _____

The REDO log is: _____

(ii). Consider the UNDO log. For each of the elements A, B, …, G, indicate when the system might have issued the corresponding OUTPUT statement. For each of the you will answer with an interval, e.g.

"<OUTPUT B> may be issued between time steps 7 and 14" (that is, you are saying that <OUTPUT B> may be issued any time after <T3,D,d> but before <COMMIT T3>; note: this is not necessarily the right answer for <OUTPUT B>). If you want to indicate that the OUTPUT may happen after the end of the log, write either "7,18" or "7, ∞".

<OUTPUT A>	
<OUTPUT B>	
<OUTPUT C>	
<OUTPUT D>	
<OUTPUT E>	
<OUTPUT F>	
<OUTPUT G>	

(iii). Repeat the same question for the REDO log:

<OUTPUT A>	
<OUTPUT B>	
<OUTPUT C>	
<OUTPUT D>	
<OUTPUT E>	
<OUTPUT F>	
<OUTPUT G>	