Solutions:

1. Yes. For example consider the following schedule deadlocks under 2PL

```
T1:  X-Lock(A) W(A)      X-Lock(B)…
T2:  X-Lock(B) W(B)      X-Lock(A)…
```

Strict 2PL also has the deadlock problem, while conservative 2PL avoids it by requesting all the locks upfront.

2.

a) i. T1 → T2, T2 → T3, T1 → T3.
ii. Yes – equivalent schedules: T1 → T2 → T3.

b) i. T2 → T1, T3 → T1, T1 → T2, T4 → T2
ii. No – there are cycles in the precedence graph (T2 → T1, T1 → T2)

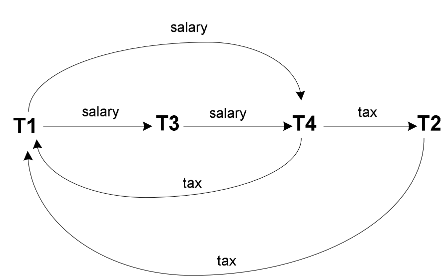
3.

	2PL	*Necessarily conflict Serializable*	*Necessarily recoverable*	*Necessarily ACR*	*Necessarily Strict Schedule*	*Necessarily Serial Schedule*	*May Result in Deadlock*
a)	*Y*	*Y*	*Y*	*Y*	*Y*	*N*	*Y*
b)	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*N*
c)	*Y*	*Y*	*N*	*N*	*N*	*Y**	*Y*

Any non-serial schedule will result in deadlock. Notice that a schedule like <L1(C); L2(B); …L2 executes to the end; L1(A); …L1 executes to the end> is (of course) legal **but also serial since the actions of T1 never started. The locks are not part of the transaction, only the scheduler. The schedule <L1(C); … ; U1(B); L2(B); … ;U2(B); CommitT1> (T1 executes but does not commit until after T2 is done) was considered for this question to be **serial** for a similar reason - we only asked you to look at the reads/write actions (i.e., un-committed reads were allowed), so a commit does not change the serializeability of the transactions.*

4.

a)



b) None, the conflict graph has a cycle.
c) Same as above with t4 removed.
d) T2 T1 T3