Problem 1:

a)

* RC and ACA.
* T2 reads page a which is already locked by T1
* To be in class RC, T1 has to be committed before T2
* But here c1 comes before c2, thus s1 belongs to class RC
* Again, T2 reads a after T1 committed
* s1 also belongs to class ACA.
* But in T2 write operation on ‘a’ comes before c1, so it’s not in class ST

b)

* ACA and ST
* T2 reads c after write operation of T1 and read ‘b’ after read operation of T1.
* T3 read ‘a’ after T2 and ‘b’ after T2.
* So, to be in class RC, commit order should be c1, c2 then c3 which is true for s1.
* Thus, s1 belongs to class RC.
* T2 reads c from T1 before T1 commits.
* Hence, s2 doesn’t belongs to class ACA as well as ST.

c)

* None
* In this case, T1 reads c after T2 but commits before T2.
* So, s3 does not belong to class RC
* s3 also can not belong class ACA and ST.

Problem 3:

Source code did not submit.

Solution:

**==== S1 ====**

s1 = [w\_1(x), r\_2(x), w\_3(y), r\_1(y), r\_3(z), w\_1(x), c\_1, w\_2(y), c\_2, w\_3(y), c\_3]

**Immediate restart** = wl\_1(x), w\_1(x), rl\_2(x)\*, wl\_3(y), w\_3(y), rl\_1(y)\*, rl\_3(z), r\_3(z), w\_3(y), wu\_3(y), ru\_3(z), **c\_3**, rl\_1(y), r\_1(y), w\_1(x), wu\_1(x), ru\_1(y), **c\_1**, wl\_2(y), w\_2(y), wu\_2(y) **c\_2**

T3 T1 T2

**Wait die** = wl\_1(x), w\_1(x), rl\_2(x)\*, wl\_3(y), w\_3(y), rl\_1(y)\*, rl\_3(z), r\_3(z), w\_1(x), w\_3(y), wl\_2(y), w\_2(y), rl\_1(y), r\_1(y), wu\_3(y), ru\_3(z), **c\_3**, wu\_2(y) **c\_2**, wu\_1(x), ru\_1(y), **c\_1**

T3 T2 T1

**Wound wait** = wl\_1(x), w\_1(x), rl\_2(x)\*, wl\_3(y), w\_3(y), rl\_1(y)\*, rl\_3(z), r\_3(z), wl\_2(y)\*, w\_3(y), w\_1(x), wl\_2(y), w\_2(y), rl\_2(x), r\_2(x), wu\_3(y), ru\_3(z), **c\_3,** wul\_1(x)\*, **c\_1**, , wu\_2(y), **c\_2**

T3 T1 T2

Problem 4:

1. Additional lock modes in addition with Shared (S) and Exclusive (X) locks:
   1. Intention Shared (IS)
   2. Intention Exclusive (IX)
   3. Shared and Intention Exclusive (SIX)
   4. Compatibility matrix (known):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | NL | S | X | IS | IX | SIX |
| NL | + | + | + | + | + | + |
| S | + |  | - | + | - | - |
| X | + | - | - | - | - | - |
| IS | + | + | - | + | + | + |
| IX | + | - | - | + | + | - |
| SIX | + | - | - | + | - | - |