1. Program Runs and Behavior

Both versions of the program were tested several times with different numbers of TA processes. The program behaved consistently across runs.

2. Part 2A Results

Part 2A runs without semaphores.
There were no deadlocks. A deadlock requires processes to wait forever for a resource that never becomes available. Since Part 2A does not wait for anything, this cannot happen.

There were no livelocks. The TAs did not get stuck repeating the same action without progress.

Part 2A did show race conditions. Examples include:

- Two TAs marking the same question

- Multiple TAs correcting the same rubric entry at the same time

- Multiple TAs loading the next exam at once

These issues were expected because Part 2A does not use any form of synchronization.
They did not cause the program to freeze.

3. Part 2B Results

Part 2B uses semaphores to protect the following:

- Writing to the rubric

- Selecting an unmarked question

- Loading the next exam

There were no deadlocks during any run. Each semaphore is locked and unlocked in the same function. No process waits for more than one semaphore at once and there is no circular waiting.

There were no livelocks. All TAs continued to progress through checking the rubric, marking questions, and loading exams until the exam with student number 9999 was reached.

The program always terminated normally.

4. Execution Order

The exact order of events changed every time because of random sleep delays and operating system scheduling.
However, the general behavior stayed the same:

1. All TAs start and read the rubric.

2. A TA may correct a rubric entry.

3. TAs mark available questions one at a time.

4. Once all questions are marked, the next exam is loaded.

5. The process repeats until exam 9999 is loaded.

6. All TAs exit and the parent process finishes the program.

5. Conclusion

Part 2A had no deadlock or livelock but did show race conditions.
Part 2B had no deadlock or livelock in any run thanks to proper semaphore use.
The system always completed all exams and terminated correctly.