EXERCISE #1

The following is the solution for “Producer & Consumer Problem” we built on February 6th (the one that prevents the race condition and spin-waits).

**Problem: CFQ (Circular Fifo Queue)**

**BASE SOLUTION: “SOLUTION #2”**

```c
int Top = 0; // the "Top" pointer
int Tail = 0; // the "Tail" pointer
int empty = N; // the "Tail" counter

void producer (void)
{
    int new_item; // a place holder for a new item
    for (i = 0; i < NUM_REPEAT; i++)
    {
        new_item = rand(); // generate a piece of data
        shm->CFQ[shm->Tail] = new_item; // insert the new item
        shm->Tail = (shm->Tail + 1) % N; // update the tail pointer
        wait(S); // wait on semaphore
        shm->empty = shm->empty - 1; // empty slots is decreased by one
        signal(S); // signal on semaphore
    }
}

void consumer (void)
{
    int new_item; // a place holder for a new item
    for (i = 0; i < NUM_REPEAT; i++)
    {
        wait(EMPTY); // wait on semaphore
        new_item = shm->CFQ[shm->Top]; // remove the first item in the CFQ
        shm->Top = (shm->Top + 1) % N; // update the top pointer
        shm->empty = shm->empty + 1 // empty slots is decreased by one
        signal(EMPTY); // signal on semaphore
        do_something(new_item);
    }
}
```

**Shared memory ("shm")**

Assuming that we have only one producer and one consumer,

**Question #1**: Is it possible to eliminate “S” (mutex) semaphore?

(a) If yes, explain “how” and why is it OK?

(b) If no, explain why not?
**Question #2:** If it is possible to eliminate “S” (mutex) semaphore, is there any merit (advantage) in eliminating the semaphore?

(a) If yes, explain “why” (or “how is it an advantage”).

(b) If not, explain why not.

**EXERCISE #2**

For the same solution for the solution for “Producer & Consumer Problem” (shown for EXERCISE #1):

Assuming that we have more than one producer and more than one consumer,

**Question #1:** Is it possible to eliminate “S” (mutex) semaphore?

(c) If yes, explain “how” and why is it OK?

(d) If no, explain why not?

**Question #2:** If it is possible to eliminate “S” (mutex) semaphore, is there any merit (advantage) in eliminating the semaphore?

(c) If yes, explain “why” (or “how is it an advantage”).

(d) If not, explain why not.