General Instructions

1. Use pencils to shade the circles in the scantron sheets - Do not tick or cross or strike.
2. You are required to return this question paper to the proctor after completing the test.
3. Use the blank sheet given to you for any calculations - Do not write or mark on the question paper.
4. Instructions on filling in the answer sheets
   a. Do not write or shade the fields corresponding to 'Name'.
   b. Write and shade your identification number.
   c. Use the special codes field to denote your section (Shade 0 under A for section 1 and shade 0 under B for section 2).
5. For answering in true or false format, use A as true and B as false.

Questions

1. Which is not a privileged operation?
   a. Switching PTBR register
   b. Editing a TLB entry
   c. Allocating memory from heap **
   d. Changing to kernel stack during system call
   e. Setting the dirty bit in the PTE

2. Assume we run the following code snippet. After waiting for a "long" time, how many processes will be running on the machine, ignoring all other processes except those involved with this code snippet? You can assume that fork() never fails.

```c
void runMe() {
    for (int i = 0; i < 3; i++) {
        int rc = fork();
        if (rc == 0) { while (1) ; }
        else { }
    }
    while (1) ;
}
```

Number of processes running:

   a. 3
   b. 4 **
   c. 6
   d. 8
   e. 9
3. Which among the following are policies and not mechanisms.

   i. The timer interrupt
   ii. How long a time quantum should be
   iii. Saving the register state of a process
   iv. Continuing to run the current process when a disk I/O interrupt occurs

   a. [ii, iv] **
   b. [i, iii]
   c. [i, ii]
   d. [ii, iii]
   e. All of the above

4. In the MLFQ scheduler, there is a rule that states the following: Rule 5: After some time period S, move all jobs in the system to the top-most queue. What is the purpose of this rule?

I) To avoid starvation
II) To re-learn about old jobs which may change from batch to interactive
III) To help new jobs learn their correct priority

   a. I only
   b. II only
   c. III only
   d. I and II **
   e. I, II, and III

5. Compute the turnaround times for STCF for these three jobs, which arrive at about the same time: Job A (which needs to run for 10 time units), Job B (needs 20), and Job C (needs 30). Let’s assume this happens when the jobs are run: ABBCCC

   a. 33.33 **
   b. 30.00
   c. 13.33
   d. 23.33
   e. None of the above

6. A set of processes A, B and C continuously access 33 pages. However there is room only for 32 pages in memory. This could lead to thrashing. One solution to this problem is implementing a more efficient page replacement algorithm that will make better choices when selecting a page to be replaced. True or False?

   a. True **
   b. False **

7. The performance of the Clock page replacement algorithm can be improved by iterating over the list of all pages more than once with a slight algorithm change.

   a. True **
   b. False
8. Given a virtual address space of size 32KB that makes use of paging with a page size of 2KB, find the triplet that specifies the <# of bits in the virtual address, # of bits needed to represent the virtual page number, size of the page table in bytes>. Assume that each page table entry is 4 bytes long.

   a. <15,4,64> **
   b. <15,4,16>
   c. <5,4,64>
   d. <15,2,64>
   e. <32,4,64>

9. Given a system with explicit code (01), heap (10) and stack (11) segments in an 8 bit address space and the following base and bounds values:

   code base: 0x1000 code bounds: 0x10
   heap base: 0x4000 heap bounds: 0x08
   stack base: 0x6000 stack bounds: 0x10

   Which of the following virtual addresses generates a fault?
   a. 0xC6
   b. 0x48
   c. 0x80
   d. All of the above
   e. None of the above **

10. Traps, such as those caused by system calls, interrupts and TLB misses always return to the user program at the instruction after the one which caused the trap.

   a. True
   b. False **