

## Sample Question

### Part One

1. When an interrupt or a system call transfers control to the operating system, a kernel stack area separate from the stack of the interrupted process is generally used. Why?
2. Multiple jobs can run in parallel and finish faster than if they had run sequentially. Suppose that two jobs, each of which needs 10 minutes of CPU time, start simultaneously. How long will the last one take to complete if they run sequentially? How long if they run in parallel? Assume 50% I/O wait.
3. Assume it takes 15 msec to get a request for work, dispatch it, and do the rest of the necessary processing, assuming that the data needed are in the block cache. If a disk operation is needed, as is the case one-third of the time, an additional 75 msec is required, during which time the thread sleeps. How many requests/sec can the server handle if it is single threaded? If it is multithreaded?
4. Give a sketch of how an operating system that can disable interrupts could implement semaphores.
5. Five jobs are waiting to be run. Their expected run times are 9, 6, 3, 5, and X. In what order should they be run to minimize average response time? (Your answer will depend on X.)
6. A machine has 48-bit virtual addresses and 32-bit physical addresses. Pages are 8 KB. How many entries are needed for the page table?
7. Suppose that a machine has 48-bit virtual addresses and 32-bit physical addresses.
  - a. If pages are 4 KB, how many entries are in the page table if it has only a single level? Explain.
  - b. Suppose this same system has a TLB (Translation Look-aside Buffer) with 32 entries. Furthermore, suppose that a program contains instructions that fit into one page and it sequentially reads long integer elements from an array that spans thousands of pages. How effective will the TLB be for this case?
8. In UNIX and Windows, random access is done by having a special system call that moves the "current position" pointer associated with a file to a given byte in the file. Propose an alternative way to do random access without having this system call.
9. How does MS-DOS implement random access to files?
10. Free disk space can be kept track of using a free list or a bitmap. Disk addresses require D bits. For a disk with B blocks, F of which are free, state the condition under which the free list uses less space than the bitmap. For D having the value 16 bits, express your answer as a percentage of the disk space that must be free.
11. It has been suggested that the first part of each UNIX file be kept in the same disk block as its i-node. What good would this do?