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1. A microprocessor supports a single hardware timer. Suppose instruction SET\_TIMER permits one to set the timer value1. Does this need to be a privileged instruction?

Answer: yes, because the hardware timer is something that would be controlled at kernel level

2. When a process executes a TRAP or is interrupted, the operating system uses a separate stack located in memory unavailable to user processes to execute any operating system code rather than the stack of the current process. Why might operating systems designers select this type of implementation?

Answer: They chose this type of implementation to avoid user programs from interfering with memory used by other programs or the operating system memory itself.

3. During an interrupt, how does the operating system select the interrupt service routine to run?

Answer: The hardware interrupt request runs the interrupt handler which creates a thread to be run and then it is queued, and the CPU runs the thread shortly thereafter.

4. Processes P3 and P7 are executing. The system has two types of pending I/O requests. P9 and P11 are waiting on secondary storage reads. P18 is waiting for a network write to complete. P25 and P19 are awaiting assignment of the CPU. Draw a queueing diagram for these processes. Draw an arrow showing where P18 will go once it completes. Write the state that each process is in next to the process bubble.

Answer: see drawing on next page.

A screenshot of a cell phone

Description automatically generated

5. Process P92 has user-level threads. Process P33 has kernel-level threads.

a. Will P33 run in supervisory mode?

Answer: Kernel mode, also known as supervisory mode, since P33 has kernel level threads, that means that it is going to run in supervisory mode.

b. Which process will have faster context switches?

Answer: Context switching should be the same for both processes.

c. What happens when a thread in P92 or P33 block?

Answer: When a thread is blocked it is unable to run until some external even happens. In the case of P92 it might slow down the user program, but in the case of P33 it might slow down or crash the computer.