A. Why is it important for the CPU scheduler to distinguish I/O-bound programs from CPU-bound programs?

B. One technique for implementing lottery scheduling works by assigning processes lottery tickets, which are used for allocating CPU time. Whenever a scheduling decision has to be made, a lottery ticket is chosen at random, and the process holding that ticket gets the CPU. The BTV operating system implements lottery scheduling by holding a lottery 50 times each second, with each lottery winner getting 20 milliseconds of CPU time (20 milliseconds × 50 = 1 second). Describe how the BTV scheduler can ensure that higher-priority threads receive more attention from the CPU than lower-priority threads.

C. Which of the following scheduling algorithms could result in starvation?
   a. First-come, first-served
   b. Shortest job first
   c. Round robin
   d. Priority

D. 6.3 in 9th edition or 5.3 in 10th edition

E. You are given set of processes, with priorities (lower number implies higher priority) and burst times, and assume all processes arrive at time zero in the order P1, P2, P3, P4, P5.

<table>
<thead>
<tr>
<th>Process</th>
<th>Burst Time</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>P2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>P3</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>P4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>P5</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Consider non-preemptive priority and RR scheduling algorithms; RR has time slice = 2. For each provide
   a. Gantt chart
   b. turnaround time for each process and average one
   c. waiting time for each process and average one
   d. What would be in this case the CPU scheduling algorithm which will give shortest average waiting time? Calculate that average waiting time.

F. Consider a system running ten I/O-bound tasks and one CPU-bound task. Assume that the I/O-bound tasks issue an I/O operation once for every msec of CPU computing and that each I/O operation takes 10 msec to complete. Also assume that the context-switching overhead is 0.1 msec and that all processes are long-running tasks. Describe the CPU utilization for a round-robin scheduler when:
   a. The time quantum is 1 msec
   b. The time quantum is 10 msec

G. Assume the following arrivals in a ready state. Process P1 with burst=28 arrives at t=0, P2 with burst 9 arrives at t=3, P3 with burst=4 arrives at t=17 and P4 with burst 12 arrives at t=25. Show Gantt chart and average waiting time for this situation if processes are served according to the multilevel feedback queues scheduling given in slide D22.

H. 6.23 in 9th edition or 5.24 in 10th edition; explain your answer