6.3 Suppose that the following processes arrive for execution at the times indicated. Each process will run for the amount of time listed. In answering the questions, use nonpreemptive scheduling, and base all decisions on the information you have at the time the decision must be made.

Process	Arrival Time	Burst Time
P_1	0.0	8
P_2	0.4	4
P_3	1.0	1

a. What is the average turnaround time for these processes with the FCFS scheduling algorithm?

b. What is the average turnaround time for these processes with the SJF scheduling algorithm?

c. The SJF algorithm is supposed to improve performance, but notice that we chose to run process P_1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that processes P_1 and P_2 are waiting during this idle time, so their waiting time may increase. This algorithm could be called future-knowledge scheduling.

FCFS	**->**	**P1**	**-** **P2**	**-** **P3**	
	WT	0.0	7.6	11.0	avg = **6.2**
	TAT	8.0	11.6	12.0	avg = **10.53**
SJF	**->**	**P1**	**-** **P3**	**-** **P2**	
	WT	0.0	7.0	8.6	avg = **5.2**
	TAT	8.0	8.0	12.6	avg = **9.53**
IDLE 1 then SJF	**->**	**P3**	**-** **P2**	**-** **P1**	
	WT	0.0	1.6	6.0	avg = **2.53**
	TAT	1.0	5.6	14.0	avg = **6.86**

6.16 Consider the following set of processes, with the length of the CPU burst given in milliseconds:

Process	Burst Time	Priority
P_1	2	2
P_2	1	1
P_3	8	4
P_4	4	2
P_5	5	3

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5, all at time 0.

a. Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, nonpreemptive priority (a larger priority number implies a higher priority), and RR (quantum = 2).

b. What is the turnaround time of each process for each of the scheduling algorithms in part a?

c. What is the waiting time of each process for each of these scheduling algorithms?

d. Which of the algorithms results in the minimum average waiting time (over all processes)?