1. a) I/O-bound: voluntary
   b) CPU-bound: nonvoluntary
   Reason: A voluntary context switching occurs when a process relinquishes control of the CPU because it requires a resource that is currently unavailable. And the nonvoluntary context switching occurs when the CPU has been taken away from a process.

2. a) First-come, first-served cannot result in starvation, because every FCFS process eventually get a chance to run.

   b) Shortest job first can result in starvation, because it is possible to have starvation in SJF when the process of higher burst time will execute before the lower burst time process.

   c) Round robin cannot result in the starvation. For each round robin cycle, every process is given a fixed time to execute.

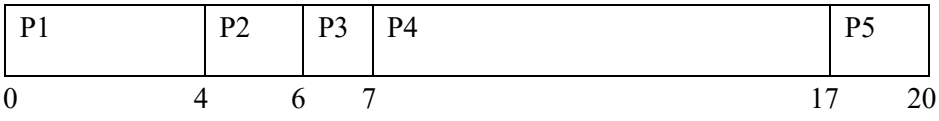
   d) Priority can result in starvation. The processes that have the higher priority would be execute first, then the lower burst time process feels the starvation.

3. a) $\alpha = 0$ and $\tau_0 = 100$ milliseconds
   most recent info has no effect
   $\tau_{n+1} = \tau_n$
   τ_{n+1} always equals to 100 milliseconds.

   b) $\alpha = 0.5$ and $\tau_0 = 10$ milliseconds
   $\tau_{n+1} = 0.5*\tau_n + (1-0.5)*10 = (\tau_n + 10)/2$

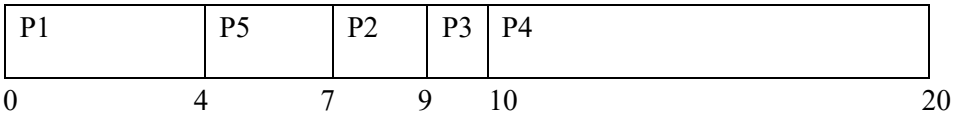
   c) $\alpha = 1$ and $\tau_0 = 10$ milliseconds
   $\tau_{n+1} = \tau_n$
   τ_{n+1} always equals to actual last burst counts.

4. a)
   FCFS:



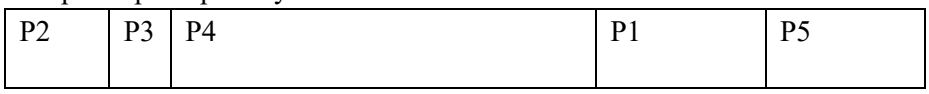
   Average turnaround time = (4+6+7+17+20)/5 = 10.8
   Average waiting time = (0+4+6+7+17)/5 = 6.8

   SJF:



   Average turnaround time = (4+7+9+10+20)/5 = 10
   Average waiting time = (0+4+7+9+10)/5 = 6

Non-preemptive priority:

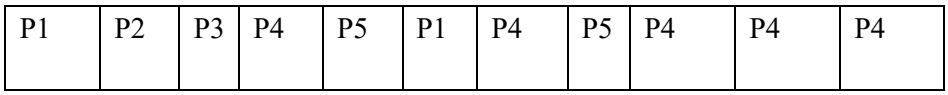


0 2 3 13 17 20

Average turnaround time = (2+3+13+17+20)/5 = 11

Average waiting time = (0+2+3+13+17)/5 = 7

RR



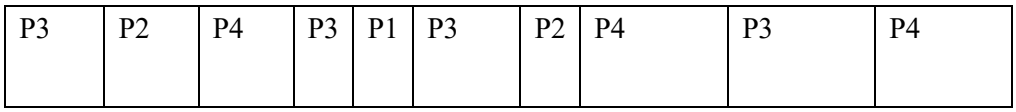
0 2 4 5 7 9 11 13 14 16 18 20

Average turnaround time = (11 + 4 + 5 + 20 + 14)/5 = 10.8

Average waiting time = ((11-4)+(4-2)+(5-1)+(20-10)+(14-3))/3 = 11.33

5. a)

FSFS:



0 8 16 24 28 32 44 46 62 78 94

b)

Response time = Start time - Arrival time

p1: 28-28 = 0

p2: 8-1 = 7

p3: 0

p4: 16-2 = 14

so, p4 has the worst response time.

c) 11

d)

Turnaround time = Finish time – Arrival time

P1: 32-28 = 4

P2: 46-1 = 45

P3: 78

P4: 94-2 = 92

Waiting time = Turnaround time – Burst time

P1: 4-4 = 0

P2: 45-10 = 35

P3: 78-40 = 38

P4: 92-40 = 52

Average waiting time: (35+38+52)/4 = 31.25 milliseconds

6. a) A's vruntime would be smaller than B's, which leads A has a greater priority.

b) Since it's I/O-bound and requires less CPU time, A has a smaller vruntime than B.

c) It is possible that B may end up running in favor of A as it will be using the processor less than A and its vruntime may in fact be less than vruntime for B.