1a)False. A process scheduling is preemptive if the CPU can be taken away from a process at any time by the scheduler

b)False. Whatever process that is executing currently can continue running

To keep the CPU busy, the short term scheduler must execute only when a running process terminates or blocks. When a new process is admitted , it may be required to execute to keep the CPU busy only if there is no other running process in the system.

TUTORIAL THREE

CPU Scheduling

1. State whether each of the following statements are true or false. Justify your answers.

(a) A process scheduling discipline is preemptive if the CPU cannot be forcibly removed from a process.

(b) When a new process is admitted in the system, the short-term scheduler must execute in order to keep the CPU busy.

(c) For a process, response time = turnaround time – waiting time.

(d) Partitioned multi-processor scheduling suffers from migration overheads due to data in private core-specific caches.

c)False. process response time = turnaround time + waiting time

turnaround time - waiting time is time spent by a process in the waiting and running states combined.
Response time is the time until the first response is produced

d)False. Each process is allocated to one CPU core. Poor mapping leads to unequal loads when a CPU core is idling while another CPU core is overloaded for partitioned scheduling

Migration overheads occurs in global scheduling when a process partially executes on one core and then migrates to another

2. Consider the following set of processes, with the CPU burst time given in milliseconds:

Process	CPU Burst Time	Priority	Arrival Time (Order)
P_1	10	3	0 (1)
P_2	1	1	0 (2)
P_3	2	3	2 (1)
P_4	1	4	2 (2)
P_5	5	2	4 (1)

(a) Draw six Gantt charts illustrating the execution of these processes using
  i. Shortest Job First (SJF), Preemptive Priority-based (smaller priority number implies higher priority) and Round-Robin (quantum=2) uni-processor scheduling.
  ii. First-Come First-Served (FCFS) partitioned multi-processor scheduling with P_1, P_5 on core 1 and P_2, P_3 and P_4 on core 2.
  iii. Shortest Remaining Time First (SRTF) and Round-Robin (quantum=2) global multi-processor scheduling with 2 cores.

(b) What is the turnaround time of each process for each scheduling algorithm in part (a)?

(c) What is the waiting time of each process for each scheduling algorithm in part (a)?

(d) Which of the schedulers in part (a) results in the minimal average waiting time (separately for uni- and multi-processors)?

3. Measurements of a certain system have shown that the average process runs for time T before blocking on I/O. A process switch requires time S, which is effectively wasted (overhead). Define what is meant by CPU efficiency. For round robin scheduling with quantum Q, give a formula for the CPU efficiency for each of the following cases:

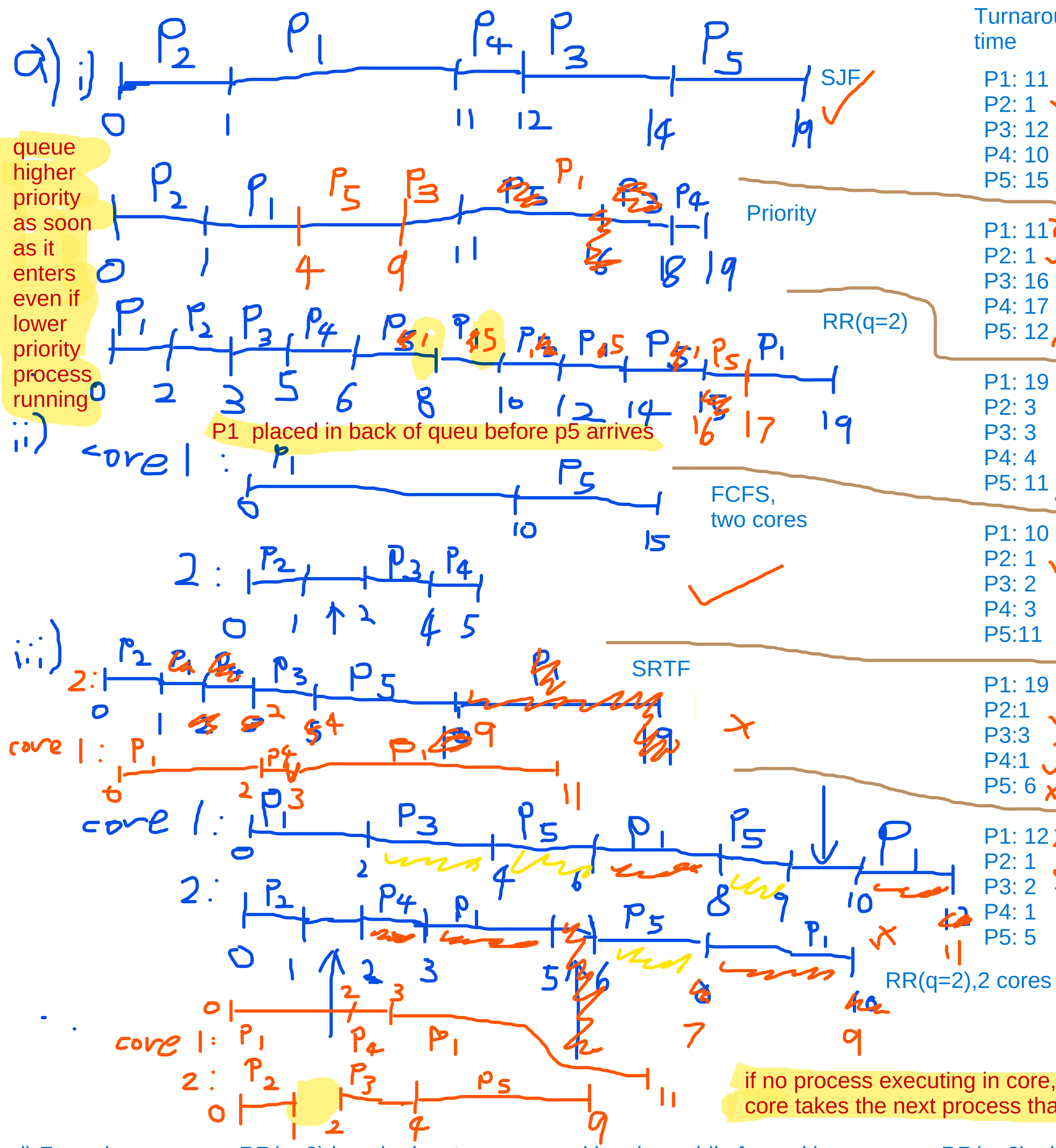
		#Ctx Switch	CPU efficiency
(a)	$Q \rightarrow \infty$	1	$\frac{T}{S+T}$
(b)	$Q > T$		
(c)	$S < Q < T$	$ceil(\frac{T}{Q})$	$\frac{T}{T+S\times ceil(\frac{T}{Q})}$
(d)	$Q = S$		
(e)	$Q \rightarrow 0$	$ceil(\frac{T}{S})$ ∞	$\frac{T}{T+S\times ceil(\frac{T}{S})}$ 0

CPU efficiency = useful CPU time/ total CPU time
= CPU burst / (CPU burst + overhead per Ctx x no. Ctx switch)
= T / (T + S x #Ctx switch)

Turnaround time = time process finishes - time process enters

Wait time = time process executes - time process enters

SC2005 Operating Systems



	Turnaround time	waiting time	Avg wait time
SJF	P1: 11 ✓	1 ✓	30/5 =6 ✓
	P2: 1 ✓	0 ✓	
	P3: 12 ✓	10 ✓	
	P4: 10 ✓	9 ✓	
	P5: 15 ✓	10 ✓	
Priority	P1: 11 ✗ 18	1 ✗ 8	~~37/5 =7.4~~ 6.2
	P2: 1 ✓	0 ✓	
	P3: 16 ✗ 9	14 ✗ 7	
	P4: 17 ✓	16 ✓	
	P5: 12 ✗ 5	6 ✗ 0	
RR(q=2)	P1: 19 ✓	9 ✓	~~21/5 =4.2~~ 4.6
	P2: 3 ✓	2 ✓	
	P3: 3 ✓	1 ✓	
	P4: 4 ✓	3 ✓	
	P5: 11 ✗ 13	6 ✗ 8	
FCFS, two cores	P1: 10 ✓	0 ✓	8/5 =1.6 ✓
	P2: 1 ✓	0 ✓	
	P3: 2 ✓	0 ✓	
	P4: 3 ✓	2 ✓	
	P5:11 ✓	6 ✓	
SRTF	P1: 19 ✗ 11	9 ✗ 1	~~11/5 =2.2~~ 1/5
	P2:1 ✓	0 ✓	
	P3:3 ✗ 2	1 ✗ 0	
	P4:1 ✓	0 ✓	
	P5: 6 ✗ 5	1 ✗ 0	
RR(q=2),2 cores	P1: 12 ✗ 11	2 ✗ 1	~~2/5 = 0.4~~ 1/5
	P2: 1 ✓	0 ✓	
	P3: 2 ✓	0 ✓	
	P4: 1 ✓	0 ✓	
	P5: 5 ✓	0 ✓	

d) For uni processors, RR(q=2) has the least average waiting time while for multiprocessors, RR(q=2) with 2 cores has the least average waiting time ✓ and SRTF

CPU efficiency means that the CPU cores are always kept busy with none of them idling at any point in time

3a) T

b) T

c) ST/Q + T

d) 2T

e) infinity ✗