COMP3230 Principles of Operating Systems
Problem Set #1

Reference Solutions

Total 5 points

(version: 1.0)

Note: This assignment weights a total of 5 points in the final marks of this course. However, just like each process has its own private virtual address space, this assignment also has its own virtual score space of 100 points, which is mapped to 5 points of physical marks. The below points for each question are given in the said virtual score space.

Question 1 – **Process** (25 points)

Answers:

(1)

Ready → Running: (1) Another process terminated causes the scheduler to schedule a ready process; (2) Another process goes to Blocked state causes the scheduler to schedule a ready process.

Running → Ready: (1) The running process uses up its time quantum and the scheduler preempts the process (2) There is another higher priority process arrives to the system which forces the scheduler to preempt the process.

Running → Blocked: (1) The running process calls the sleep() system call; (2) The running process calls the open() system call.

Running → Terminated: (1) The process terminates voluntarily, e.g., call exit(); (2) The process terminates involuntarily, e.g., receives SIGKILL signal.

Blocked → Ready: (1) Completion of IO, e.g, the file is ready; (2) The waiting event has occurred, e.g., timer expires.

(2) Not entirely correct. A child process does inherit most properties from the parent process. Yet the newly created process will become Ready first and then waits for the OS scheduler to determine when to run.

(3) No Blocked state is needed. Ready->Running->Terminated.

Question 2 – Context Switch and Mode Switch (30 points)

Answer:

(1) #context switches: 5 (there can be quite a few different orders of execution, but the number of context switches will be the same because in any case A becomes ready later than B&C after being blocked)

#mode switches: 2x (#system calls)

Time spent on context switches: 5 * 2500 / (2500) microseconds = 5 us

Time spent on mode switches:

- A: 10 * 2 * 500/2500 us = 4 us
- B: 5 * 2 * 500 / 2500 us = 2 us
- C: 20 * 2 * 500 / 2500 us = 8 us

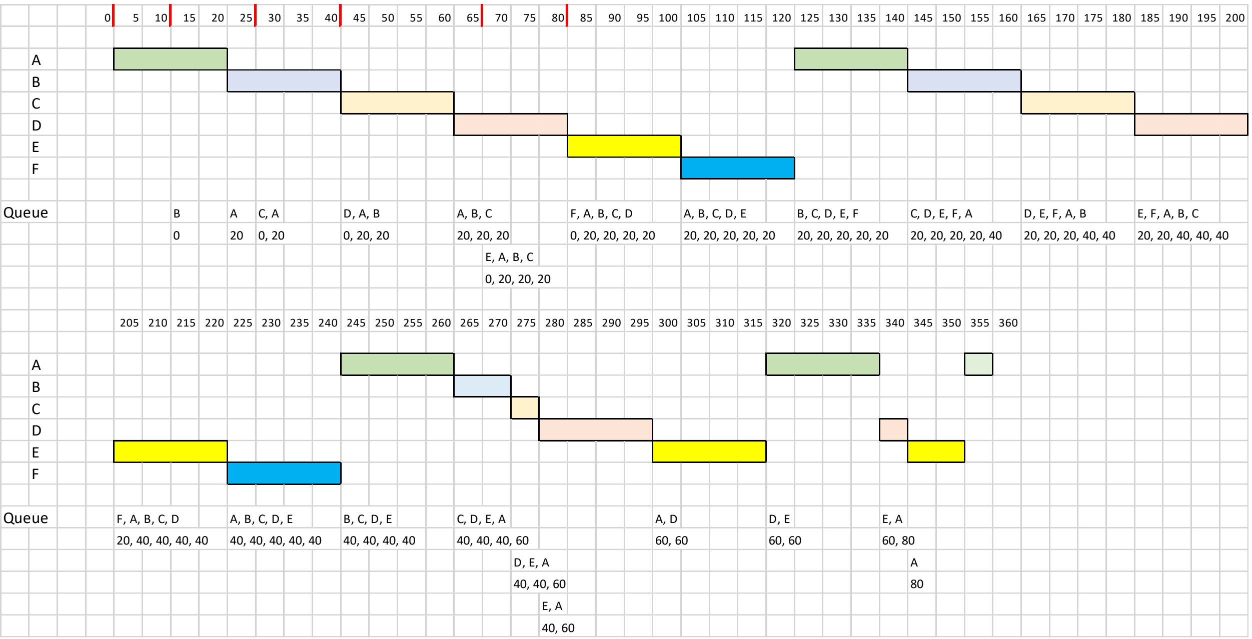
(2) There could be 4 or 5 context switches, depending on when the I/O event is triggered and finished (before or after 10 ms when B/C arrives).

Question 3 - Process Scheduling (45 points)

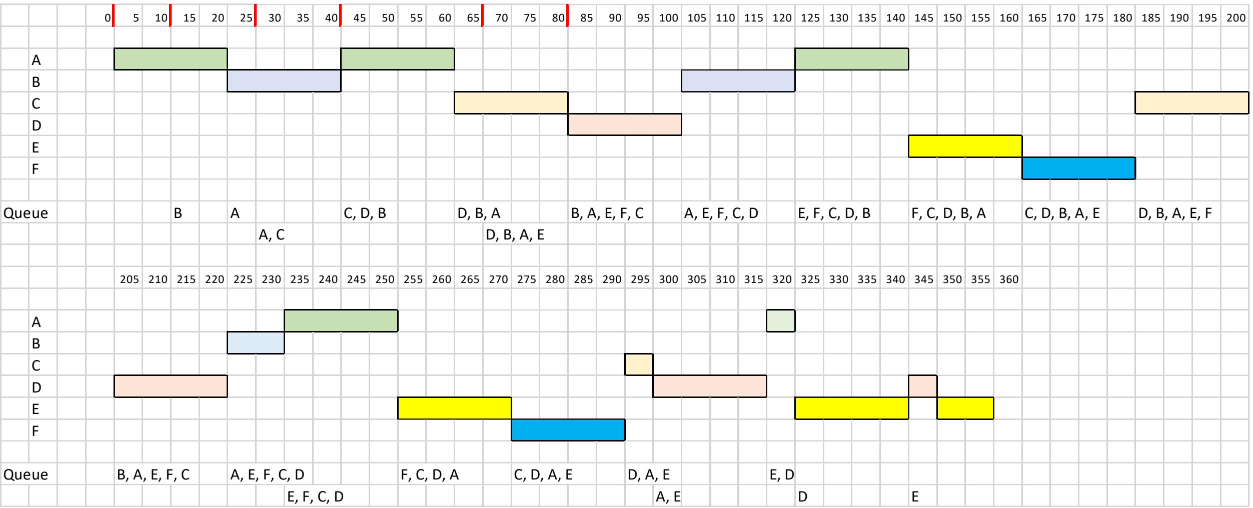
Answer:

a)

Turnaround time = (355 + 260 + 250 +300 + 285 +160) / 6 = 268.3
Waiting time = [(355 + 260 + 250 +300 + 285 +160) – (85 + 50 + 45 + 65 + 70 + 40)] /6 = 209.2
Response time = (0 + 10 + 15 + 20 + 15 +20) / 6 = 13.3



b) RR scheme

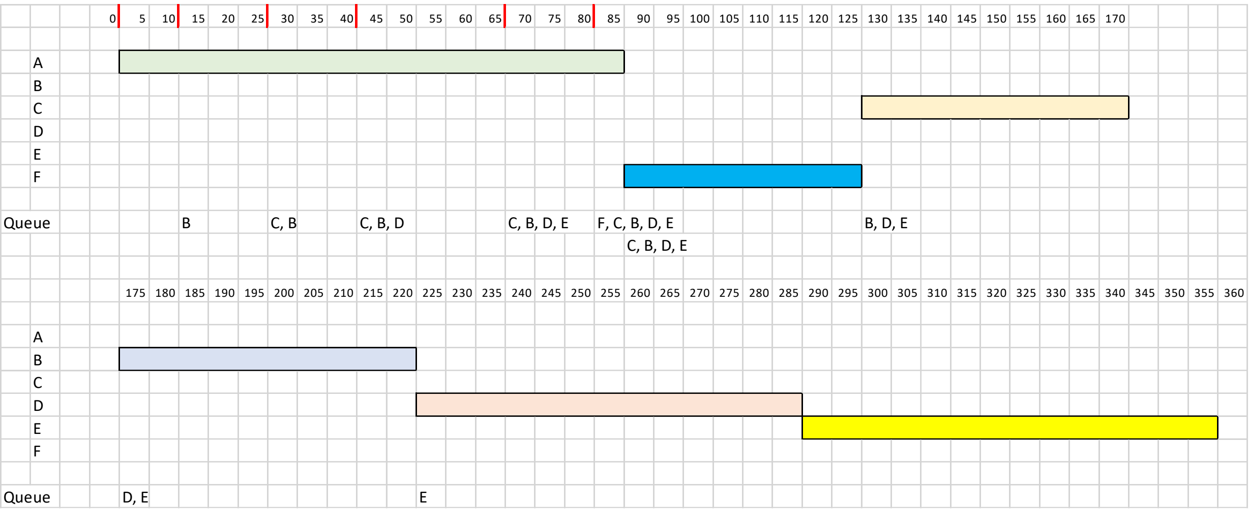


Turnaround time = (320 + 220 + 275 + 305 + 290 + 210) / 6 = 270

Waiting time = [(320 + 220 + 275 + 305 + 290 + 210) – (85 + 50 + 45 + 65 + 70 + 40)] /6 = 210.8

Response time = (0 + 10 + 35 + 40 + 75 + 80) / 6 = 40

SFJ scheme



Turnaround time = (85 + 210 + 145 + 245 + 290 + 45) / 6 = 170

Waiting time = [(85 + 210 + 145 + 245 + 290 + 45) – (85 + 50 + 45 + 65 + 70 + 40)] /6 = 110.8

Response time = (0 + 160 + 100 + 180 + 205 + 5) / 6 = 108.3

c) Here is the comparison table of the three schemes.

	Turnaround	Waiting	Response
New scheme	268.3	209.2	13.3
RR	270	210.8	40
SFJ	170	110.8	108.3

From the analysis, we can see that the overall performance of the new scheme is similar to the RR scheme but with a much better response time. SJF shows that it has the best overall performance but sacrifices the response time. Thus, we can conclude that the new scheme can maintain the fairness and good for interactive processes.