

1.

(a) SRT:

$P_1$	$P_2$	$P_3$	$P_4$	$P_5$
0	3	8	14	24

$$P_1: \text{Waiting Time} = 14 - 1 = 13$$

$$\text{Turnaround Time} = 24$$

$$P_2: \text{Waiting Time} = 8 - 3 = 5$$

$$\text{Turnaround Time} = 13$$

$$P_3: \text{Waiting Time} = 0$$

$$\text{Turnaround Time} = 5$$

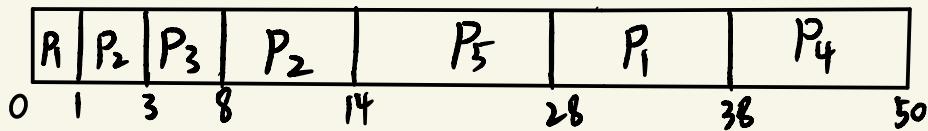
$$P_4: \text{Waiting Time} = 18$$

$$\text{Turnaround Time} = 30$$

$$P_5: \text{Waiting Time} = 28$$

$$\text{Turnaround Time} = 42$$

## (b) Priority with preemption (Linux)



P<sub>1</sub>: Waiting Time = 27  
Turnaround Time = 38

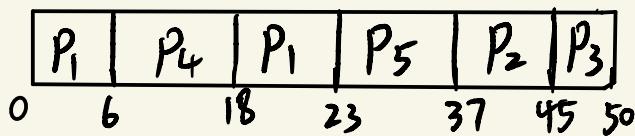
P<sub>2</sub>: Waiting Time = 5  
Turnaround Time = 13

P<sub>3</sub>: Waiting Time = 0  
Turnaround Time = 5

P<sub>4</sub>: Waiting Time = 32  
Turnaround Time = 44

P<sub>5</sub>: Waiting Time = 6  
Turnaround Time = 20

### (C) Priority with preemption (Windows)



P<sub>1</sub>: Waiting Time = 12  
Turnaround Time = 23

P<sub>2</sub>: Waiting Time = 36  
Turnaround Time = 44

P<sub>3</sub>: Waiting Time = 42  
Turnaround Time = 47

P<sub>4</sub>: Waiting Time = 0  
Turnaround Time = 12

P<sub>5</sub>: Waiting Time = 15  
Turnaround Time = 29

cd RR with Q=5

R	P <sub>2</sub>	P <sub>3</sub>	P <sub>1</sub>	P <sub>4</sub>	P <sub>5</sub>	P <sub>2</sub>	P	R <sub>4</sub>	P <sub>5</sub>	P <sub>4</sub>	P <sub>5</sub>	
0	5	10	15	20	25	30	33	34	39	44	46	50

P<sub>1</sub>: Waiting Time = 23  
Turnaround Time = 34

P<sub>2</sub>: Waiting Time = 24  
Turnaround Time = 32

P<sub>3</sub>: Waiting Time = 7  
Turnaround Time = 12

P<sub>4</sub>: Waiting Time = 28  
Turnaround Time = 40

P<sub>5</sub>: Waiting Time = 28  
Turnaround Time = 42

(e) RR with  $Q=3$

1	2	1	3	2	4	5	1	3	2	4	5	1	4	5	4	5	5
0	3	6	9	12	15	18	21	24	26	28	31	34	36	39	42	45	48

$P_1$ : Waiting Time = 25  
Turnaround Time = 36

$P_2$ : Waiting Time = 19  
Turnaround Time = 27

$P_3$ : Waiting Time = 18  
Turnaround Time = 23

$P_4$ : Waiting Time = 27  
Turnaround Time = 39

$P_5$ : Waiting Time = 28  
Turnaround Time = 42

(7)

Process	SRT			PR-Linux			PR-Win			RR-5			RR-3		
	T=0	T=1	T=2	T=0	T=1	T=2	T=0	T=1	T=2	T=0	T=1	T=2	T=0	T=1	T=2
$P_1$	24	28	30	38	43	46	23	25	27	34	41	48	36	48	60
$P_2$	13	16	17	13	16	17	44	48	52	32	28	44	27	40	50
$P_3$	5	6	5	5	6	5	47	52	51	12	14	16	23	31	39
$P_4$	30	35	38	44	50	54	12	13	14	40	50	60	39	54	69
$P_5$	42	48	52	20	24	26	29	32	35	42	53	64	42	59	76
Average	30.8	26.6	26.4	24	27.8	29.6	31	34	37	32	39.2	76.4	33.4	46.4	58.8

Add the T content switch, average ↑ increase.

2.

(a)

## Fixed Priority Scheduling:

high:

R	P <sub>2</sub>	P <sub>3</sub>	P <sub>3</sub>	P <sub>2</sub>	P <sub>4</sub>	P <sub>3</sub>	P <sub>5</sub>	P <sub>4</sub>	P <sub>5</sub>
0	2	4	6	8	10	12	14	16	18

medium:

R	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	P <sub>1</sub>	P <sub>4</sub>	P <sub>5</sub>	
20	24	28	29	33	37	40	44	48

low:

P <sub>5</sub>
48

(b)

## Time Slicing Scheduling:

Q <sub>1</sub>	R	P <sub>2</sub>	P <sub>1</sub>
0	24	6	

	P <sub>3</sub>	P <sub>2</sub>	P <sub>4</sub>
13	15	17	19

	P <sub>5</sub>	P <sub>3</sub>	P <sub>4</sub>
23	25	27	29

	P <sub>5</sub>
37	39

Q <sub>2</sub>	R	P <sub>1</sub>
6	10	13

	P <sub>2</sub>
19	23

	P <sub>3</sub>	P <sub>4</sub>
29	30	34

	P <sub>4</sub>	P <sub>5</sub>	P <sub>5</sub>
39	40	44	47

	P <sub>5</sub>
47	48

P <sub>5</sub>
48

turnaround waiting

P<sub>1</sub> 13 2P<sub>2</sub> 22 14P<sub>3</sub> 27 22P<sub>4</sub> 34 22P<sub>5</sub> 42 28

AVG 27.6 17.6

3.  $50, 88, 96, 37, 93, 35, 63, 27, 49, 68, 33, 58$

(a) first-fit

234	321	108	
50   88   96	37   93   35   63   27   49	68   33	X 58

$$\begin{aligned} & (1000 - 234 - 321 - 108 + \\ & 50 + 88 + 96 + 37 + 93 + 35 \\ & + 63 + 27 + 49 + 68 + 33) \\ & \quad \div 1000 \\ & = 97.6\% \end{aligned}$$

(b) best-fit

234	321	108	
88, 96, 37	93, 63, 27, 49, 68	50, 35	X 33, 58

$$\begin{aligned} & (1000 - 234 - 321 - 108 + \\ & 50 + 88 + 96 + 37 + 35 + 93 \\ & + 63 + 27 + 49 + 68) \div 1000 \\ & = 94.3\% \end{aligned}$$

(c) worst-fit

234	321	108	
96, 35, 27, 49	50, 88, 37, 93, 33	63	X 68, 58

$$\begin{aligned} & (1000 - 234 - 321 - 108 + \\ & 96 + 35 + 27 + 49 + 50 \\ & + 88 + 37 + 93 + 33 + 63) \\ & \quad \div 1000 = 90.8\% \end{aligned}$$

(d) optimal ①

234	321	108	
93, 27, 49, 63	88, 96, 33, 35, 68	50, 58	X 37

$$\begin{aligned} & (1000 - 234 - 321 - 108 + \\ & 93 + 27 + 49 + 63 + 88 + 96 \\ & + 33 + 35 + 68 + 50 + 58) \\ & \quad \div 1000 = 99.7\% \end{aligned}$$

(d) optimal ②

234	321	108
96,33,35,68	93,27,49,63,88	50,58

☒ 37

$$(1000 - 234 - 321 - 108 + 96 + 33 + 35 + 68 + 93 + 27 + 49 + 63 + 88 + 50 + 58) \div 1000 = 99.7\%$$

(e) 234      321      109

50,88,96	93,37,63,58	27,33,49
68		

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$$\therefore 1000 - 2 \div 1000 = 99.8\%$$

the size is: 234, 321, 109 K.

(f), (g), (h)

	(f) At most 9 tasks each			(g) Unlimited number of tasks			(h) Strictly 1 to 9 tasks each		
Case	1	2	3	1	2	3	1	2	3
x	22×(4)	26×(8)	28×(4)	22×(4)	26×(16)	28×(25)	22×(1)	26×(5)	28×(4)
y	33×(0)	43×(8)	65×(9)	33×(0)	43×(2)	65×(0)	33×(2)	43×(8)	65×(9)
z	50×(6)	77×(0)	74×(1)	50×(8)	77×(0)	74×(1)	50×(8)	77×(1)	74×(1)
S	488	556	777	488	556	777	488	556	777
Max usage	100%	49.6%	99.4%	100%	99.8%	99.7%	100%	99.5%	99.4%

4.

Segment table for $P_2$	Base			Length / Limit
	(a) FF	(b) BF	(c) WF	
0	1554	2736	1554	212
1	1248	4343	1766	88
2	1766	3476	6204	345
3	6209	6209	1854	511
4	2432	2432	2432	304
5	2736	5208	5208	321
6	1348	3821	3476	72

(d) Translate the following logical addresses for  $P_1$  and  $P_2$  by filling in the table below.

Allocation algorithm for $P_2$		FF	BF	WF
Logical address	Physical address for $P_1$	Physical address for $P_2$		
(0, 19)	1452	1573	2755	1573
(1, 88)	4519	1336	4437	1854
(2, 246)	3377	2070	3740	6513
(3, 304)	ERR	6513	6513	2158
(4, 188)	5866	2620	2620	2620
(5, 234)	1236	2970	5442	5442
(6, 33)	3944	1281	3854	3509

