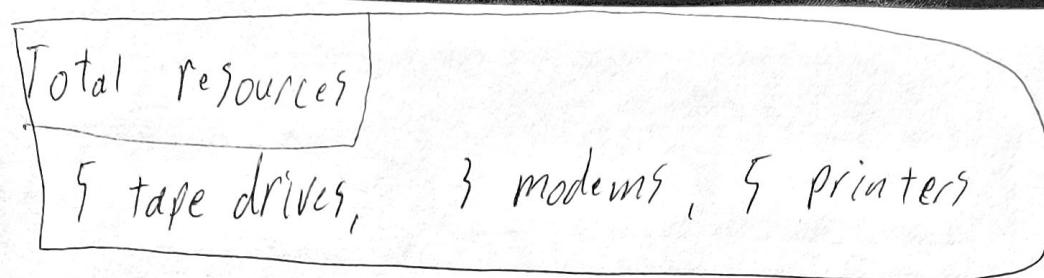


Q1)



currently allocated

	Tapes	modems	printers
P ₀	0	0	1
P ₁	0	0	1
P ₂	1	0	1
P ₃	2	2	2
P ₄	1	0	0

still required

	T	M	P
P ₀	5	2	1
P ₁	0	1	0
P ₂	1	2	3
P ₃	1	1	1
P ₄	4	2	4

Available

	T	M	P
	1	1	0

Q1) (cont.)

Available: T M P
1 1 0

Run P_1 (requires 1 modem)

Available: T M P
1 0 0

P_1 completes and releases 1 modem and 1 printer

~~Available~~

Available: T M P
1 1 1

Run P_3 , completes and releases 3 of each

Available: T M P
3 3 3

Run P_2 , completes and releases 2T, 2M, ~~2P~~ 4P

Available: T M P
4 3 4

Run P_4 : releases 5T, ~~2M~~, 4P

Available: T M P
5 3 4

Run P_0 , releases 5T, 2M, 2P

Available: T M P
5 3 5

No dead-locks, state is safe

(Q2)

Reference order: A, B, A, B, A, A, C, D, D, B, D, E, A, D, A

FIFO with 3 frames = [6 replacements]

F ₁	F ₂	F ₃
A		
A	B	
A	B	C
D	B	C
D	E	C
D	E	A

FIFO with 4 frames

F ₁	F ₂	F ₃	F ₄
A			
A	B		
A	B	C	
A	B	C	D
E	B	C	D
E	A	C	D

FIFO with 5 frames

F ₁	F ₂	F ₃	F ₄	F ₅
A				
A	B			
A	B	C		
A	B	C	D	
A	B	C	D	E

[5 Replacements]

[5 Replacements]

Q2)

Ref: A, B, A, B, A, A, C, D, D, B, D, E, A, D, A

Second Chance with 3 frames

F ₁	F ₂	F ₃
A ₁		
A ₁	B ₁	
A ₁	B ₁	C ₁
D ₀₁	B ₀	C ₀
D ₁	B ₀	E ₁
D₀₁	B₀ A ₁	E₀₁
D ₁	A ₁	E ₁

6 replacements

Q2)

Second chance with 4 frames

F_1	F_2	F_3	F_4
A_1			
A_1	B_1		
A_1	B_1	C_1	
A_1	B_1	C_1	D_1
E_1	B_0	C_0	D_0
E_1	A_1	C_0	D_0
E_1	A_1	C_0	D_1

6 replacements

Q2)

Second chance with 5 frames

F_1 F_2 F_3 F_4 F_5

A_1

A_1 B_1

A_1 B_1 C_1

A_1 B_1 C_1 D_1

A_1 B_1 C_1 D_1 E_1

5 replacements

Q2)

clock with 3 frames

F_1	F_2	F_3	
A_1			(1)
A_1	B_1		(2)
A_1	B_1	C_1	(3)
D_1	B_0	C_0	(1)
D_1	B_1	C_0	
D_1	B_0	E_{10}	(3)
D_0	A_1	E_1	(2)
D_1	A_1	E_1	

6 replace marks

(Q2)

clock with 4 frames

F_1	F_2	F_3	F_4	
A_1				(1)
A_1	B_1			(2)
A_1	B_1	C_1		(3)
A_1	B_1	C_1	D_1	(4)
E_1	B_0	C_0	D_0	(1)
E_1	A_1	C_0	D_0	(2)
E_1	A_1	C_0	D_1	

6 replacements

(Q2)

clock with 5 frames

$F_1 \quad F_2 \quad F_3 \quad F_4 \quad F_5$

A_1 (1)

$A_1 \quad B_1$ (2)

$A_1 \quad B_1 \quad C_1$ (3)

$A_1 \quad B_1 \quad C_1 \quad D_1$ (4)

$A_1 \quad B_1 \quad C_1 \quad D_1 \quad E_1$ (5)

5 replacements