COMPUTER SCIENCE

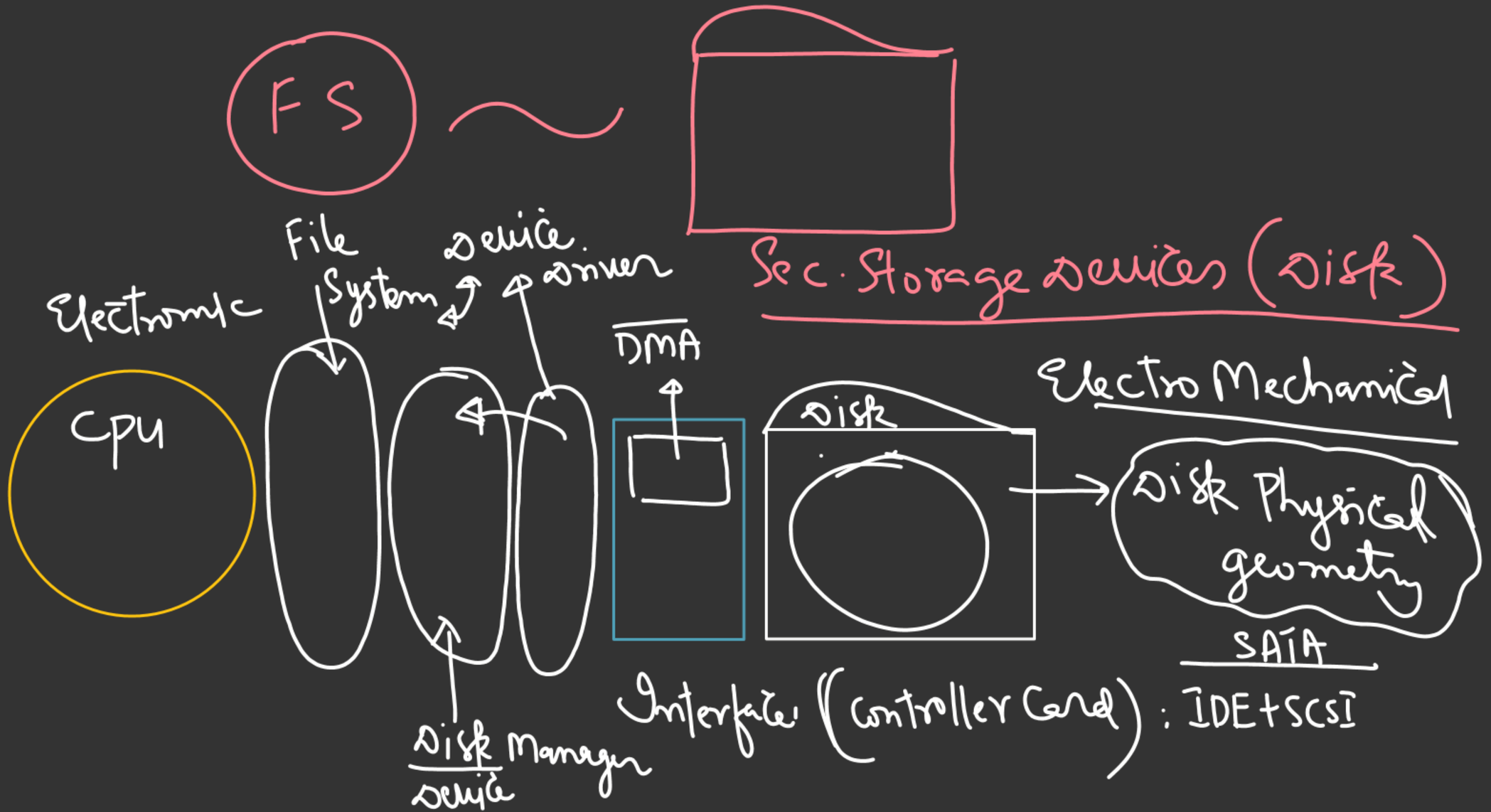
Operating System

Page Replacement Algorithms

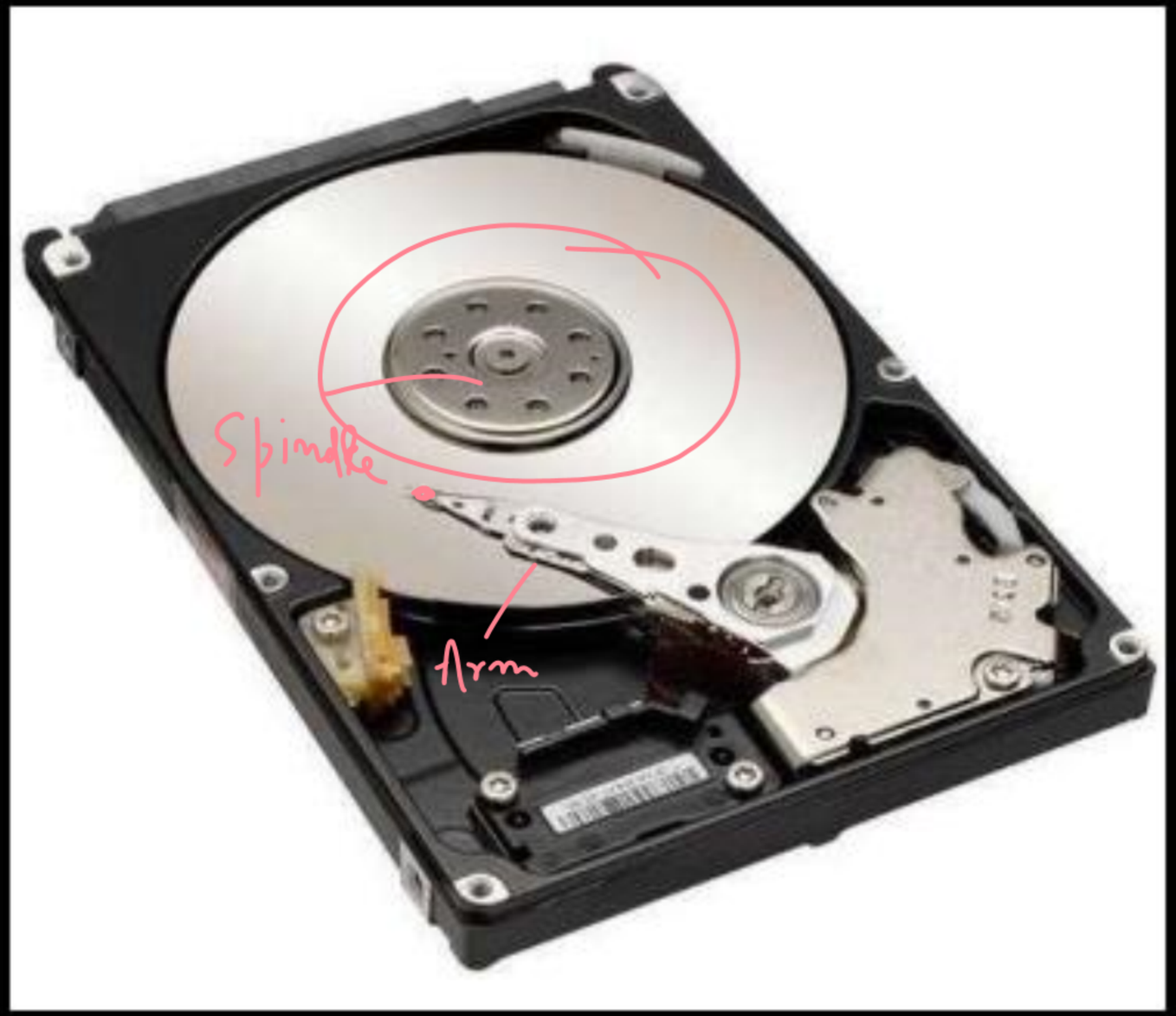
Lecture no:08

Page Replacement Algorithms

File System : is the visible portion of O.S



Disk Physical Structure (Physical Geometry)


Spindle
Arm

H.D.D → Platters
↳ 2 Surfaces
↳ Tracks
↳ Sectors
(unit of
Transfer)

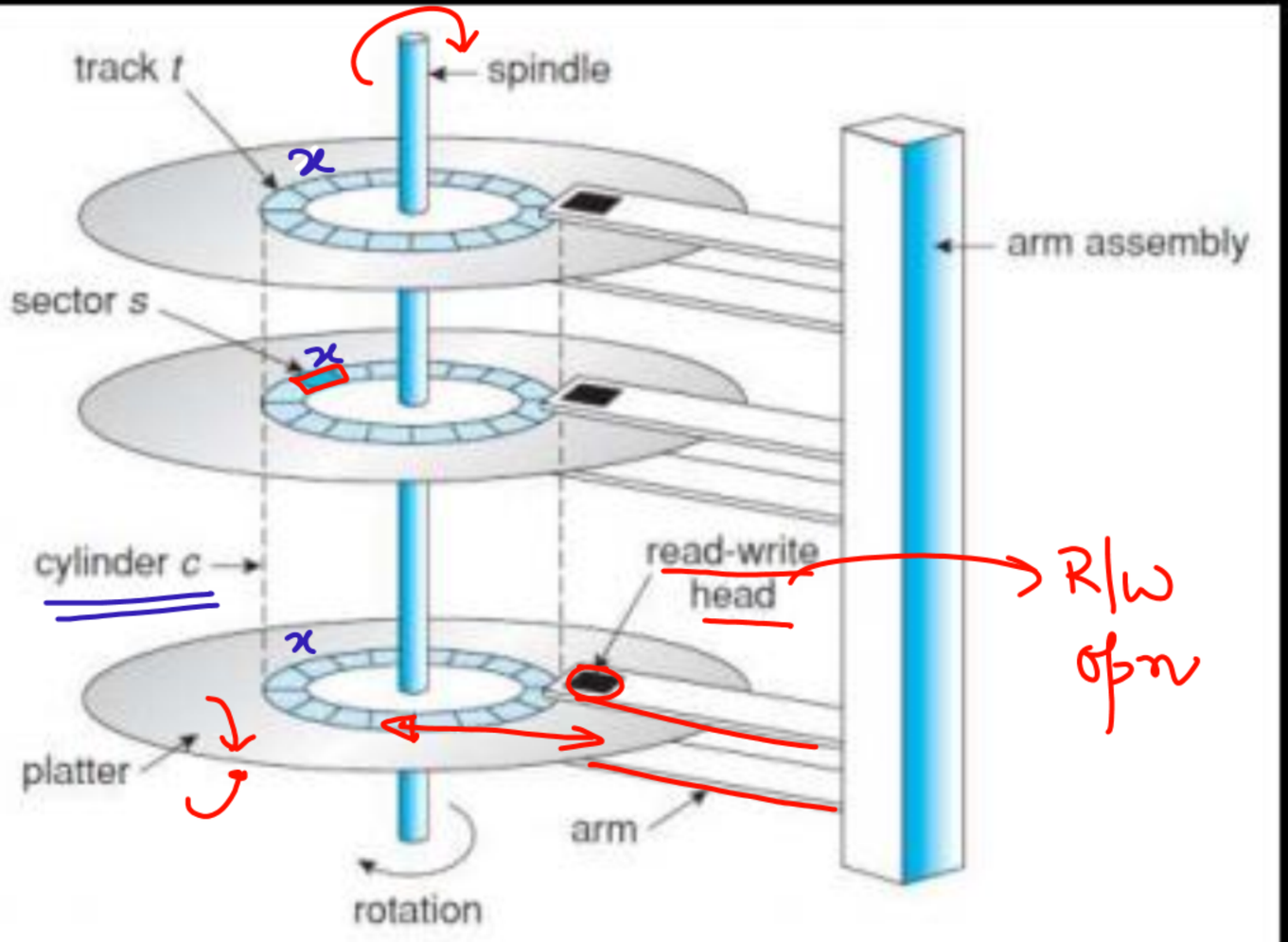


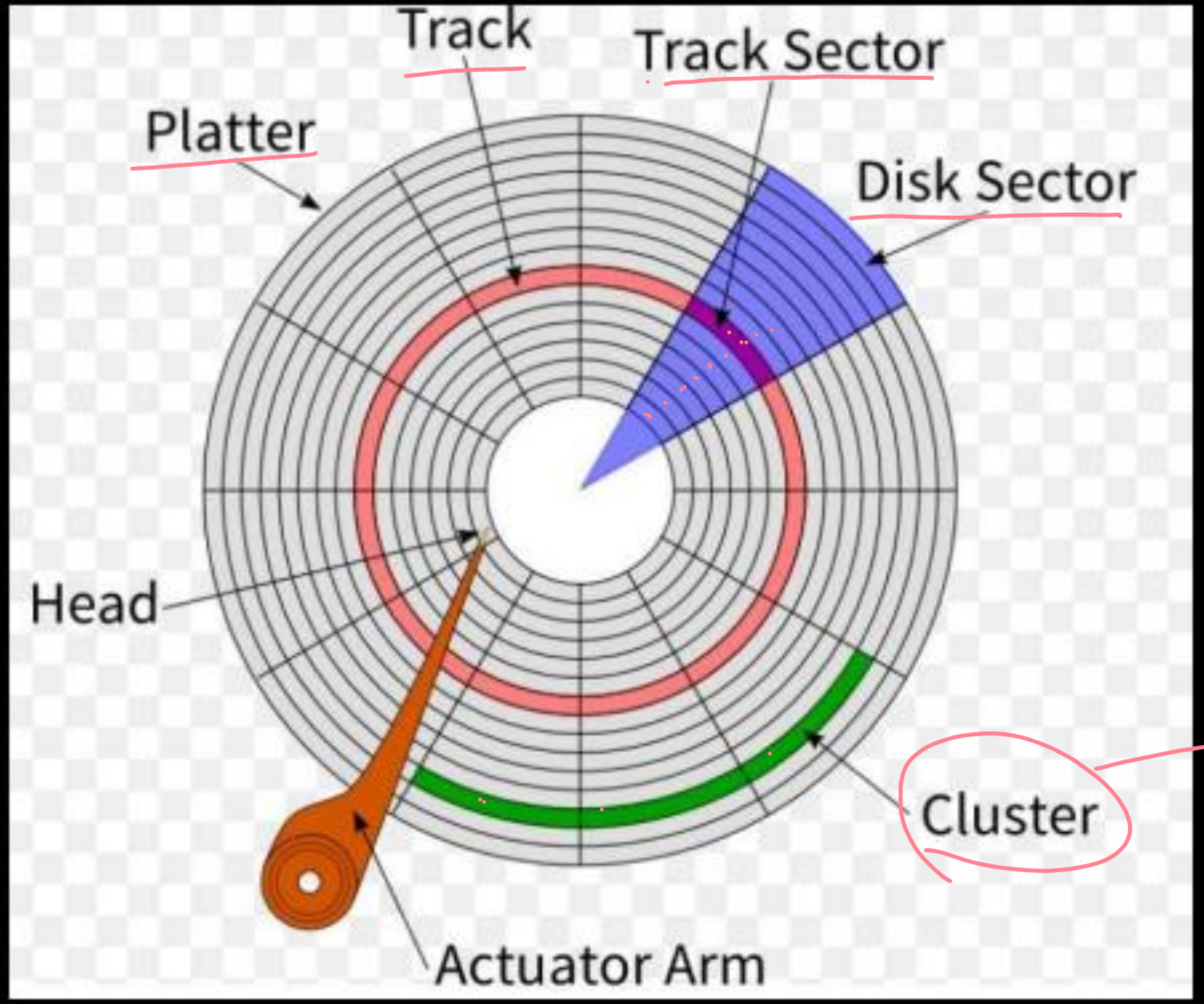
Figure 10.1 Moving-head disk mechanism.

Disk
↓
Platters
↳ 2 Surface
↓
Tracks
↳ Sectors

No. of Cylinders = No. of Tracks

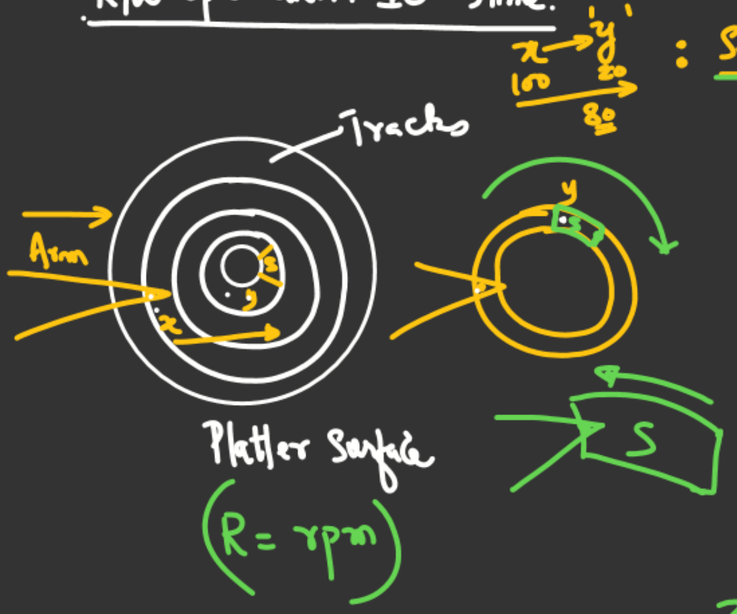
R/W opn

Angular Motion (Spindle)
Linear Motion (Arm)



1/more
group of Sectors on
same track.

R/W operation: IO - Time:



TTT: t-t: 1ms

: Seek Time (S.T) (R = Time for 1 Rotation)

+ Rotational Latency Time (L.T) ($\frac{R}{2}$)

+ Transfer Time (TT)

: 3600 rpm

3600 r — 60 s

1 r — ?

$$R = \frac{60}{3600} = 16.67 \text{ ms}$$

Track-Size = 'Z' Bytes

Sector-Size = 'x' Bytes

Rot - Time = 'R' ms

'Z' Bytes — 'R' ms

x Bytes = ?

$$TT = \left(\frac{X \cdot R}{Z}\right) \text{ ms}$$

$$\frac{\text{IO\_time}}{\text{Sector}} = S.T + L.T + TT$$

Data Transfer rate (B/s)

Z Bytes — R ms

? — 1 s

$$\frac{Z}{R} \times 10^3 \text{ B/s}$$

DTR

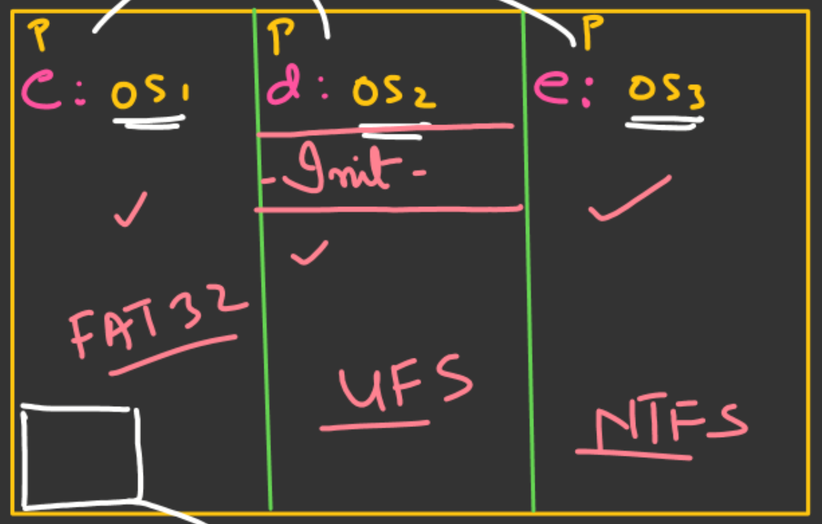
File System Workflow

Disk Logical Structure

Partitions / volumes / Mini Disk

Formatting Process

NTFS.
FAT 32.
EXT 4.
UFS



Partitions

Primary — Bootable <OS + Data>

Extended — Non-Bootable <only Data>

Disk

Formatted

Raw

Multi-Boot Computer

Disk <fdisk; df . . >

MBR = Master Boot Record

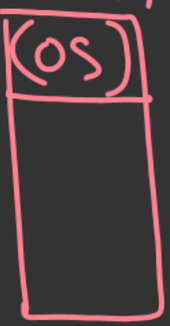
- Partition Table
- Boot loader

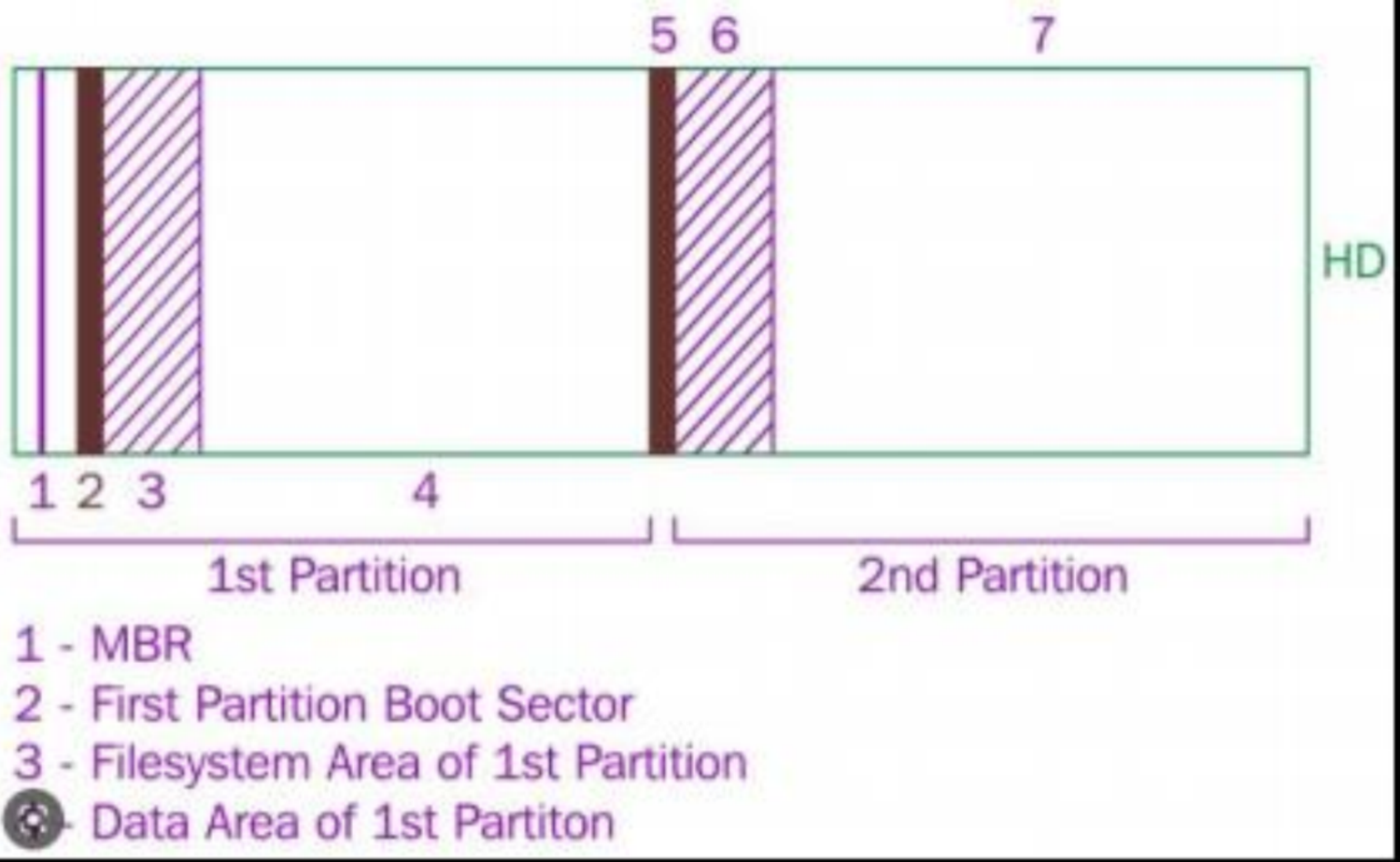
Booting Steps :

1. POST
2. BIOS <ROM>
3. BootStrap <ROM>
4. M.B.R in RAM

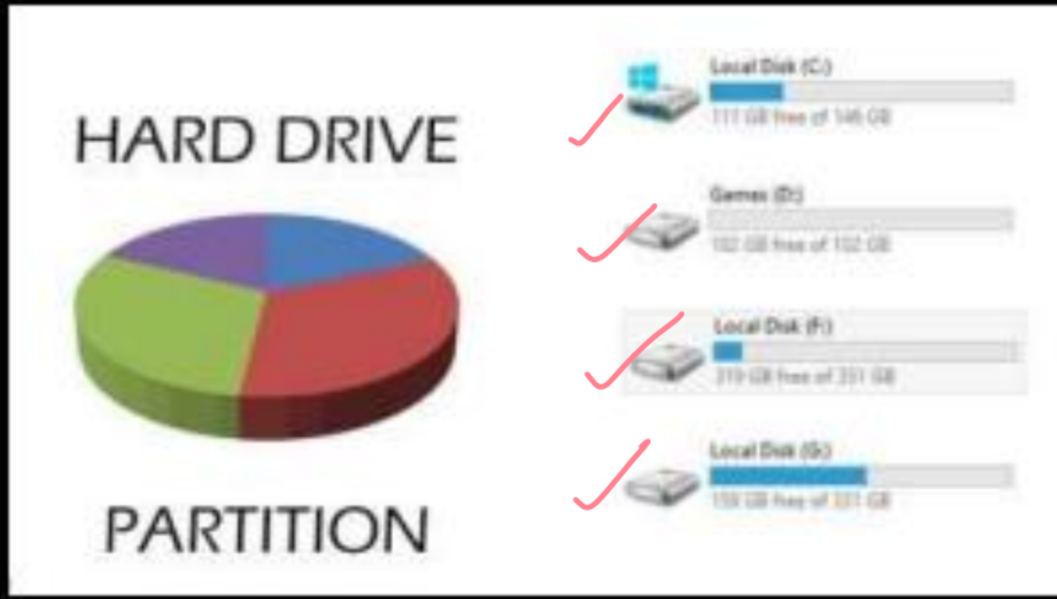
<Boot Loader>

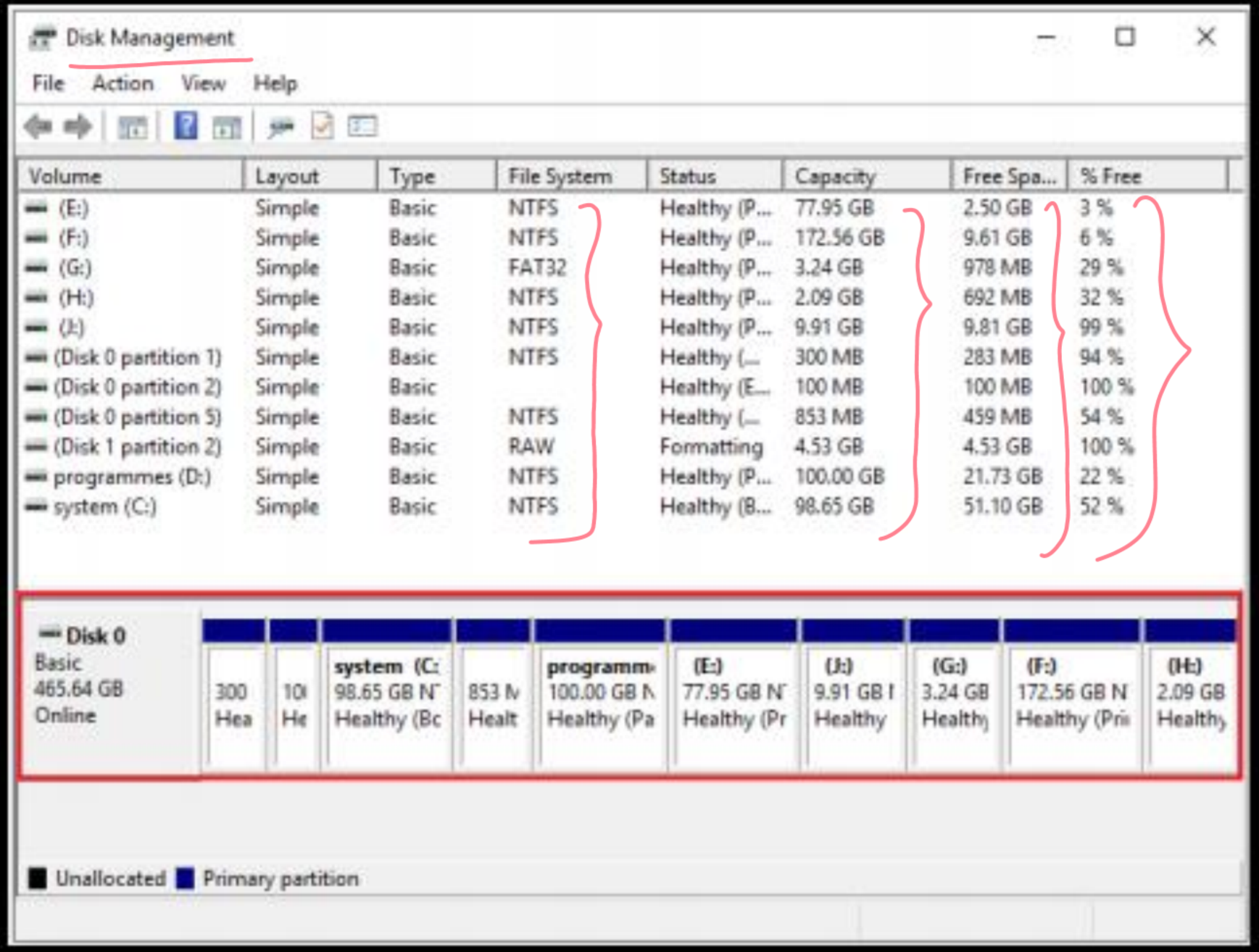
Partition Table





1 - MBR
2 - First Partition Boot Sector
3 - Filesystem Area of 1st Partition
4 - Data Area of 1st Partiton





Partition Structure

?

Q.1 Consider the following Disk Specifications:

Number of Platters = 16 (2)

Number of Tracks/Surface = 512

Number of Sectors/Track = 2048

Sector offset = 12 bits ; d=12 ⇒ S.S = 2^d

Average Seek Time = 30 ms

Disk RPM = 3600 ; R = 16.6 ms

Calculate the Following:

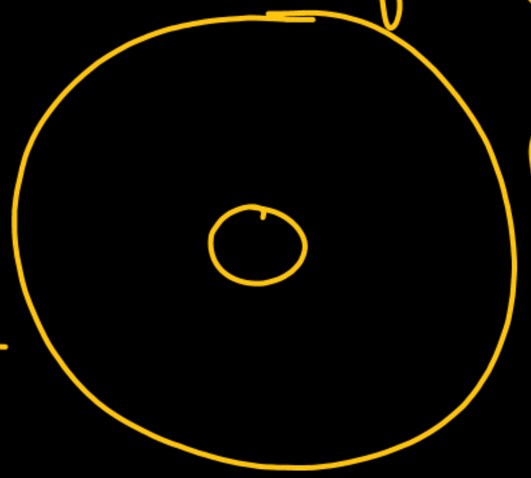
A. Unformatted Capacity of Disk. (128GB)

B. IO-Time/Sector : ST+LT+TT = [(30ms + 8.3) + x]

C. Data Transfer Rate

D. Sector Address

Surface Capacity



S.S = 2^{12}

512 x 2K * 4kB

TS = 2K * 4kB

= 8mB

Disk Capacity = 32 * 512 x 2K x 4kB

$= 2^5 \times 2^9 \times 2^{11} \times 2^{12} \times 2^{37} = 2^{74}$

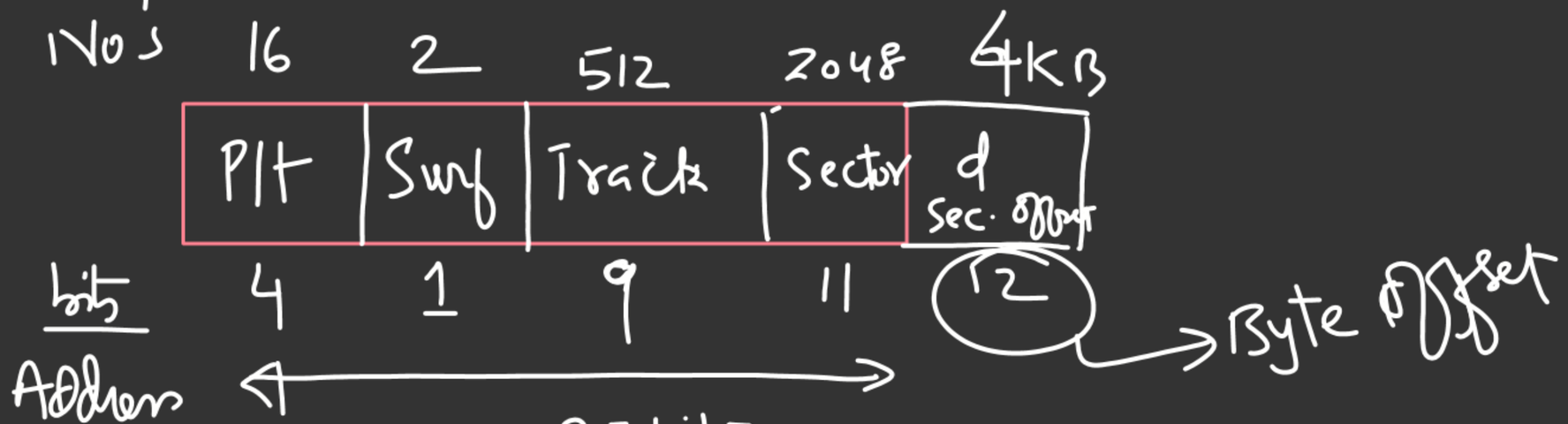
= 128GB ✓

8mB — 16.6ms

4kB — ?

TT $\left(\frac{4 \times 16.6}{28K}\text{ ms}\right) = x$

Sector Address :



SecAddr = 25 bits

Total disk capacity = 2^{37} = 128GB ✓

Q.2

Consider a Disk with the following Specifications:

Number of surfaces = 64

Outer diameter = 16 cm

Inner diameter = 4 cm

Inter Track space = 0.1 mm

Max Density = 8000 bits/cm

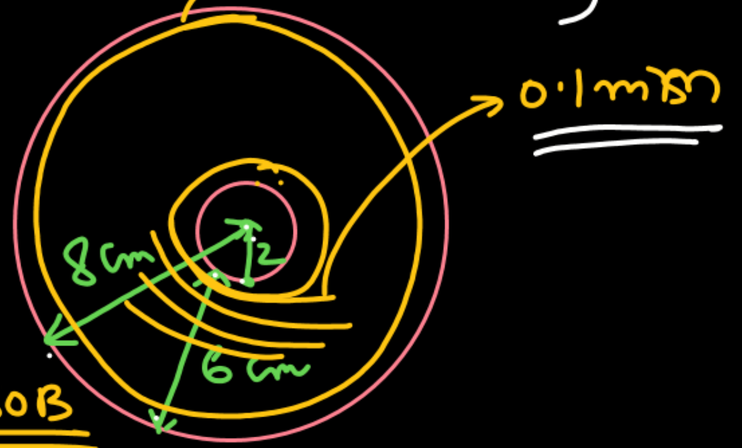
Track Size = $2\pi r$
= $2 \cdot 3.14 \times 2$ cm
= 12.56 cm

12.56 cm

8000 bits — 1 cm
? — 12.56 cm

$\left(\frac{8000 \times 12.56 \text{ bits}}{8}\right)$: TS

= $1000 \times 12.56 = 12560$ B



Calculate the Unformatted Capacity of Disk.

T.S = 12560 B = 12.56 KB

Surf. Cap = 600 × 12.56 KB

= 6 × 12.56 KB

Disk Cap = 64 × 6 × 12.56 KB

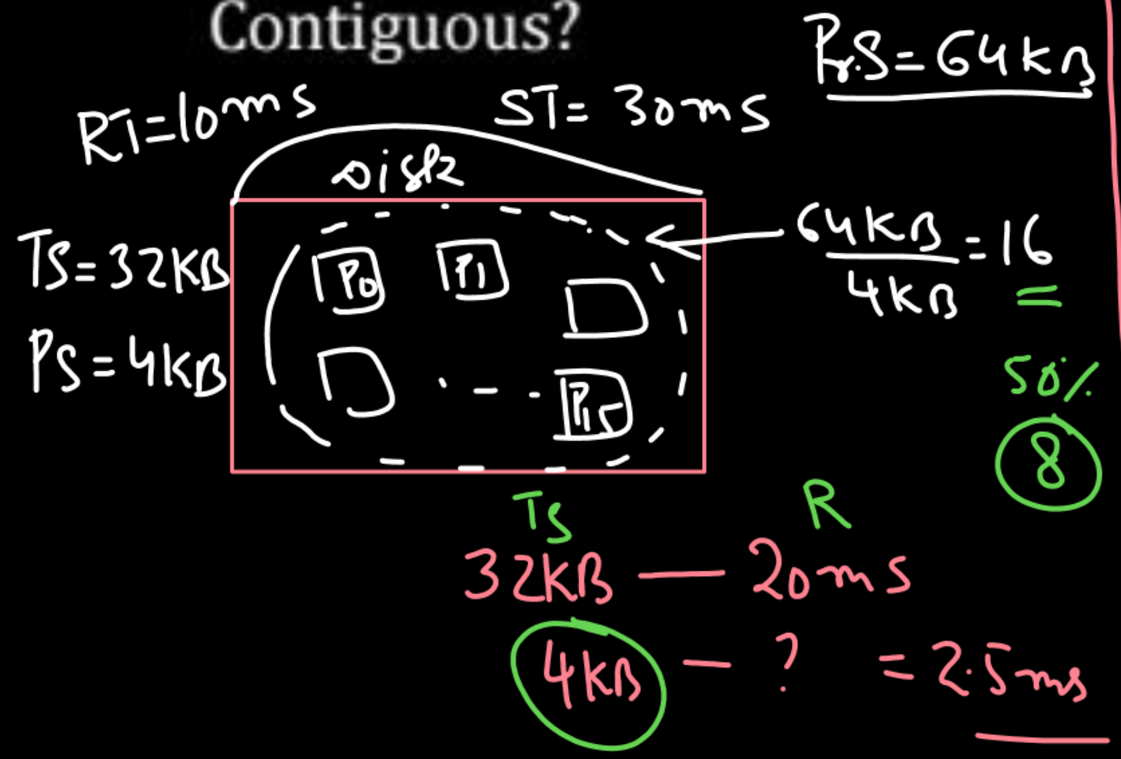
No. of Tracks = $\frac{6\text{cm}}{0.1\text{mm}}$ = $\frac{6\text{cm}}{0.01\text{cm}}$ = 600

No. of Tracks / Surf.

Q.3

How long does it take to load a 64 Kbytes Program from a disk whose Average Seek time is 30 ms Rotation time is 20 ms, Track Size is 32 Kbytes, Page Size is 4 Kbytes. Assume that Pages of the Program are distributed randomly around the disk. What will be the % saving in time if 50% of the Pages of program are Contiguous?

0.685



P.S = 64KB

Time to Load Program = (Time to Load a Page) * No. of Pages

Time to load

= 8 * (ST+LT+TT)

+ S.T+L.T+8xTT

= 8x42.5 + (60) ms

= 340 + 60 = 400 ms

= 0.4s

= (S.T+L.T+TT) * 16

= (30+10ms+2.5ms) * 16

= 42.5x16 ms = 680 ms

= 0.68s

= 0.28/0.68

Q.4

An Application requires 100 libraries at startup. Each library requires 1 disk access. Seek Time is 10 ms, Disk RPM is 6000. All 100 libraries are at random locations. 50% of Libraries requires transfer time of ½ Rotation, while for the remaining 50% it is negligible. How long does it take to load all 100 libraries?

H/w

THANK YOU!