Q1. What is the average access time for transferring 512 bytes of data with the following specifications-

- Average seek time = 5 msec
- Disk rotation = 6000 RPM
- Data rate = 40 KB/sec
- Controller overhead = 0.1 msec

Solution-

Given-

- Average seek time = 5 msec
- Disk rotation = 6000 RPM
- Data rate = 40 KB/sec
- Controller overhead = 0.1 msec

Time Taken For One Full Rotation-

Time taken for one full rotation
= (60 / 6000) sec
= (1 / 100) sec
= 0.01 sec
= 10 msec

Average Rotational Delay-

Average rotational delay
= 1/2 x Time taken for one full rotation
= 1/2 x 10 msec
= 5 msec

Transfer Time-

Transfer time
= (512 bytes / 40 KB) sec
= 0.0125 sec
= 12.5 msec

Average Access Time-

Average access time
= Average seek time + Average rotational delay + Transfer time + Controller overhead + Queuing delay
= 5 msec + 5 msec + 12.5 msec + 0.1 msec + 0
= 22.6 msec

Q2: A certain moving arm disk storage with one head has the following specifications-

- Number of tracks per surface = 200
- Disk rotation speed = 2400 RPM
- Track storage capacity = 62500 bits
- Average latency = P msec
- Data transfer rate = Q bits/sec

What is the value of P and Q?

Solution-

Given-

- Number of tracks per surface = 200
- Disk rotation speed = 2400 RPM
- Track storage capacity = 62500 bits

Time Taken For One Full Rotation-

Time taken for one full rotation
= (60 / 2400) sec
= (1 / 40) sec
= 0.025 sec
= 25 msec

Average Latency-

Average latency or Average rotational latency
= 1/2 x Time taken for one full rotation
= 1/2 x 25 msec
= 12.5 msec

Data Transfer Rate-

Data transfer rate
= Number of heads x Capacity of one track x Number of rotations in one second
= 1 x 62500 bits x (2400 / 60)
= 2500000 bits/sec
= 2.5×10^6 bits/sec

Thus, P = 12.5 ms and Q = 2.5×10^6 bits/sec

Q3. Consider a typical disk that rotates at 15000 RPM and has a transfer rate of 50×10^6 bytes/sec. If the average seek time of the disk is twice the average rotational delay and the controller's transfer time is 10 times the disk transfer time. What is the average time (in milliseconds) to read or write a 512 byte sector of the disk?

Solution-

Given-

- Rotation speed of the disk = 15000 RPM
- Transfer rate = 50×10^6 bytes/sec
- Average seek time = 2 x Average rotational delay
- Controller's transfer time = 10 x Disk transfer time

Time Taken For One Full Rotation-
Time taken for one full rotation
= (60 / 15000) sec
= 0.004 sec
= 4 msec

Average Rotational Delay-
Average rotational delay
= 1/2 x Time taken for one full rotation
= 1/2 x 4 msec
= 2 msec

Average Seek Time-
Average seek time
= 2 x Average rotational delay
= 2 x 2 msec
= 4 msec

Disk Transfer Time-
Disk transfer time
= Time taken to read or write 512 bytes
= 512 bytes / (50×10^6 bytes/sec)
= 10.24×10^{-6} sec
= 0.01024 msec

Controller's Transfer Time-

Controller's transfer time
= 10 x Disk transfer time
= 10 x 0.01024 msec
= 0.1024 msec

Average Time To Read Or Write 512 Bytes-
Average time to read or write 512 bytes
= Average seek time + Average rotational delay + Disk transfer time + Controller's transfer time + Queuing delay
= 4 msec + 2 msec + 0.01024 msec + 0.1024 msec + 0
= 6.11 msec

Q4. Consider a disk pack with a seek time of 4 milliseconds and rotational speed of 10000 rotations per minute (RPM). It has 600 sectors per track and each sector can store 512 bytes of data. Consider a file stored in the disk. The file contains 2000 sectors. Assume that every sector access necessitates a seek, and the average rotational latency for accessing each sector is half of the time for one complete rotation. The total time (in milliseconds) needed to read the entire file is _____.

Solution-

Seek time (given) = 4ms

RPM = 10000 rotation in 1 min [60 sec]

So, 1 rotation will be =60/10000 =6ms [rotation speed]

Rotation latency= 1/2 * 6ms=3ms

To access a file,

total time includes =seek time + rot. latency +transfer time

TO calc. transfer time, find transfer rate

Transfer rate = bytes on track /rotation speed

so, transfer rate = 600*512/6ms =51200 B/ms

transfer time= total bytes to be transferred/ transfer rate

so, Transfer time =2000*512/51200 = 20ms

Given as each sector requires seek time + rot. latency

= 4ms+3ms =7ms

Total 2000 sector takes = 2000*7 ms =14000 ms

To read entire file, total time = 14000 + 20(transfer time)

= 14020 ms