1. A manufacturer wishes to design a hard disk with a capacity of 30 GB or more (using the standard definition of 1 GB = 2^30 bytes). If the technology used to manufacture the disks allow 1024-byte sectors, 2048 sectors/track, and 4096 tracks/platter, how many platters are required? (Assume a fixed number of sectors per track)

Solution:

30 GB = 30 x 2^{30} = 32,212,254,720 bytes   ; 1 GB = 2^{30} bytes

According to a disk capacity, a disk allow 1,024-byte sectors, 2,048 sectors/track, 4,096 tracks/ platter

The number of sectors   = 32,212,254,720 / 1,024 = 31,457,280 sectors
The number of tracks   = 31,457,280 / 2,048 = 15,360 tracks
The number of platters   = 15,360 / 4,096 = 3.75 platters

Therefore, to design a hard disk with a capacity of 30 GB, a hard disk requires to contain 4 platters.

2. A hard disk with one platter rotates at 15,000 r/min and has 1024 tracks, each with 2048 sectors. The disk head starts at track 0 (track is numbered from 0 to 1023). The disk then receives a request to access a random sector on a random track. If the seek time of the disk head is 1 ms for every 100 tracks it must cross;

a) What is the average seek time?

Solution:

Average seek time   = Half of the total tracks / the seek time of the disk head for every 100 tracks
            = (1023 / 2) / 100
            = 5.115 msec

b) What is the average rotational latency?

Solution:

Average rotational latency   = (1 / 2) x (1 / rotational speed)   ; rotational speed = 15,000 r/min
            = (1 / 2) x (1 / 15,000)
            = 0.0000333333 min/r
            = 2 msec/r