Name: _____ USC ID: _____

INF 551 – Spring 2018

Quiz 2: Storage systems (10 points), 10 minutes

Consider a hard drive with the following characteristics:

Number of cylinders	512
Number of heads	8
Number of sectors per track	256
Size of sector	4KB
Number of sectors per block	1
(Maximum) bandwidth	100MB/s
Rotational speed	**7,200RPM**
Maximum seek time	15ms

a) [2 points] What is the capacity of the hard drive?

Capacity = #cylinders * #heads * #sector per track *size of sector
= 512 * 8 * 256 *4 KB = 2^9 * 2^3 * 2^8 * 2^2 * 2^10 Bytes
= 2^32 Bytes = 4 GB

b) [4 points] How much does it take to access 100 blocks **randomly** located on the disk? What is the actual bandwidth for this workload?

Random access: For each block

T_{seek} = Average seek time = 1/3 * Maximum seek time = 5 ms

$T_{rotation}$ = ½ rotation * Full rotation time

= ½ rotation * (60000 ms per minute) / (7200 Rotations per minute)

= ½ rotation * 8.33 ms / rotation

= 4.17 ms

$T_{transfer}$ = 4 KB / (100MB/s) = 4KB / (100KB/ms) = 0.04 ms

T = (T_{seek} + $T_{rotation}$ + $T_{transfer}$) * #blocks = 9.21 * 100 = 921 ms

Actual bandwidth = 100 blocks * 4 KB/sector * 1 sector/block / 921 ms
= 400/921 KB/ms = 0.43 KB/ms = 0.43 MB/s

c) [4 points] How much does it take to access 100 blocks **sequentially** located on the disk? What is the actual bandwidth for this workload?

Sequential access:

For the full process:

T_{seek} = 5 ms

$T_{rotation}$ = 4.17 ms

For each block:

$T_{transfer}$ = = 0.04 ms

T = T_{seek} + $T_{rotation}$ + $T_{transfer}$ * #blocks
= 5 + 4.17 + 0.04 * 100
= 13.17 ms

Actual bandwidth = 400/13.17 KB/ms = 30.37 KB/ms = 30.37 MB/s