

1.

a) Time for one rotation is 6ms. The average rotational latency is 3ms (half of 6ms)

b) This file has 2,000 sectors, which need 2 adjacent tracks.

Time to read the first track: 5ms + 3ms + 6ms = 14ms.

Time to read the second track: 3ms + 6ms=9ms

The total time is 23ms.

c) For each sector, the average access time is 5ms + 3ms + 0.006ms = 8.006ms.

Repeat this for 2,000 blocks, we have 2000 * 8.006ms = 16012ms

2. Suppose the disk has a set of tracks from 0 to N. The seek length between any two tracks x and y could be written in the absolute value of the difference |x-y|

To compute the average seek length, we need to first add up all the possible seek lengths in the following form

$$\sum_{x=0}^N \sum_{y=0}^N |x - y|$$

Then we need to divide this number by the number of possible seeks: N^2

For simplicity, we use the integral form to compute the sum.

$$\int_{x=0}^N \int_{y=0}^N |x - y| dy dx$$

Let's split the absolute value into two parts,

$$\int_{x=0}^N \left[\int_{y=0}^x (x - y) dy + \int_{y=x}^N (y - x) dy \right] dx$$

By computing the inner integral with y, we will have the following equation

$$\int_{x=0}^N \left(x^2 - Nx + \frac{1}{2}N^2 \right) dx = \frac{N^3}{3}$$

To compute the average seek length, we need to divide the $\frac{N^3}{3}$ by N^2 , leading to $\frac{N}{3}$. Thus the average seek length on a disk is one-third the full length, meaning that the average seek time is one-third of the full seek time.

3.

a)

FIFO	82	170	43	140	24	16	190
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SSTF	43	24	16	82	140	170	190
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SCAN	82	140	170	190	199	43	24	16
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C-SCAN	82	140	170	190	199	0	16	24	43
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b)

FIFO: The total number of tracks is $(82-50)+(170-82)+(170-43)+(140-43)+(140-24)+(24-16)+(190-16)=642$. The average seek length is $642/7=91.7$

SSTF: The total number of tracks is $(50-43)+(43-24)+(24-16)+(82-16)+(140-82)+(170-140)+(190-170)=208$. The average seek length is $208/7=29.7$

SCAN: The total number of tracks is $(199-50)+(199-16)=332$. The average seek length is $332/7=47.4$

C-SCAN: The total number of tracks is $(199-50)+(199)+(43)=391$. The average seek length is $391/7=55.8$