1. 1 / (10000 / 60)

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.

1.024e6/512 = 2000 = 2 x 1000

Ta = 5 + 3 + 6 + (2 - 1)(3 + 6) = 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

Ta = 2000(5 + 6/2 + 1/1000 x 6) = 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.

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

Let's split the absolute value into two parts,

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

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
SSTF	43	24	16	82	140	170	190
SCAN	82	140	170	190	43	24	16
C-SCAN	82	140	170	190	16	24	43

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 (50 - 16) + (190 - 16) = 208

SCAN: The total number of tracks is (190-50)+(190-16)=314. The average seek length is 314/7=44.8

C-SCAN: The total number of tracks is (190-50)+(190-16)+(43-16)=341. The average seek length is 48.7