HW #4

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1) How much is average rotational delay?

15,000 rpm seeks for 1 minute

$$\frac{60s \times 1000}{15000 \, rpm} = 4ms$$

average rotational delay is half the time for one full rev

$$\frac{4ms}{2} = \boxed{2m/s}$$

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2) How many records can be stored in one sector?

bits per sector 512, 20000 records, each 64 bits

$$512/64 = 8 \qquad \boxed{8 \text{ records per sector}}$$

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3) How many clusters are needed for the file?

8 sectors per cluster   20,000 files   each sector 8 records

#of sectors needs $= 20000/8 = 2500$ sectors for file

#of clusters needed $= \dfrac{2500}{8} = 312.5 \qquad \boxed{313 \text{ clusters need for the file}}$

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4) How much is the time for reading one track, including the seek time, the average rotational delay, and transfer time

Seek time: 6 ms   Average rotational delay: 2ms

Bytes per track: 400 sector × 512 byte per sector = 204,800 bytes

transfer rate: 204,800 bytes / 4 ms = 51,200 bytes/ms

transfer time for one track: 204,800 bytes / 51,200 bytes/ms = 4ms

Total time: 6ms(seek time) + 2ms(rotational delay) + 4ms(transfer time) = $\boxed{12 ms}$

5) Assuming contiguous storage, namely, the records are stored in clusters from the same track as long as possible, how much is the total time for reading the whole file

400 sectors per track   One track takes 12ms

8 record per sector   8×400=3200 records per track

$$\frac{20,000}{3200} = 6.25 \text{ tracks} \qquad 6.25 \times 12 = 75 \text{ ms}$$

$$\text{or 7 tracks or} \qquad 7 \times 12 = 84 \text{ m/s}$$

6) Assuming the minimal transfer unit is one cluster, how much is the time for reading one cluster, including seek time, average rotational delay, and transfer time

Each cluster has 8 sectors   transfer time per sector is 0.01

Seek time: 6ms

rotational delay = 2ms

$$6ms \text{ (seek time)} + 2ms \text{ (rotational delay)} + \frac{4}{400} = 8.08 ms$$

$$6ms \text{ (seek time)} + 2ms \text{ (rotational delay)} + (8)(0.01 ms) = 8.08 ms$$

7)

7) Assuming random storage of the records and every record is stored in a different cluster, reading a cluster will include the seek time, the average rotation delay, and the transfer time for that cluster, how much is the total time for reading the whole file

If each record is stored in a different cluster we need 20,000 clusters

$$20000 \text{ clusters} \times 8.08 \text{ m/s per cluster} = 161600 \text{ ms}$$