

Question 1.

Suppose the Super2020 drive has the following characteristics:

- There are 3 platters with 250,000 tracks each surface.
- Tracks have 8000 sectors of 512 bytes each.
- 8% of each track is used for gaps.
- The disk rotates at 7200 RPM.
- The time it takes the tape head to move n tracks is $(1+0.0003n)$ mS

Answer the following questions about the Super2020 drive:

1. What is the capacity of the disk?
 - Capacity = 6.144 TB
 - 3 platters = 6 surfaces
 - 6 surfaces * 250,000 tracks * 8000 sectors * 512 bytes = 6.144e12 bytes
2. Suppose this disk has a 2.5in laptop drive, what is the average bit density in the sectors of the outermost track?
 - $\frac{6553600}{\text{in}}$ bit/in
 - 1 track = 8000 sectors
 - 1 sector = 512 bytes
 - 1 byte = 8 bits
 - $8000 \text{ sectors} * 512 \text{ bytes} * 8 \text{ bits} / [(2.5\text{in radius} * 2)]$
3. What is the maximum seek time?
 - Time it takes to move from innermost to outermost track = 76 mS
 - $(1 + 0.0003(250,000))$ mS
 - 1 full revolution takes 8.3mS
4. What is the average rotational latency?
 - Average rotational latency is about 4.2mS
 - 7200 RPM drive, minute/round = 1/7200
 - second/round = 60/7200
 - 8.3mS, average rotational latency is half of this

Question 2.

Suppose we are scheduling I/O requests for the Super2020 drive given in problem 1, and the head is initially at track 35,000. Further, suppose requests come in according to the table below:

Cylinder Requested	Time Request Made From Start Time in mS
60,000	0
1,000	2
44,000	11
7,000	19

From the slides: *'If there were no further requests in that direction, the direction of moving inward or outward is reversed.'*

(a) the elevator algorithm is used (initially moving inward)?

Start Cylinder	End Cylinder	Seek time (mS)	Average Rotational (mS)	Transfer Time (mS)	Latency Time (mS)	Time Completed (ms)
35000	60000	8.5	4.2	0.008217	12.708217	12.708217
60000	44000	5.8	4.2	0.008217	10.008217	22.716434
44000	7000	12.1	4.2	0.008217	16.308217	39.024651
7000	1000	2.8	4.2	0.008217	7.008217	46.032868

(b) We use first-come-first-served scheduling.

Start Cylinder	End Cylinder	Seek time (mS)	Average Rotational (mS)	Transfer Time (mS)	Latency Time (mS)	Time Completed (ms)
35000	60000	8.5	4.2	0.008217	12.708217	12.708217
60000	1000	18.7	4.2	0.008217	22.908217	35.616434
1000	44000	13.9	4.2	0.008217	18.108217	53.724651
44000	7000	12.1	4.2	0.008217	16.308217	70.032868

Question 3

Suppose we have 3 data drives and 1 redundant disk and we are using RAID level 4. Assume blocks are a single byte.

(a) What would be the redundant block corresponding to the three data blocks: 10100011, 11010011, 01110101?

- 0000101

(b) What would be the redundant block corresponding to the three data blocks: 11000011, 11010011, 10011101?

- 10001101