Advanced Databases
Assignment 1

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Question 1

(1) The capacity of each cylinder:

$$10 \times 512 \times 1000 = 5.12 \times 10^6 \text{ bytes} = 5.12 \text{ MB}.$$

(2) Total degrees covered by ~~two~~ two consecutive blocks (64 sectors, 63 gaps):

$$\left(\frac{64}{1000} \times 80\% + \frac{63}{1000} \times 20\% \right) \times 360 = 22.97 \text{ degrees}$$

Total time to transfer two consecutive blocks:

$$\frac{22.97}{360} \times \frac{60}{10000} s = \frac{22.97}{360} \times 6 \text{ms} = 0.38 \text{ ms}$$

(3) Degree for a block: $\left(\frac{32}{1000} \times 80\% + \frac{31}{1000} \times 20\% \right) \times 360 = 11.45 \text{ degrees}$

$$\text{Average time} = 4 \times \left(3 + \frac{11.45}{360} \times 6\text{ms} \right) = 12.76 \text{ ms}$$

(4) Average number of tracks have traveled:

$$\frac{2500}{2} \times \frac{1}{4} + \frac{7500}{2} \times \frac{3}{4} = 3125.$$

Average seek time: $1 + 0.001 \times 3125 = 4.125 \text{ ms}$

Average time to read the random block:

$$\left(3 + \frac{11.45}{360} \times 6\text{ms} \right) + 4.125 = 7.32 \text{ ms}$$

Question 2

$$M = 100 \times 2^{20} \qquad B = 16,384 \text{ bytes} \qquad R = 160 \text{ bytes}$$

$$\frac{M^2}{RB} = \frac{(100 \times 2^{20})^2}{160 \times 16384} = 4.2 \text{ billion records}.$$

$$\frac{4.2 \text{ billion}}{100} \times 2 \times 11 \text{ms} = 9.24 \times 10^8 \text{ ms} = 924000 s = 15400 \text{ minutes}$$

$$\text{Total time} = 15400 + 15400 = 30800 \text{ minutes}.$$

Question 3

	1	2	3	4	5	6	7
	1	1	1	0	1	0	0
	1	1	0	1	0	1	0
	1	0	1	1	0	0	1

(a) Disks 1 and 7.

To recover disk 1 by taking the modulo-2 sum of disks 2, 3, and 5. (Row 1)

To recover disk 7 by taking the modulo-2 sum of disks 1, 3, and 4. (Row 3)

(b) Disks 1 and 4.

To recover disk 1 by taking the modulo-2 sum of disks 2, 3, and 5. (Row 1)

To recover disk 4 by taking the modulo-2 sum of disks 1, 2, and 6. (Row 2)

(c) Disks 3 and 6.

To recover disk 3 by taking the modulo-2 sum of disks 1, 2, and 5. (Row 1)

To recover disk 6 by taking the modulo-2 sum of disks 1, 2, and 4. (Row 2)

Question 4

	1	2	3	4	5	6	7	8	9	10	11
	1	1	1	1	0	0	0	0	1	0	0
	0	0	0	0	1	1	1	1	0	1	0
	0	1	0	1	0	1	0	1	0	0	1