Problem.

A disk has 8 equidistant tracks. The diameters of the innermost and outermost tracks are 1 cm and 8 cm respectively . The innermost track has a storage capacity of 10 MB.

[1] what is the total amount of data that can be stored on the disk if it is used with a drive that rotates it with

(1) Constant linear velocity

(2) Constant Angular velocity

(A) (1) 80 MB (2) 2040 MB (B) (1) 2040 MB (2) 80 MB

(C) (1) 80 MB (2) 360 MB (D) (1) 360 MB (2) 80 MB

[2] If the disk has 20 sectors per track and is currently at the end of the 5th sector of the inner most track and the head can move at a speed of 10 m/sec and it is rotating at constant angular velocity of 6000 rpm, how much time will it take to read 1 MB contiguous data starting from the sector 4 of the outer most track?

(A) 13.5ms (B) 10ms (C) 9.5ms (D) 20ms

Solution.

[1] (1) If disk rotates with constant velocity then total amount of data that can be stored on the tracks is linearly related to track length. The track with diameter has a storage capacity of 10 MB and length π (diameter 1 cm). Hence, if diameter of the track equals d then it has length πd and a storage capacity of $10d$ MB. The amount of data that can be stored equals

$$\sum_{d=1}^{8} 10d = 10 \sum_{d=1}^{8} d = 10 \cdot \frac{8 \cdot 9}{2} = 360 \text{ MB}.$$

(2) If disk rotates with constant angular velocity then total amount of data that can be stored on the tracks is linearly related to degree measure of track. The degree measures of all tracks are equal. Hence, the amount of data that can be stored equals

$$8 \cdot 10 = 80 \text{ MB}.$$

Answer: (D) (1) 360 MB (2) 80 MB.

[2] The time needed to read 1 MB contiguous data starting from the sector 4 of the outer most track consist of time needed to move from the end of the 5th sector of the inner most track and to the start of the 3th sector of the outer most track and time needed to read to read 1 MB contiguous data.

The head need to pass 18 sectors of the track (rotate for $\frac{18}{20}$ of the circle). It will take $\frac{18}{20} \cdot \frac{60}{6000} = 0.009 \text{ s} = 9$ ms.

The head need to move from inner track to the outer track. The distance between inner and outer track equals $\frac{8-1}{2} = 3.5 \text{ cm} = 0.035$ m. It will take $0.035 : 10 = 0.0035 \text{ s} = 3.5$ ms.

The head capacity of the outer track 10 MB(as we have constant angular velocity). The head need to read 1 MB. It will take $\frac{1}{10} \cdot \frac{60}{6000} = 0.001 \text{ s} = 1$ ms.

We should notice that head will have enough time to move from inner track to outer track, while it will be passing 18 sectors of the track (9 ms $>$ 3.5 ms).

Hence it will take 1 ms + 9 ms = 10 ms.

Answer: (B) 10ms.