DISK SCHEDULING

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June 2014 Paper III

Consider a program that consists of 8 pages (from 0 to 7) and we have 4 page frames in the physical memory for the pages. The page reference string is :
1 2 3 2 5 6 3 4 6 3 7 3 1 5 3 6 3 4 2 4 3 4 5 1
The number of page faults in LRU and optimal page replacement algorithms are respectively (without including initial page faults to fill available page frames with pages):
(A) 9 and 6
(B) 10 and 7
(C) 9 and 7
(D) 10 and 6

(B) 10 and 7

LRU Page Replacement:-

1	2	3	2	5	6	3	4	6	3	7	3	1	5	3	6	3	4	2
				5	5	5	5	5	5	7	7	7	7	7	6	6	6	6
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	2	2	2	2	2	2	4	4	4	4	4	1	1	1	1	1	4	4
1	1	1	1	1	6	6	6	6	6	6	6	6	5	5	5	5	5	2
					F		F			F		F	F		F		F	F

Number of Page Fault = 10

Optimal Page Replacement :-

1	2	3	2	5	6	3	4	6	3	7	3	1	5	3	6	3	4	2
				5	5	5	4	4	4	7	7	7	5	5	5	5	5	5
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	2	2	2	2	6	6	6	6	6	6	6	6	6	6	6	6	4	4
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
					F		F			F			F				F	F

Number of Page Fault = 7

June 2014 Paper III

Which of the following statements is not true about disk-arm scheduling algorithms?
(A) SSTF (shortest seek time first) algorithm increases performance of FCFS.
(B) The number of requests for disk service are not influenced by file allocation method.
(C) Caching the directories and index blocks in main memory can also help in reducing disk arm movements.
(D) SCAN and C-SCAN algorithms are less likely to have a starvation problem.

(B) The number of requests for disk service are not influenced by file allocation method.

A)is true

B)is NOT CORRECT as the number of requests for disk service can be greatly influenced by file allocation method.e.g a program reading contiguous allocated file will generate several requests that are closed together on the disk hence minimal head movement . on the other hand linked file or indexed file may include scattered block which need more head movement

C)is TRUE Caching the directories and index blocks in main memory can also help in reducing disk arm movements especially for read operation.

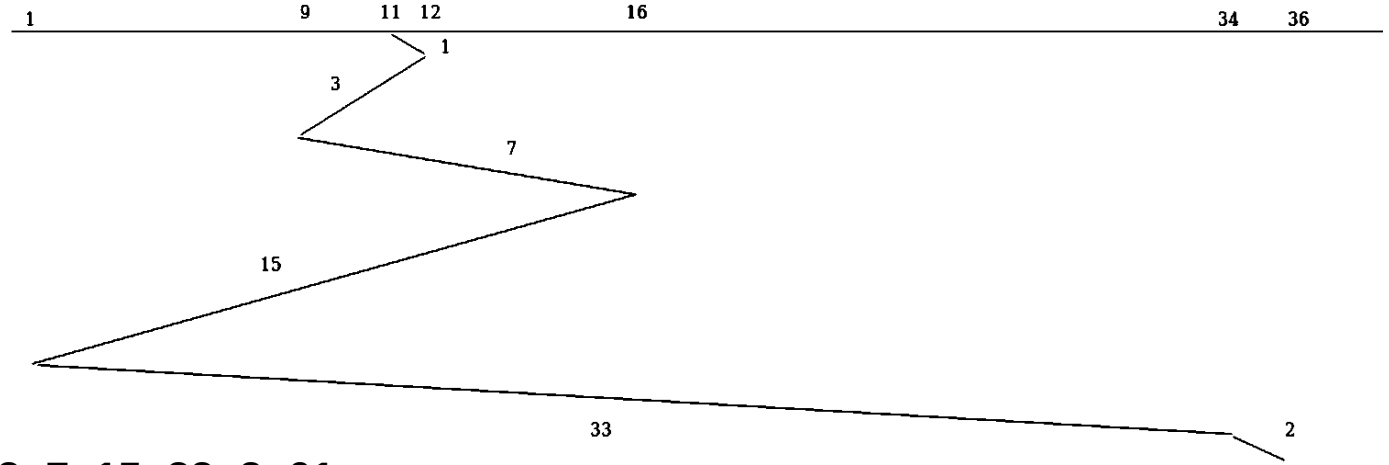
d)is TRUE as SCAN & C-SCAN are less likely to be suffer from starvation as they move in both direction irrespective of type of request. SSTF may suffer from starvation

Paper III December 2014

Consider an imaginary disk with 40 cylinders. A request come to read a block on cylinder 11. While the seek to cylinder 11 is in progress, new requests come in for cylinders 1, 36, 16, 34, 9 and 12 in that order. The number of arm motions using shortest seek first algorithm is

(A) 111 (B) 112
(C) 60 (D) 61

(D) 61



1+3+7+15+33+2=61

Paper II June 2015

A disk drive has 100 cylinders, numbered 0 to 99. Disk requests come to the disk driver for cyclinders 12, 26, 24, 4, 42, 8 and 50 in that order. The driver is currently serving a request at cyclinder 24. A seek takes 6 msec per cyclinder moved. How much seek time is needed for shortest seek time first (SSTF) algorithm?

(A) 0.984 sec **(B) 0.396 sec**

(C) 0.738 sec **(D) 0.42 sec**

(D) 0.42 sec

12, 26, 24, 4, 42, 8 and 50

24-26-12-8-4-42-50 sequence of access
seek time = 2 =(2 + 14 + 4 + 4 + 38 + 8) = 420 msec
1000 msec = 1 sec
420 msec = 0.42 sec

Paper II June 2015

A LRU page replacement is used with four page frames and eight pages. How many page faults will occur with the reference string 0172327103 if the four frames are initially empty?

(A) 6 **(B) 7**

(C) 5 **(D) 8**

(B) 7

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

Total page fault = 7

Paper II December 2015

Consider a disk with 16384 bytes per track having a rotation time of 16 msec and average seek time of 40 msec. What is the time in msec to read a block of 1024 bytes from this disk?

(A) 57 msec (B) 49 msec

(C) 48 msec (D) 17 msec

(B) 49 msec

Transfer time = ((1024 bytes *16 ms)/ (16384 bytes)) = 1 msec

Rotational letency = 16 msec / 2 = 8 msec

total time = seek + rotational letency + transfer time

= 40 + 8 + 1 = 49 msec

Paper II July 2016

Consider the reference string
0 1 2 3 0 1 4 0 1 2 3 4
If FIFO page replacement algorithm is used, then the number of page faults with three page frames and four page frames are ..... and ..... respectively.
(A) 10, 9 (B) 9, 9
(C) 10, 10 (D) 9, 10

(D) 9, 10

For frame size =3

0 1 2 3 0 1 4 0 1 2 3 4

F F F F F F F H H F F H

Total 9 page fault

For Frame Size =4

0 1 2 3 0 1 4 0 1 2 3 4

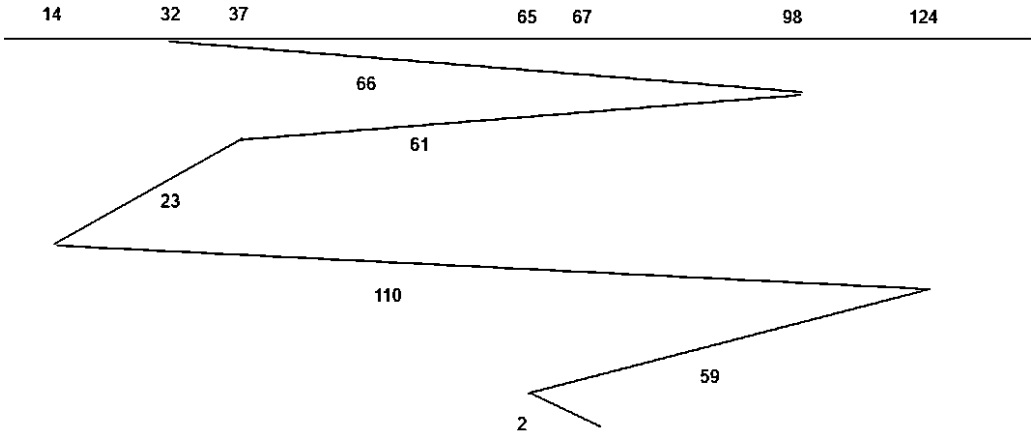
F F F F H H F F F F F F

Total 10 page fault

Paper II July 2016

If the Disk head is located initially at track 32, find the number of disk moves required with FCFS scheduling criteria if the disk queue of I/O blocks requests are:
98, 37, 14, 124, 65, 67
(A) 320 (B) 322
(C) 321 (D) 319

(C) 321



(98-32) + (98-37) + (37-14) +(124-14) + (124-65) + (67-65)

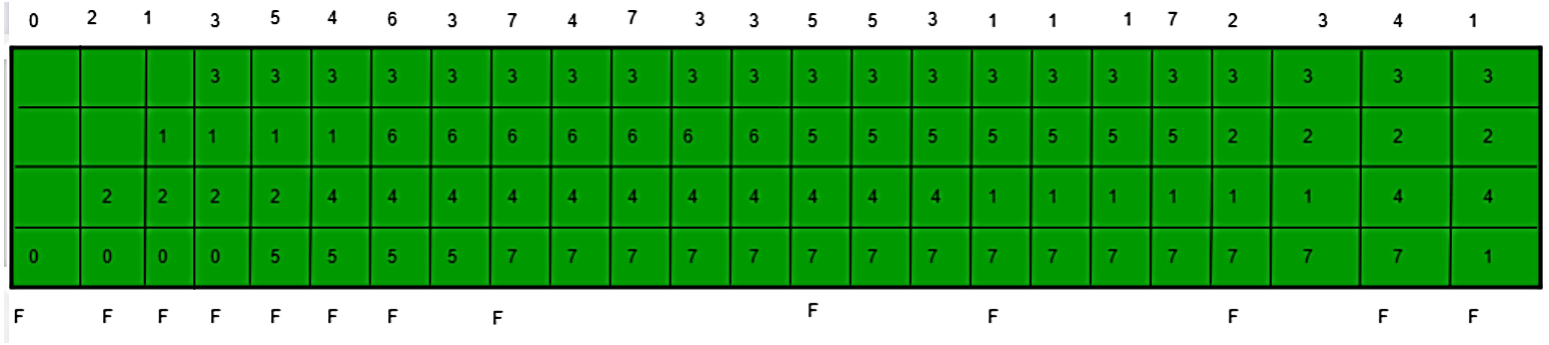
= 66+61+23+110+59+2

=321

Paper II August 2016 (Re-test)

Suppose that the virtual Address space has eight pages and physical memory with four page frames. If LRU page replacement algorithm is used, ... number of page faults occur with the reference string.
0 2 1 3 5 4 6 3 7 4 7 3 3 5 5 3 1 1 1 7 2 3 4 1
(A) 11
(B) 12
(C) 10
(D) 9

(A) 11


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

Paper III August 2016 (Re-test)

Consider the following page reference string :

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6

Which of the following options, gives the correct number of page faults related to LRU, FIFO, and optimal page replacement algorithms respectively, assuming 05 page frames and all frames are initially empty ?

(A) 10, 14, 8 **(B) 8, 10, 7**

(C) 7, 10, 8 **(D) 7, 10, 7**

Paper III August 2016 (Re-test)

Consider the following page reference string :
1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6
Which of the following options, gives the correct number of page faults related to LRU, FIFO, and optimal page replacement algorithms respectively, assuming 05 page frames and all frames are initially empty ?

(A) 10, 14, 8 **(B) 8, 10, 7**
(C) 7, 10, 8 **(D) 7, 10, 7**

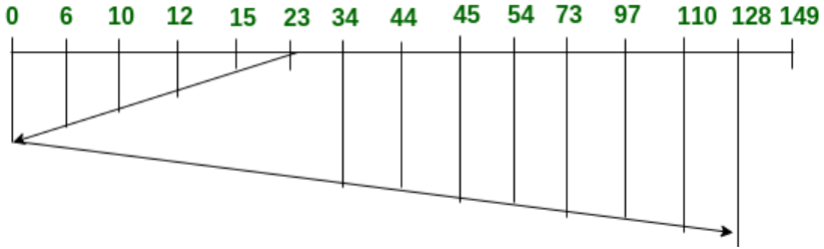
Paper III January 2017

Consider a disk queue with I/O requests on the following cylinders in their arriving order:
6,10,12,54,97,73,128,15,44,110,34,45
The disk head is assumed to be at cylinder 23 and moving in the direction of decreasing number of cylinders. Total number of cylinders in the disk is 150. The disk head movement using SCAN-scheduling algorithm is:
(1) 172
(2) 173
(3) 227
(4) 228

All options incorrect ans should be = 151

disk head initailly at 23 and direction is towards 0

first arrange in sorted order and use SCAN method



now from 23 to 15 then 15 to 12 and 12 to 10 and 10 to 6 then 6 to 0 then 0 to 34 34 to 44 and so on finally stops at 128

total head movements = 8+3+2+4+6+34+10+1+9+19+24+13+18 =151

Paper II November 2017

In ..... disk scheduling algorithm, the disk head moves from one end to other end of the disk, serving the requests along the way. When the head reaches the other end, it immediately returns to the beginning of the disk without serving any requests on the return trip.

(1) LOOK
(2) SCAN
(3) C - LOOK
(4) C - SCAN

Paper II November 2017

In ..... disk scheduling algorithm, the disk head moves from one end to other end of the disk, serving the requests along the way. When the head reaches the other end, it immediately returns to the beginning of the disk without serving any requests on the return trip.

(1) LOOK
(2) SCAN
(3) C - LOOK
(4) C - SCAN

Paper III November 2017

Consider a virtual page reference string 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0, 1, 7, 0, 1. Suppose a demand paged virtual memory system running on a computer system such that the main memory has 3 page frames. Then ..... page replacement algorithm has minimum number of page faults.

(1) FIFO
(2) LIFO
(3) LRU
(4) Optimal

(4) Optimal

In FIFO algorithm 15 page fault will occur.

7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
		1	2	2	3	3	4	2	3	3	3	2	1	2	2	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
F	F	F	F		F		F	F	F			F	F	F					

In LIFO algorithm 11 page fault will occur.

7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
		1	1	1	3	3	3	2	2	2	2	2	2	2	2	2	7	7	7
	0	0	0	0	0	0	0	0	3	3	3	3	3	3	0	0	0	0	0
7	7	7	2	2	2	2	4	4	4	0	0	0	1	1	1	1	1	1	1
F	F	F	F		F		F	F	F	F			F	F			F		

In LRU algorithm 12 page fault will occur.

7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
		1	1	1	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1
	0	0	0	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0	0
7	7	7	2	2	2	2	2	2	2	2	2	2	2	2	2	2	7	7	7
F	F	F	F		F		F			F			F				F		

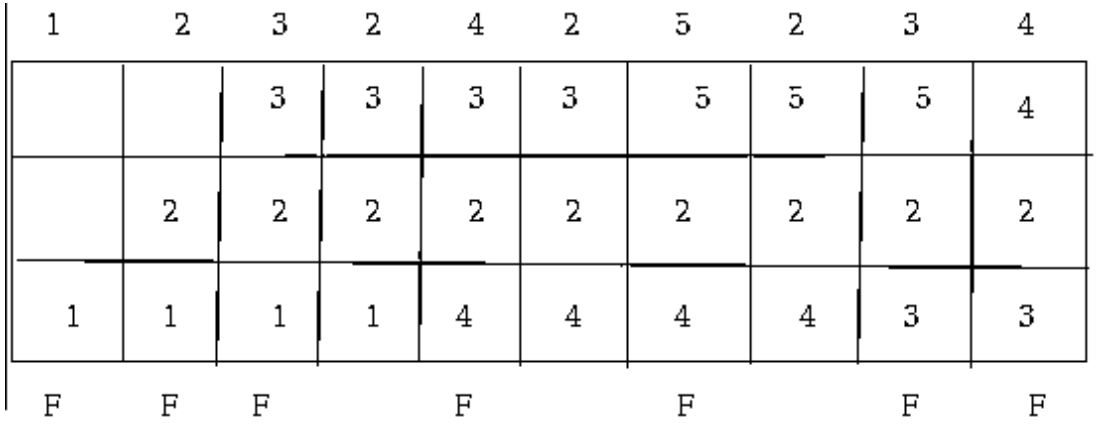
In optimal algorithm 9 page fault will occur.

Paper II July 2018

Consider a virtual page reference string 1, 2, 3, 2, 4, 2, 5, 2, 3, 4. Suppose LRU page replacement algorithm is implemented with 3 page frames in main memory. Then the number of page faults are .....

(1) 5
(2) 7
(3) 9
(4) 10

(2) 7



Paper II December 2018

Suppose for a process P, reference to pages in order are 1,2,4,5,2,1,2,4. Assume that main memory can accommodate 3 pages and the main memory has already 1 and 2 in the order 1 – first, 2 – second. At this moment, assume FIFO Page Replacement Algorithm is used then the number of page faults that occur to complete the execution of process P is

(1) 4
(2) 3
(3) 5
(4) 6

(3) 5

The requests are :

$1 \rightarrow 1|2$

$2 \rightarrow 1|2$

$4 \rightarrow 1|2|4,\ Pagefault = 1$

$5 \rightarrow 2|4|5,\ Pagefault = 2$

$2 \rightarrow 2|4|5,\ Pagefault = 2$

$1 \rightarrow 4|5|1,\ Pagefault = 3$

$2 \rightarrow 5|1|2,\ Pagefault = 4$

$4 \rightarrow 1|2|4,\ Pagefault = 5$

Paper II June 2019

Consider that a process has been allocated 3 frames and has a sequence of page referencing as : 1, 2, 1, 3, 7, 4, 5, 6, 3, 1
What shall be the difference in page faults for the above string using the algorithms of LRU and optimal page replacement for referencing the string?

(a) 2 **(b) 0**
(c) 1 **(d) 3**

(a) 2

Input page referencing 1,2,1,3,7,4,5,6,3,1

LRU :

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

=> Least Recently Used = 9 page faults

Optimal page replacement:

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

=> Optimal page replacement = 7 page faults

=> Difference of page faults in the above page referencing using the algorithm of LRU and Optimal page replacement = 9 – 7

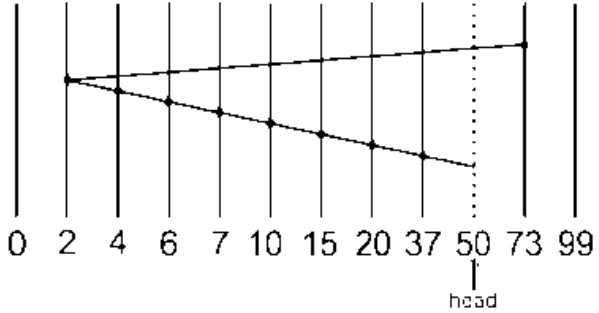
= 2

Paper II June 2019

Consider a disk system with 100 cylinders. The requests to access the cylinders occur in the following sequence:
4, 34, 10, 7, 19, 73, 2, 15, 6, 20
Assuming that the head is currently 50, what is the time taken to satisfy all requests if it takes 1 ms to move from the cylinder to adjacent one and the shortest seek time first policy is used?
(a) 357 ms (b) 238 ms
(c) 276 ms (d) 119 ms

(d) 119 ms

Initial head is **50th** cylinder



Total head movement = |50 – 2| + |2 – 73| = 48 +71 = 119

Paper II November 2020

Consider a hypothetical machine with 3 pages of physical memory, 5 pages of virtual memory, and < A, B, C, D, A, B, E, A, B, C, D, E, B, A ,B> as the stream of page references by an application. If P and Q are the number of page faults that the application would incur with FIFO and LRU page replacement algorithms respectively, then (P, Q) =_____. (Assuming enough space for storing 3 page frames)

a) (11, 10)
b) (12, 11)
c) (10, 11)
d) (11, 12)

d) (11, 12)

FIFO:

A	**D**	D	D	**E**	E	E	**B**	B
B	B	**A**	A	A	**C**	C	C	**A**
C	C	C	**B**	B	B	**D**	D	D

Page fault = 11

LRU:

A	**D**	D	D	**E**	**C**	C	C	**B**	B
B	B	**A**	A	A	A	**D**	D	D	**A**
C	C	C	**B**	B	B	B	**E**	E	E

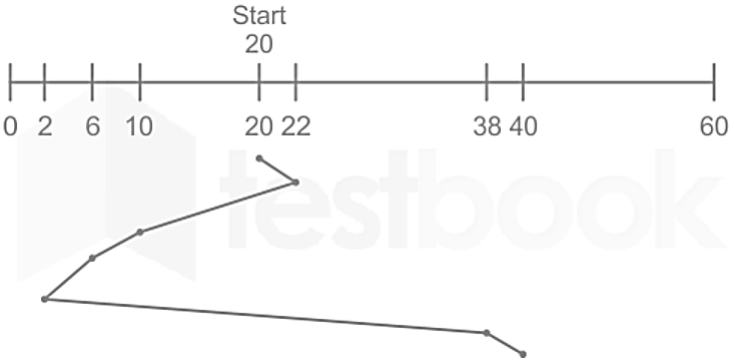
Page fault = 12

Paper II November 2020

Consider a disk system having 60 cylinders. Disk requests are received by a disk drive for cylinders 10, 22, 20, 2, 40, 6 and 38, in that order. Assuming the disk head is currently at cylinder 20, what is the time taken to satisfy all the requests if it takes 2 milliseconds to move from one cylinder to adjacent one and Shortest Seek Time First (SSTF) algorithm is used?

a) 240 milliseconds
b) 96 milliseconds
c) 120 milliseconds
d) 112 milliseconds

c) 120 milliseconds



SSTF = (22-20)+(22-2)+(40-2)= 2+20+38=60
milliseconds to move from one cylinder to adjacent one = 60x2 =120 milliseconds

Paper II November 2020

Comprehension:

A disk with a sector size of 512 bytes, 2000 tracks per surface, 50 sectors per track, five double sided platters, and average seek time of 10 milliseconds.

What is the capacity of the disk in bytes?

a) 25,000 K
b) 500,000 K
c) 250,000 K
d) 50,000 K

b) 500,000 K

capacity of the disk = bytes/sector x sector/track x track/surface x surface/disk=512 x 50 x 2000 x5x2
=500000K

A disk with a sector size of 512 bytes, 2000 tracks per surface, 50 sectors per track, five double sided platters, and average seek time of 10 milliseconds.

If T is the capacity of a track in bytes, and S is the capacity of each surface in bytes, then (T, S) = _____.

a) (50 K, 50000 K)
b) (25 K, 25000 K)
c) (25 K, 50000 K)
d) (40 K, 36000 K)

c) (25 K, 50000 K)

Capacity of track = Number of sector/track * sector size
= 50∗512B=25600B=25K
Capacity of surface = Capacity of track * number of tracks= 25K∗2000=50000K

A disk with a sector size of 512 bytes, 2000 tracks per surface, 50 sectors per track, five double-sided platters, and average seek time of 10 milliseconds.

Given below are two statements:

Statement I : The disk has a total number of 2000 cylinders.
Statement II : 51200 bytes is not a valid block size for the disk.

In the light of the above statements, choose the correct answer from the options given below:

Both Statement I and Statement II are true
a)Both Statement I and Statement II are false
b)Statement I is correct but Statement II is false
c)Statement I is incorrect but Statement II is true

a) Both Statement I and Statement II are true

Statement I: correct.
The number of cylinders is 2000, which is the same as the number of tracks on each platter. Hence it is correct.
Statement II: correct
The block size will be a multiple of the sector size. 51200 is not a valid block size in this case because block size cannot exceed the size of a track, which is 25600 bytes. Hence it is correct.

A disk with a sector size of 512 bytes, 2000 tracks per surface, 50 sectors per track, five double-sided platters, and average seek time of 10 milliseconds.

If the disk platters rotate at 5400 rpm (revolutions per minute), then approximately what is the maximum rotational delay?

a) 0.011 seconds
b) 0.11 seconds
c) 0.0011 seconds
d) 1.1 seconds

a) 0.011 seconds

If the disk platters rotate at 5400rpm, the time required for one complete rotation will be, 1/5400 x60=0.011 seconds

A disk with a sector size of 512 bytes, 2000 tracks per surface, 50 sectors per track, five double sided platters, and average seek time of 10 milliseconds.

If one track of data can be transferred per revolution, then what is the data transfer rate?

a) 2,850 KBytes/second
b) 4,500 KBytes/second
c) 5,700 KBytes/second
d) 2,250 KBytes/second

d) 2,250 KBytes/second

The capacity of a track is= bytes/sector x sector/track=512x50=25k

Since one track of data can be transferred per revolution,
Data transfer rate = tracksize/rotational delay

Rotational delay=0.011

Data transfer rate=2250K/0.011=2,250 KBytes/second

Paper II October 2022

For the following page reference string 4, 3, 2, 1, 4, 3, 5, 4, 3, 2, 1, 5, the number of page faults that occur in Least Recently Used (LRU) page replacement algorithm with frame size 3 is

6
8
10
12

c) 10

4	**1**	1	1	**5**	5	5	**2**	2	2
3	3	**4**	4	4	4	4	4	**1**	1
2	2	2	**3**	3	3	3	3	3	**5**

Paper II October 2022
Consider the following:

List I		List II	
(A)	Stack algorithm	(I)	Deadlock
(B)	Elevator algorithm	(II)	Disk scheduling
(C)	Priority scheduling algorithm	(III)	Page replacement
(D)	Havender's algorithm	(IV)	CPU scheduling

Which of the following is correct matching?

a) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
b) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
c) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
d) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

a) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

Paper II JUNE 2023

Consider a disk system with cylinders. The request to access the cylinders occurs in the following sequence: 4, 34, 10, 7, 19, 73, 2, 15, 6, 20 Assuming that the head is currently at cylinder 50, what is the time taken to satisfy all requests if it takes 1 ms to move from one cylinder to adjacent one and shortest seek time first policy is used?

a) 119 ms
b) 120 ms
c) 142 ms
d) 146 ms

Paper II JUNE 2023

Consider a disk system with cylinders. The request to access the cylinders occurs in the following sequence: 4, 34, 10, 7, 19, 73, 2, 15, 6, 20 Assuming that the head is currently at cylinder 50, what is the time taken to satisfy all requests if it takes 1 ms to move from one cylinder to adjacent one and shortest seek time first policy is used?

a) **119 ms**
b) **120 ms**
c) **142 ms**
d) **146 ms**

Paper II JUNE 2023

Consider the following statements:
S1: LRU page replacement algorithm suffers from the belady's anomaly
S2: Shortest remaining time first scheduling may cause starvations
S3: Stack is shared by all threads in a process

a) S1, S2 and S3 are true
b) S1, S3 false and S2 is true
c) S1, S2 are false and S3 is true
d) S1, S2 and S3 are false

b) S1, S3 false and S2 is true

S1: LRU (Least Recently Used) page replacement algorithm suffers from belady's anomaly. False - The LRU (Least Recently Used) page replacement algorithm does not suffer from Belady's anomaly. Belady's anomaly is the phenomenon where increasing the number of page frames results in an increase in the number of page faults. This anomaly is typically associated with the FIFO (First-in, First-out) page replacement algorithm, not with LRU.

S2: Shortest remaining time first scheduling may cause starvations. True - The Shortest Remaining Time First (SRTF) scheduling algorithm can indeed cause starvation. This happens when short processes keep coming. This can indefinitely postpone the execution of longer processes, leading to their starvation.

S3: Stack is shared by all threads in a process. False - In a multithreaded process, each thread has its own separate stack space. This is necessary to keep track of the execution state for each individual thread. Other parts of the process such as the heap, global variables, and code segment are shared among all threads.

Paper II December 2023

The head of a moving head disk with 200 tracks, numbered 0 to 199, has just finished a request at track 125, and currently serving a request at track 143. The queue of requests is given in the FIFO order as 86, 147, 91, 177, 94, 150, 102, 175, 130. What will be the total number of head movements required to satisfy these requests for SCAN algorithm?

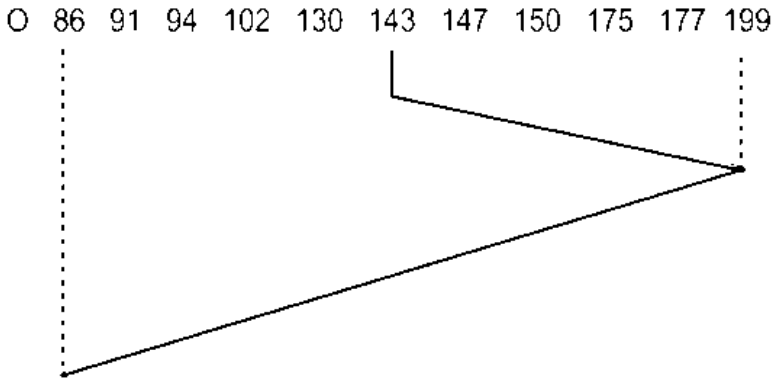
(1) 259 cylinders

(2) 169 cylinders

(3) 154 cylinders

(4) 264 cylinders

(2) 169 cylinders



Total number of head movements = (199 -143) + (199 - 85)

Total number of head movements = 56 + 113 = 169