Operating Systems Test 4

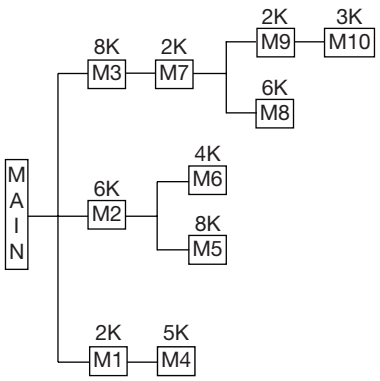
Number of Questions: 25 **Section Marks: 30**

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Suppose that, the time to service a page fault is 10 sec on average, memory access time is 1 m sec. If a page fault occurs for every 10000 references, what is the average memory access time?
(A) 1.9999 m sec (B) 1 m sec
(C) 9.999 m sec (D) 1.9999 μ sec

2. If an instruction takes '*n*' micro seconds and page fault takes an additional '*m*' micro seconds. If the average page fault occurs for every '*k*' instructions, then effective access time is ____.
(A) $(n + m)/k$ (B) $m + n/k$
(C) $n + m/k$ (D) $n + m * k$

3. The overlay tree of the program is shown below:



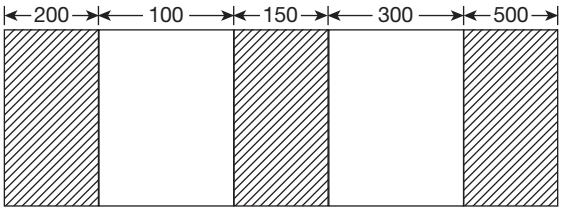
What will be the minimum partition size required to execute the program?
(A) 50K (B) 11K
(C) 8K (D) 20K

4. Dirty bit for a page table _____.
(i) helps to reduce number of page faults
(ii) helps to reduce page fault penalty
(iii) helps to avoid unnecessary writes on a paging device.
Which of the following is true?
(A) (i) (ii) (B) (i) (iii)
(C) (ii) (iii) (D) (i) (ii) and (iii)

5. A 2000 KB memory is managed using variable partitions but with no compaction. If, there exists two free partitions with sizes 400 KB and 250 KB. The smallest allocation request that could be denied is:
(A) 225K (B) 375K
(C) 425K (D) 650K

6. The address sequence generated during the execution of a program is given below:
681 351 357 421 499 099 118 129 654 454
There exists only one free frame, with the size 100 records per frame. If pure demand paging is used, what is the number of page faults?
(A) 10 (B) 9
(C) 8 (D) 7

7. Consider the following heap.



The hatched regions are not free. The sequence of requests for the blocks of size 250, 25, 75, 50 can be satisfied if we use:
(i) First fit (ii) Best fit
(iii) Worst fit
(A) (i) (ii) (B) (ii) (iii)
(C) (i) (iii) (D) (i) (ii) and (iii)

8. Consider a system with 128 MB physical memory and a 32-bit virtual address space. If the page size is 2 KB, what is the approximate page table size?
(A) 2 MB (B) 4 MB
(C) 8 MB (D) 16 MB

9. Match the following:

List–1		List–2	
1.	Virtual memory	p.	Spatial locality
2.	Shared memory	q.	Mutual exclusion
3.	Look-ahead buffer	r.	Temporal locality
4.	Look-aside buffer	s.	Address translation

	1	2	3	4
(A)	p	q	r	s
(B)	s	q	r	p
(C)	q	p	s	r
(D)	s	r	q	p

10. Let a memory has five free blocks $2k$, $4k$, $6k$, $8k$ and $20k$. These blocks are allocated using best fit strategy. The allocations requests are stored in a queue as shown below:

Job	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8
Size	$2k$	$16k$	$4k$	$5k$	$7k$	$12k$	$8k$	$18k$
Time	4	9	3	7	6	2	8	10

The time at which the process '*P*7' will be completed is _____.
(A) 8 (B) 14
(C) 21 (D) 39

11. Consider a memory consisting of the following holes in the given order:
20K, 15K, 28K, 18K, 23K, 24K and 30K
For the request sequence 24K, 22K and 18K, the first fit allocates the Blocks _____.
(A) 24K, 23K, 18K (B) 28K, 23K, 20K
(C) 28K, 24K, 20K (D) 28K, 23K, 24K

12. Consider the following statements:
*S*1: Segmentation may suffer from external fragmentation.
*S*2: Paging may suffer from internal fragmentation.
*S*3: Segmentation may suffer from internal fragmentation.
*S*4: Paging may suffer from external fragmentation.
Which of the following are true?
(A) *S*1, *S*3 (B) *S*3, *S*4
(C) *S*1, *S*2 (D) *S*1, *S*2, *S*3, *S*4

13. Inverted Page Table contains,
(A) Page Number, Process ID, Offset.
(B) Page Number, Frame Number, Link Field
(C) Page Number, Process ID, Link field
(D) Page Number, Frame Number, Process ID

14. Consider a simple paging system with 4 GB main memory and 256 MB virtual memory. The page size is 1 KB. Based on this dat*a*, Match the following:

List-1		List-2	
1.	Bits in Logical Address	p.	22
2.	Bits in Frame Number	q.	18
3.	Entries in Page Table	r.	28
4.	Bits in Page Number	s.	2^{18}

	1	2	3	4
(A)	r	p	s	q
(B)	p	q	r	s
(C)	r	p	q	s
(D)	r	s	p	q

15. Consider the following page reference sequence:
2, 1, 5, 2, 2, 1, 3, 6, 4, 2, 5, 1, 3, 6
How many page faults will occur using LRU, FIFO and optimal respectively, if the memory contains 6 frames?
(A) 6 6 6 (B) 6 5 4
(C) 5 6 4 (D) 7 8 6

16. In a particular Unix OS, the *i*-node block of size 2K, contains 10 direct data block, addresses, one address for single indirect block. One for double indirect block, and one for Triple indirect block. Each block can contain 128 addresses. The approximate maximum size of the file in the file system is _____.
(A) 2 GB (B) 4 GB
(C) 8 GB (D) 16 GB

17. Consider a system with four files of sizes 11150 B, 4970 B, 5520 B and 10640 B. For storing these files on disk we can use either 100 B blocks or 200 B blocks but not both. For each block 4 B are used for book information. A disk block can store either book keeping information or file data, but not both.
What is the total number of blocks required for files using 100 B blocks and 200 B blocks respectively?
(A) 340 and 338 (B) 340 and 169
(C) 340 and 170 (D) 315 and 163

18. Hard disk transfers 20 MB/sec using DMA. The processor runs at 1.2 GHz takes 600 and 1800 clocks to initiate and terminate DMA transfer respectively. If the size of transfer is 10 KB, what is the percentage of processor time consumed for the transfer operation?
(A) 4% (B) 0.4%
(C) 1% (D) 10%

19. Consider a disk pack with 16 platters, each with 2 surfaces, 256 tracks per surface, 512 sectors per track and 1 KB sector size. The capacity of the disk and number bits required to address a sector uniquely in the disk are respectively:
(A) 8 GB, 32 bits (B) 4 GB, 22 bits
(C) 4 GB, 32 bits (D) 16 GB, 22 bits

20. Which of the following request set will cause the head to change its direction after servicing every request assuming that the head does not change direction if there is a tie in SSTF and all the requests arrive before the servicing starts?
(A) 1, 129, 160, 168, 171, 174, 191, 255
(B) 0, 128, 160, 168, 171, 175, 191, 255
(C) 0, 129, 159, 168, 171, 174, 191, 255
(D) 0, 128, 160, 168, 171, 175, 190, 255

21. What is the maximum cardinality of request set, so that head changes its direction for every request service, if there exists a total of 4096 tracks and head can start from any track?
(A) 10 (B) 11
(C) 12 (D) 13

22. Consider a disk with 100 cylinders. The per track seek time is 2 m sec. The requests to access the cylinders occurs in the following sequence:
5, 40, 15, 12, 24, 65, 3, 18, 10
Assuming that the head is currently at 55 cylinder, what is the time taken to satisfy all the requests using SSTF.
(A) 72 m sec (B) 144 m sec
(C) 204 m sec (D) 102 m sec

23. Consider a disk with 100 cylinders. The per track seek time given as 3 m sec. The requests to access the cylinders occurs in the following sequence:
25, 45, 65, 32, 75, 15, 50, 20
What is the total seek time using FCFS disk scheduling. Assume that the initial position of head is at track 0.
(A) 269 (B) 300
(C) 807 (D) 225

24. Consider a system with 3 memory frames and the following reference string over 8 pages: 1, 2, 3, 4, 2, 8, 1, 3, 5, 7, 6, 1, 2
What will be the final content of memory if FIFO replacement policy used.
(A) 6 1 2
(B) 1 2 6
(C) 1 6 2
(D) 2 1 6

25. For the above count what will be the number of page faults if LRU is used?
(A) 10 (B) 11
(C) 12 (D) 13

Answer Keys

1. A	**2.** C	**3.** D	**4.** C	**5.** C	**6.** D	**7.** C	**8.** B	**9.** A	**10.** B
11. B	**12.** C	**13.** C	**14.** A	**15.** A	**16.** B	**17.** B	**18.** B	**19.** B	**20.** B
21. C	**22.** B	**23.** C	**24.** A	**25.** C					

Hints and Explanations

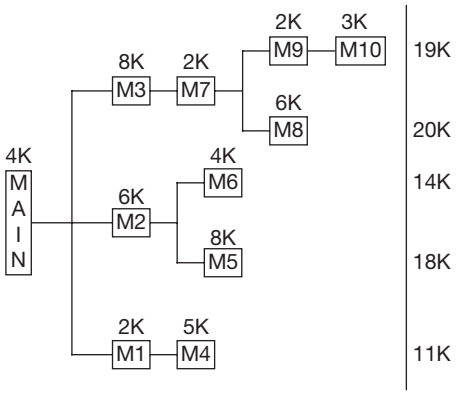
1. EAT = H*MAT + $(1 - H)$*$(P.F.T)$
H = 0.9999 (1 page fault for every 10000)
MAT = 1 m sec
$P.F.T$ = 10 sec
EAT = 0.9999 * 1 m sec + (0.0001)* 10 sec.
= 0.9999 + 1 m sec
= 1.9999 m sec Choice (A)

2. EAT = H * MAT + $(1 - H)$*$(P.F.T$ + MAT)

$$= \frac{k-1}{k} \times n + \frac{1}{k}(m+n)$$

$$= n + \frac{m}{k}$$ Choice (C)

3.



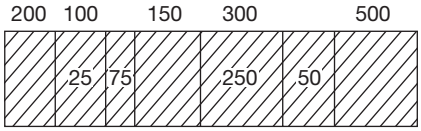
The maximum memory required when module $M8$ is under execution, which is 20K. Choice (D)

4. Choice (C)

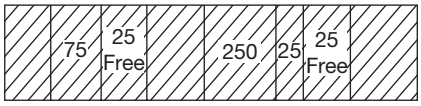
5. Choice (C)

6. 681 351 357 421 499 019 118 129 654 454
PF PF PH PF PH PF PF PH PF PF
PF → Page Fault, *PH* → Page Hit
Number of *PFs* = 7 Choice (D)

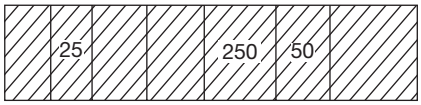
7. First Fit:



Best Fit:



50 cannot be allocated.
Worst Fit:



Choice (C)

8. Number of page $= \frac{\text{(Virtual memory size)}}{\text{(Page size)}}$

Number of frames $= \frac{\text{Main Memory size}}{\text{Page size}} = \frac{2^{27}}{2^{11}} = 2^{16}$

Page Table size = Number of pages * Number of bits to address frame
= 2^{21} * 16 bits
= 2^{21} * 2 B = 4 MB Choice (B)

9. Choice (A)

10.

2K	4K	6K	8K	20K
P1	P3	P4	P5	P2

On completion of $P5$, Block 4 will be allocated to $P7$.
Hence completion time of $P7$ is = 6 + 8 = 14
Choice (B)

11. Choice (B)

12. Choice (C)

13. Choice (C)

14. Virtual memory = 256 MB = 2^{28} B
Bits in logical address = 28

$$\text{Number of frames} = \frac{4\text{ GB}}{1\text{ kB}} = \frac{2^{32}}{2^{10}} = 2^{22}$$

Number of bits in frame Number = 22

$$\text{Number of pages} = \frac{256\text{ MB}}{1\text{ kB}} = \frac{2^{28}}{2^{10}} = 2^{18}$$

Number of entries in page table = 2^{18}
Number of bits in page number = 18 Choice (A)

15. Number of pages referred is 6, Number of frames also 6. Hence for any algorithm, number of page faults are 6. Choice (A)

16. Maximum file size

$$[\underbrace{1}_{\text{Inode}} + \underbrace{10}_{\text{Direct}} + \underbrace{(1+128)}_{\text{Single indirect}} + \underbrace{(1+128+128\times128)}_{\text{Double indirect}} + \underbrace{(1+128+128\times128+128\times128\times128)]}_{\text{Triple indirect}}$$

$2k$ (Block size)
$\cong$ 4 GB Choice (B)

17.

File Size	100B Data Blocks	Book Keeping Blocks
11150	112	5
4970	50	2
5520	56	3
10640	107	5
Total	325	15

Total = 340

File Size	200B Data Blocks	Book Keeping Blocks
11150	56	2
4970	25	1
5520	28	1
10640	54	2
Total	163	6

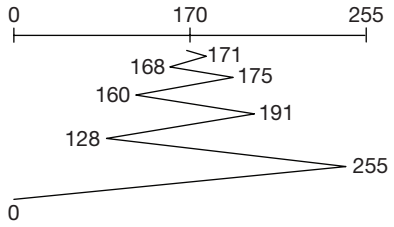
Total = 169 Choice (B)

18. **Transfer Time:**
20 MB – 1 sec
10 KB – x
x*20 MB = 1 sec * 10 KB
x = ½ m sec = 500 μ sec
CPU Time:
1.2 GHz $\Rightarrow$ 1.2 * 10^9 clocks/sec
= 1200 * 10^6 clocks/sec
CPU Time consumed = 600 + 1800
= 2400 clocks
1200 * 10^6 clocks – 1 sec
2400 clocks – y
y * 1200 × 10^6 = 1 sec * 2400
y = 2 μs
Percentage of CPU involvement

$$= \frac{2\,\mu s}{500\,\mu s} \times 100 = 0.4\%$$ Choice (B)

19. Disk Capacity = 16 * 2 * 256 * 512 * 1 KB = 4 GB
Number of sectors = 16 × 2 × 256 × 512 = 2^{22}
Choice (B)

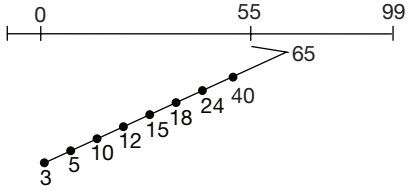
20. Assume the head at track 170 (Based on choices).
Then



Choice (B)

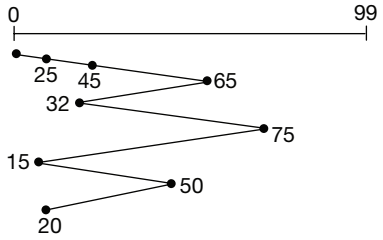
21. 4096 = 2^{12} tracks
Hence cardinality = 12 Choice (C)

22.



Total tracks moved = 72
Total seek time = 72 × 2 = 144 m sec Choice (B)

23.



Total tracks moved = |0 – 25| + |25 – 45| + |45 – 65|
+ |65 – 32| + |32 – 75| + 75 – 12| + |15 – 50| + |50 – 20|
= 25 + 20 + 20 + 33 + 43 + 63 + 35 + 30 = 269
Total seek time = 269 * 3 = 807 Choice (C)

24. Choice (A)

25.
1, 2, 3, 4, 2, 8, 1, 3, 5, 7, 6, 1, 2
x x x x ✓ x x x x x x x

~~1~~	~~2~~	~~3~~	~~4~~	2			
~~2~~	~~3~~	6					
~~3~~	~~8~~	~~5~~	1				

x $\Rightarrow$ Page Fault
✓ $\Rightarrow$ Page Hit Choice (C)