Operating Systems Test 1

Number of Questions: 35 **Section Marks: 30**

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. Which of the following service is provided by an Operating System?
(i) Access to I/O Devices
(ii) Controlled access to files
(iii) System Access
(iv) Accounting
(A) (i), (ii) (B) (iii), (iv)
(C) (i), (ii), (iii) (D) (i), (ii), (iii), (iv)

2. In which of the following modes, privileged instructions will be executed?
(A) Kernel mode only
(B) User mode only
(C) Either kernel mode or user mode
(D) execution of privileged instruction is independent of mode

3. In which of the following environment, the computer memory can hold three, four or more programs and a single CPU switches among all of them for execution?
(A) Uniprogramming (B) Multiprogramming
(C) Multiprocessing (D) Both (B) and (C)

4. What is the principle objective of Time sharing system?
(A) Maximize processor use
(B) Minimize response time
(C) Maximize memory usage
(D) Minimize CPU idle time

5. Which of the following will not be included in the Process Control Block of a process?
(A) Process state (B) Program counter
(C) Priority (D) None of the above

6. Which of the following best explains 'process spawning'?
(A) The OS creates a process at the explicit request of another process.
(B) The OS creates a process to perform a function on behalf of a user program.
(C) A process is created when a user logs on to the system.
(D) The OS creates a process as per its requirement.

7. For which of the following reason, a process will move from 'Running' state to 'Blocked' state?
(A) Timeout (B) Dispatch
(C) Suspend (D) Event wait

8. If a process is in secondary memory and is available for execution as soon as it is loaded into main memory, then it is in _____ state.
(A) Ready (B) Blocked
(C) Blocked/Suspend (D) Ready/Suspend

9. Which of the following will be a reason for Process Suspension?
(A) Swapping
(B) Interactive user request
(C) Parent process request
(D) All the above

10. Which of the following is TRUE?
(A) The overhead involved in mode switch is more compared to process switch.
(B) The overhead involved in process switch is more compared to mode switch.
(C) The overhead involved in process switch is same as mode switch.
(D) comparing the overhead involved in process switch and mode switch is irrelevant.

11. Viruses, Logic bombs and Backdoors are examples of
(A) Parasitic malware
(B) Self-replicated malware
(C) Self-contained malware
(D) Active malware

12. Which of the following details will be maintained by each thread, in a multithreaded environment?
(i) Register state (ii) Priority
(iii) Stack
(A) (i), (ii) (B) (ii), (iii)
(C) (i), (iii) (D) (i), (ii) and (iii)

13. Which of the following are advantages of using User-Level-Threads (ULT) over Kernel-Level-Threads?
(i) There is no need of kernel mode privileges for thread switching.
(ii) ULTs can run on any OS.
(iii) A system call cannot block the entire process.
(A) (i), (ii) (B) (i) only
(C) (ii), (iii) (D) (i), (iii)

14. Consider a multiprogramming environment, in which two processes are running and one process is unaware of another process, then which of the following problems will occur?
(A) Mutual exclusion (B) Deadlock
(C) Starvation (D) All the above.

15. Which of the following will be (a) requirement(s) for mutual exclusion?
(A) A process remains inside its critical section for a finite time only.
(B) A process that halts in its non critical section must do so without interfering with other processes.
(C) When no process is in a critical section, any process that requests entry to its critical section may be permitted to enter with some delay.
(D) Both (A) and (B)

16. Identify the correct sequence of actions from the following, to read data with a Virtual address using TLB and cache (Assume TLB and cache has miss):
(i) Access the TLB
(ii) Read from cache
(iii) Access memory to get address
(iv) Access memory to read data.
(A) (i), (ii), (iii), (iv) (B) (i), (iii), (ii), (iv)
(C) (i), (ii), (iv), (iii) (D) (i), (iii), (iv), (ii)

17. A 2-Level page translation scheme has 4 K byte pages and 4 Byte page table entries. The virtual address has 32-bits. What is the number of bits required to access first level; second level page table entries and offset in a page respectively?
(A) 9, 9, 14 (B) 12, 12, 8
(C) 10, 10, 12 (D) 8, 12, 12

18. What is the effective access time for TLB with 90% hit rate, 1 ns to access TLB and 10 ns to access memory. (Assume a 2-level page table)
(A) 1 ns (B) 2 ns
(C) 3 ns (D) 4 ns

19. Consider the page reference string: 1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5. The number of page frames allocated is 3. Using FIFO, in which way, the number of page faults change by increasing the page frames allocated to 4.
(A) increases by two (B) decreases by two
(C) increases by one (D) decreases by one

20. A 512 KB file is stored contiguously on one disk track. Each track contains 1024 sectors, each sector is 512 bytes. Average seek time is 1 ms. And the rotational speed is 15000 rpm. What is the average access time to read the entire file?
(A) 2 ms (B) 4 ms
(C) 7 ms (D) 3 ms

21. Consider mapping a Virtual memory of 1 GB onto a physical memory organized into 256 page frames of 4 KB each. Assume that the smallest addressable unit is 1 byte. Then which of the following is TRUE?
I. The page table fit in the main memory
II. The frame table fit in a single page.
(A) I only (B) II only
(C) Both I and II (D) Neither I nor II

22. Consider below program segment:

```
# include < stdio.h>
# include < unistd.h>
.....
int main ()
{
pid p;
p = fork ();
if (p = = 0)
{
fork ();
fork ();
for k ():
}
return 0;
}
```

Including the initial parent process, how many processes will be created?
(A) 7 (B) 15
(C) 8 (D) 9

23. Consider the following resource requests.
P_1 requests exclusive use of both R_1 and R_2
P_2 requests exclusive use of both R_2 and R_3
P_3 requests exclusive use of both R_3 and R_4
P_4 requests exclusive use of both R_4 and R_2
Resources are assigned in process request order. (P_1 is first). Which of the following is TRUE?
(A) Given system is in deadlock.
(B) There is a possibility of deadlock after P_1 finishes its execution.
(C) There is no deadlock in given system.
(D) After P_1, if P_2 executes then there is a possibility of deadlock.

24. Which of the following instructions can only be executed in kernel mode?
(i) Load Instruction
(ii) Modify PC register
(iii) Modify SP register
(iv) Modify the register that controls kernel/user mode.
(v) Direct access to I/O device.
(A) (i), (ii), (v) (B) (i), (iii), (iv)
(C) (iv), (v) (D) (ii), (iv)

Directions for questions 25 and 26: A computer with a 32-bit address uses a 2-level page table. The virtual address format is shown below:

1^{st}-level page table	2^{nd}-level page table	Off set

25. What is the page size?
(A) 1024 B (B) 2048 B
(C) 4096 B (D) 8192 B

26. How many pages are there?
(A) 2^9 (B) 2^{11}
(C) 2^{12} (D) 2^{20}

27. Suppose that a 32-bit virtual address is broken up into four fields p, q, r and s. The first three are used for a 3-level page table system. The fourth field, s is the offset. Then which of the following is TRUE?
(A) The number of pages depend on the total number of bits in p, q, r combined.
(B) The number of pages depend on the total number of bits in p, q, r and s combined.
(C) The number of pages depend on the split among the fields p, q, r.
(D) The number of pages depend on the split among the fields p, q, r and s.

28. A computer provides each process with 65, 536 bytes of address space. A particular program has a text size of 32768 bytes, a data size of 16386 bytes and a stack size of 15870 bytes. If a page may not contain parts of two different segments then which of the following is TRUE?
(A) The program will fit in the address space if the page size is 4096 bytes.
(B) The program will fit in the address space if the page size is 2048 bytes.
(C) The program will fit in the address space if the page size is 1024 bytes.
(D) The program will fit in the address space if the page size is 512 bytes.

29. The Newton–Raphson method is applied to compute a root of the equation $f(x) = x^4 - x^3 - x^2 - 21x + 18 = 0$. With $x_0 = 3.1$ as the initial solution, the method converges to an exact solution after how many iterations?
(A) 1 (B) 4
(C) 7 (D) 10

30. How many disk operations are needed to fetch the inode for the file Admin/OS/UNIX/File/src.p?
Assume that the inode for this root directory is memory but nothing else along the path is in memory. (Note: All directories fit in one disk block)
(A) 5 (B) 10
(C) 4 (D) 8

31. The beginning of a free space bitmap looks like below after the disk partition is first formatted:
1000 0000 0000 0000 ……
The system always searches for free blocks starting at the lowest numbered block. So after writing file *A*, which uses 5 blocks, the bit map looks like: 1111 1100 0000 0000 Then what will be the bit map after performing following
actions:
(i) File *B* of 6 blocks is written
(ii) File *A* is deleted
(iii) File *C* of 7 blocks is written
(iv) File *B* is deleted
(A) 1111 1111 0000 0000 ……..
(B) 1111 1111 1111 1100 ……
(C) 1111 1100 0000 1100 ……
(D) 1000 0000 0111 1111 ……

32. Consider below features:
(i) This scheduler has more speed.
(ii) The scheduler has less control over the degree of multiprogramming.
(iii) The scheduler is minimal in time sharing systems.
Which scheduler has above features?
(A) Long-term scheduler
(B) Medium-term scheduler
(C) Short-term scheduler
(D) None of these

33. Consider a system consisting of four processes and single resource. The current status of the Claim and Allocation matrices are:

$$C = \begin{bmatrix} 4 \\ 3 \\ 10 \\ 7 \end{bmatrix} \qquad A = \begin{bmatrix} 2 \\ 2 \\ 4 \\ 2 \end{bmatrix}$$

What is the minimum number of units of the resource(s) needed to be available for this state to be safe?
(A) 0 (B) 1
(C) 2 (D) 3

Common Data Questions 34 and 35:
Consider two CPU scheduling algorithms for a single CPU: Round Robin scheduling and Shortest job First scheduling. Consider below five processes with arrival times and expected CPU time.

Process	Arrival time	Expected CPU Time
P1	0	15
P2	3	13
P3	5	9
P4	6	5
P5	18	8

34. What is the average waiting time using SJF?
(A) 5 (B) 10
(C) 13.6 (D) 15.4

35. What is the average waiting time using Round Robin scheduling with time quantum of 6 units?
(A) 36.2 (B) 18.4
(C) 12.6 (D) 23.4

Answer Keys

1. D	**2.** A	**3.** B	**4.** B	**5.** D	**6.** A	**7.** D	**8.** D	**9.** D	**10.** B
11. A	**12.** D	**13.** A	**14.** D	**15.** D	**16.** B	**17.** C	**18.** C	**19.** C	**20.** C
21. C	**22.** D	**23.** B	**24.** C	**25.** C	**26.** D	**27.** A	**28.** D	**29.** B	**30.** B
31. C	**32.** C	**33.** B	**34.** C	**35.** D					

Hints and Explanations

1. All those services are provided by OS. Choice (D)

2. Privileged instructions will be executed in kernel mode, in which protected areas of memory will be accessed. Choice (A)

3. In Uniprogramming, the memory holds only a single program. In multiprogram, the CPU executes more than one program in time interleaved fashion, which are present in memory. In multiprocessing, There will be more than one CPU executing more than one program. Choice (B)

4. The Time sharing system handles multiple interactive jobs, so that response time will be reduced. Choice (B)

5. PCB holds information about a process. Choice (D)

7. A process will be in blocked state if it is waiting for an event to occur. Choice (D)

10. Mode switch occurs without changing the state of process. Process switch requires some changes in its environment.

$\therefore$ Overhead of process switch is greater than mode switch. Choice (B)

11. In Parasitic malware, the fragments of programs do not exist independently Choice (A)

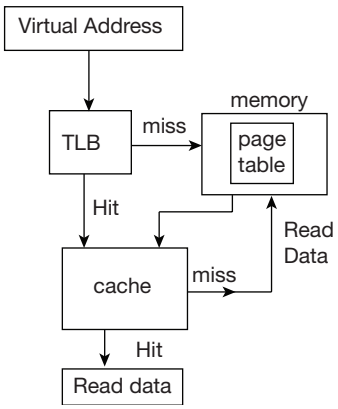
12. In multithreaded environment, each thread maintains a stack, register values, priority and other thread related state information. Choice (D)

13. In ULTs, the thread management will be done by thread library. So no need of kenel mode privileges for thread switching. On any OS, ULTs can run. A system call blocks entire process. Choice (A)

14. If processes are unaware of each other then competition exist between them. There is a possibility of Mutual exclusion, Deadlock and Starvation. Choice (D)

15. There will be no delay in permitting a process to enter its critical section if no process is in critical section. Choice (D)

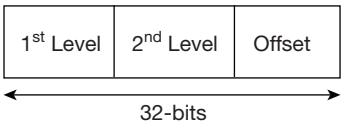
16.



So the sequence of actions will be (i), (iii), (ii), (iv) Choice (B)

17. Page size = 4 KB = 2^{12} B.

$\Rightarrow$ 12-bits required to identify a byte in a page.

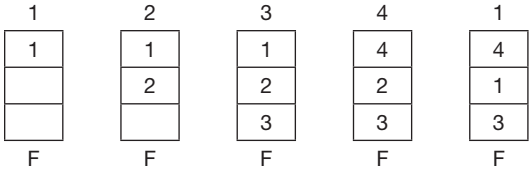


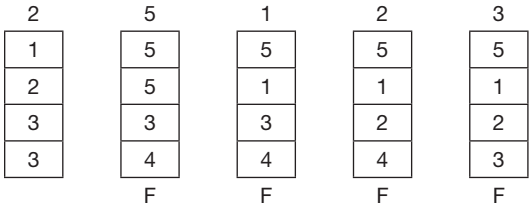
Number of entries in 2nd level Page table $= \frac{2^{12}}{4} = 2^{10}$

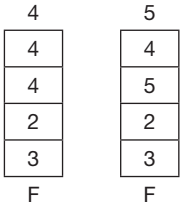
$\therefore$ 10 bits required for 2nd level. Similarly for first level also 10-bits required. Choice (C)

18. Effective TLB access time
= hit ratio * TLB access time + (1-hit ratio) * (TLB access time + memory access time *2)
= 0.9 * 1 + (0.1) * (1 + 20) = 0.9 + 2.1 = 3 ns.
Choice (C)

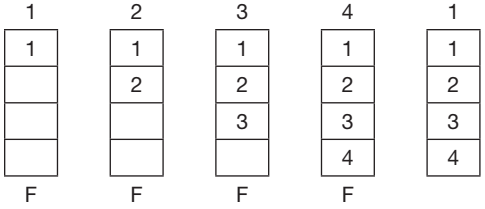
19. Initially, page frames allocated = 3

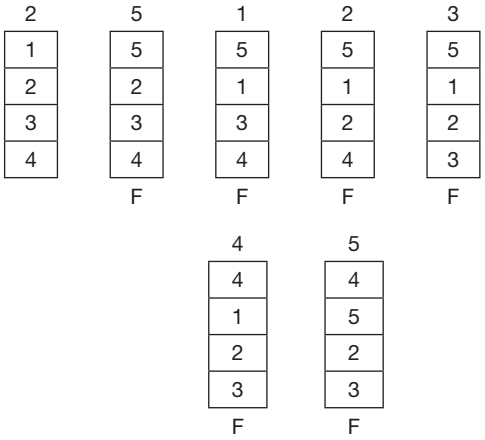






$\therefore$ Number of page faults = 9
Page frames Allocated = 4





∴ Number of page faults = 10

∴ Number of page fault increases by one. Choice (C)

20. Seek time = 1 ms

Rotational speed = 15000 RPM.

15000 RPM = 15000/60 RPS = 250 rps

$$\text{Rotational delay} = \frac{1}{2\times250} = 2 \text{ ms}$$

$$\text{Transfer time} = \frac{512\times1024}{250\times1024\times512} = 4 \text{ ms}$$

∴ Total time = seek time + Rotational delay + Transfer time = 7 ms Choice (C)

21. Virtual memory = 1 GB = 2^{30} B

Page frames = 256

Page size = 4 KB

Physical memory = 256 * 4 K = 2^{20} B.

$$\text{Number of pages} = \frac{2^{30}}{2^{12}} = 2^{18}$$

Page table size will fit in main memory. (main memory = 2^{20} B, Page table size = 2^{18} * PTE,

PTE will be less than 4 B)

∴ I is true

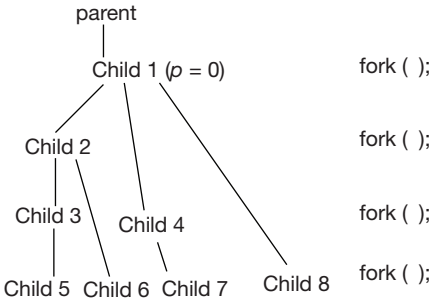
Frame table size = 256 * (8 + 18) = 6656 bits

This can fit in a page.

∴ It is true. Choice (C)

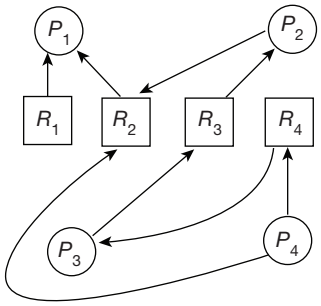
22. Fork () is used to create a child process *A* parent process returns the id of its children. A child process returns zero The first fork () call creates a child process. Only for child process $p = 0$, so child process only executes 3 fork() call statements, which creates 7 child processes.

∴ Total processes = 7 + 1 + 1 = 9



Choice (D)

23. The resource allocation graph of given system is shown below:



Initially P_1 completes and releases its resources. Now if P_4 acquires R_2, then P_2 waits for R_2, P_4 waits for R_4, P_3 waits for R_3. There is a circular wait. But if P_2 acquires R_2 then there will be no deadlock. Choice (B)

24. Load, modify *PC*, *SP* are not protected instructions. Modifying the register that controls kernel/user mode is a protected instruction. Otherwise any process can make itself run in kernel mode. I/O devices are only directly accessible by the *OS*. Choice (C)

25. Offset = 12 bits

Using 12-bits, we can access 2^{12} bytes. So the page size is 2^{12} = 4096 bytes. Choice (C)

26. $$\text{Number of pages} = \frac{\text{Virtual memory}}{\text{Page size}}$$

$$\text{Number of pages} = \frac{2^{32}}{2^{12}} = 2^{20}$$ Choice (D)

27. The number of pages depend on $p + q + r$. Choice (A)

28. Given total address space = 65536 bytes

Text size = 32768 bytes

Data size = 16386 bytes

Stack size = 15870 bytes

If page size = 4096

$$\text{Total pages in memory} = \frac{65536}{4096} = 16$$

$$\text{Pages for text} = \frac{32768}{4096} = 8$$

$$\text{Pages for data} = \frac{16386}{4096} = 5$$

$$\text{Pages for stack} = \frac{15870}{4096} = 4$$

Total pages required for process = 8 + 5 + 4 = 17

∴ Choice (A) is wrong.

Similarly if page size is 2048, the memory consists of 32 pages. If page size is 1024, the memory consists of 64 pages, but process requires 65 pages.

If page size = 512 bytes,

Memory consists of 128 pages and process requires 128 pages.

∴ Choice (D) is correct Choice (D)

29. The iterative formula for finding root of $f(x) = 0$ in Newton–Raphson method is

$$x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)}$$

By using this formula, starting with $k = 0$ and $x_0 = 3.1$, it can be easily observed that $x_4 = 3$ (the exact root)
$\therefore$ After 4 iterations, the method converges to exact root. Choice (B)

30. As all directories fit in one disk block, then all required data on a directory is stored in the inode itself.
To open /Admin/OS/UNIX/file/src.p
We do following reads:
1. inode of /→ Already in memory
2. Directory for /
3. inode of /Admin
4. Directory of /Admin
5. inode of /Admin/OS
6. Directory of /Admin/OS
7. inode of /Admin/OS/UNIX
8. Directory of /Admin/ OS/UNIX/File
9. inode of /Admin/OS/UNIX/File
10. Directory of /Admin/ OS/UNIX/File
11. inode of /Admin/OS/UNIX/file /scr.p

$\therefore$ 10-disk read operations required. Choice (B)

31. Bitmap after writing A is
1111 1100 0000 0000 …..
File B (6 Blocks): $\underbrace{1111\ \ 11}_{A}\ \ \underbrace{11\ \ 1111}_{B}\ \ 0000\ \ .....$
Delete A : 1000 0011 1111 0000 ……
File C (7 blocks): $\underbrace{1111\ \ 11}_{C}\ \ \underbrace{11\ \ 1111}_{B}\ \ \underbrace{1100}_{C}\ \ .....$
Delete B: $\underbrace{1111\ \ 11}_{C}\ \ 000000\ \ \underbrace{110}_{C}\ \ .....$
$\therefore$ Final bitmap : 1111 1100 0000 1100 ... Choice (C)

32. A short-term scheduler selects the process which is ready to execute. It does not have that much of control over degree of multiprogramming Choice (C)

33.

$$\text{Allocation} = \begin{matrix} p_1 \\ p_2 \\ p_3 \\ p_4 \end{matrix}\begin{bmatrix} 2 \\ 2 \\ 4 \\ 2 \end{bmatrix}$$

Total resources (R) = 10, Available (V) = 0
Need 1 more additional resource for execution of P_2.
$\Rightarrow$ $R = 11$, $V = 1$
Now p_2 can complete. And it releases its allocted resources.
$\Rightarrow$ $R = 11$, $V = 3$
p_1 requires 2 more resources. After execution it releases those 2 + allocated resources i.e., 4
$\Rightarrow$ $R = 11$, $V = 5$
Now p_4 can execute with the available and allocated resources.
$\Rightarrow$ $R = 11$, $V = 7$
Now p_3 can execute.
$\therefore$ One additional resource required.
Choice (B)

34. Shortest-job-First algorithm will select the shortest CPU burst time first.

P_1	P_4	P_5	P_3	P_2
0	15	20	28	37	50

Waiting time of $P_1 = 0$
Waiting time of $P_2 = 37 - 3 = 34$
Waiting time of $P_3 = 28 - 5 = 23$
Waiting time of $P_4 = 15 - 6 = 9$
Waiting time of $P_5 = 20 - 18 = 2$

$\therefore$ Average waiting time $= \dfrac{(0+34+23+9+2)}{5}$

$= 13.6$ units
Choice (C)

35. In Round Robin algorithm with time quantum 6 units, each job executed for 6 units and wait in waiting queue. The job with more waiting time will be executed first.

P_1	P_2	P_3	P_4	P_1	
0	6	12	18	23	29

P_2	P_5	P_3	P_1	P_5	
35	41	44	47	49	

Waiting time of $P_2 = (6 - 3) + (29 - 12) = 20$
Waiting time of $P_3 = (12 - 5) + (41 - 18) = 30$
Waiting time of $P_4 = (18 - 6) = 12$
Waiting time of $P_5 = (35 - 18) + (47 - 41) = 23$

Average waiting time $= \dfrac{32+20+30+12+23}{5} = 23.4$
Choice (D)