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Class	10th	Chapter	01
Subject	Computer Science	Board	Punjab

Chapter 01: Operating Systems: Structure and Services

Chapter 01: Multiple Choice Questions (MCQs)

1. Which is NOT an example of an operating system?

(a) Linux (b) Windows **(c) Photoshop** (d) macOS

2. In multi-user environments, the OS ensures:

(a) Equal access and data privacy (b) All users share the same files (c) Hardware is never used (d) Internet speed is increased

3. In Windows, user accounts can be created via:

(a) Task Manager **(b) Control Panel or Settings** (c) Disk Management (d) BIOS settings

4. The core part of the OS that interacts directly with hardware is the:

(a) Shell **(b) Kernel** (c) Device Driver (d) System Library

5. A graphical shell allows the user to:

(a) Type commands only **(b) Click icons and use menus** (c) Interact only via code (d) Access only the BIOS

6. In the FCFS scheduling method, processes are served:

(a) Randomly (b) Shortest job first **(c) In the order they arrive** (d) By priority only

7. Threads in the same process:

(a) Have separate memory spaces **(b) Share the same memory and resources** (c) Run on different OS (d) Cannot run simultaneously

8. Which system call is used to create a new process?

(a) open (b) read (c) write **(d) fork**

Short Questions

1. Why is the operating system referred to as the "central controller"?

Answer: The OS acts like a traffic controller that manages all hardware components, allocates CPU time, manages computer memory, and controls active peripheral devices (like printers or speakers) to ensure the system runs smoothly.

2. How does the OS act as a translator between the user and hardware?
Answer: Computer hardware only understands binary language (0s and 1s), whereas humans use languages like Urdu or English. The OS converts user actions (like clicking or typing) into machine-understandable binary instructions and displays the result back to the user.
3. Define one way to create a new user account in Windows.
Answer: In Windows, a new user account can be created by opening **Settings** or **Control Panel**, navigating to **User Accounts**, selecting **Add New User**, and providing a username, password, and account type.
4. How is kernel different from shell?
Answer:

- **Kernel:** The core inner part of the OS that directly interacts with and manages the hardware (CPU, RAM, storage).
- **Shell:** The outer interface of the OS that interacts directly with the user (via CLI or GUI) to receive commands and forward them to the kernel.

5. Give one example of a system library and its purpose.
Answer: A system library provides ready-made instructions for common tasks. For example, when a photo viewer app needs to open an image, it calls an OS system library to handle reading the image file from storage instead of writing custom code for file opening.
6. Explain one advantage and one disadvantage of FCFS scheduling.
Answer:

- **Advantage:** It is simple to understand and implement because tasks are processed in the exact order they arrive without skipping any process.
- **Disadvantage:** Short processes can be delayed significantly if they arrive behind a long-running process (known as the *convoy effect*).

7. Why is virtual memory slower than RAM?
Answer: Virtual memory uses space on secondary storage drives (like HDDs or SSDs). Storage drives operate at much lower data transfer speeds and higher latency/access times compared to primary RAM.
8. Define a system call.
Answer: A system call is a program's request to the operating system kernel to perform specific low-level or hardware-related operations that user applications cannot execute directly.
9. What is the role of a file system?
Answer: A file system organizes, stores, tracks, and manages files and folders on physical storage devices so data can be located, retrieved, and kept secure.
10. Define multitasking in computer system.
Answer: Multitasking allows an OS to keep multiple programs open and actively usable for a user at the same time, allowing seamless switching between tasks.
Long Questions
1. Describe the architecture of an operating system, explaining kernel, shell, and layered design with examples.

Answer:
The architecture of an OS organizes its internal components into clear functional parts:

- **Kernel:** The foundational core component that interacts directly with physical hardware (CPU, Memory, Storage, I/O devices). It manages system resources safely. *Analogy:* It works like the engine of a car.
- **Shell:** The user-facing software boundary that interprets user commands and forwards them to the kernel. Shells can be Command-Line Interfaces (like Terminal/Command Prompt) or Graphical Interfaces (like Windows Desktop). *Analogy:* It works like a car's dashboard and steering wheel.
- **Layered Design:** The system architecture is divided into modular layers where each layer has a distinct role:
    1. *Lower Layer:* Works directly with physical hardware components.
    2. *Middle Layer:* Handles resource management (memory allocation, process scheduling, file system).
    3. *Upper Layer:* Executes application programs and provides user interface displays.

Example Analogy: In a school, support staff act as lower layers (maintaining the physical grounds), administration acts as middle layers (allocating rooms and schedules), and teachers/students act as upper layers (executing academic activities).

2. Explain the process lifecycle in detail with examples.

Answer:
A process is a program currently under execution. It passes through three main lifecycle stages:
[Creation] ---> [Execution] ---> [Termination]

1. **Creation:**
    - Occurs when a user launches an application (e.g., clicking Google Chrome).
    - The OS loads the program binary into memory and allocates necessary resources (CPU priority, memory blocks).
2. **Execution:**
    - The process actively uses CPU cycles to run code instructions, load webpages, render media, or process user inputs.
3. **Termination:**
    - Occurs when the program finishes its work or is closed by the user/system.
    - The OS halts execution and completely releases allocated RAM and resources back to the pool.

3. Differentiate between RAM and virtual memory, and explain how multithreading improves performance.

Answer:

Difference between RAM and Virtual Memory

Feature	Primary Memory (RAM)	Virtual Memory
Type	Main physical semiconductor memory	Portion of secondary storage (SSD/HDD) used as RAM
Speed	Extremely fast data access	Slower due to storage drive latency
Capacity	Limited physical capacity	Extends available memory pool when RAM fills up
Volatility	Volatile (data lost when powered off)	Temporary space managed on storage media

How Multithreading Improves Performance

Multithreading divides a single process into smaller concurrent execution units called *threads* that share memory space. It boosts performance by:

- **Responsiveness:** Enables an app to remain interactive (e.g., typing in a document while a background thread runs spellcheck).
- **Parallel Processing:** Executes sub-tasks across CPU cores concurrently.
- **Resource Efficiency:** Requires fewer system overhead resources than spawning separate individual processes.

4. Describe system calls, their purpose, and give examples of at least three types.

Answer:

System Call & Purpose:

A system call acts as a secure programmatic interface between user applications and the OS kernel. Because application code cannot directly control hardware for security reasons, it uses system calls to request the kernel to perform protected operations.

Types and Examples of System Calls:

1. open: Requests the OS to open an existing file or create a new file for reading or writing (e.g., opening a video file in a media player).
2. read: Retrieves stored data bytes from a file or hardware input device into memory (e.g., reading text contents of a document).
3. write: Sends processed data bytes from memory to an output device or disk file (e.g., saving an image file to disk).
4. fork: Creates a new child process by cloning an existing parent process (e.g., opening a new tab in a web browser).

5. Numerical Problem: First-Come, First-Served (FCFS) Scheduling

Given Table:

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Process	Arrival Time (s)	Burst Time (s)
P1	0	4
P2	1	3
P3	2	1

Solution:

I. Execution Order:

Since FCFS processes jobs in exact arrival sequence:

Order: $P_1 \rightarrow P_2 \rightarrow P_3$

II. Execution Timeline (Gantt Chart):

- P_1 runs from 0s to 4s
- P_2 runs from 4s to 7s
- P_3 runs from 7s to 8s

[P1: 0 - 4] → [P2: 4 - 7] → [P3: 7 - 8]

III. Start Time and Completion Time:

- **P1:** Starts at 0s, Completes at 4s
- **P2:** Starts at 4s, Completes at 7s
- **P3:** Starts at 7s, Completes at 8s

IV. Calculation of Waiting Time:

$$\text{Waiting Time} = \text{Start Time} - \text{Arrival Time}$$

- Waiting Time for $P_1 = 0 - 0 = 0$ seconds
- Waiting Time for $P_2 = 4 - 1 = 3$ seconds
- Waiting Time for $P_3 = 7 - 2 = 5$ seconds

V. Average Waiting Time:

$$\text{Average Waiting Time} = \frac{\text{WT}(P_1) + \text{WT}(P_2) + \text{WT}(P_3)}{3}$$

$$\text{Average Waiting Time} = \frac{0 + 3 + 5}{3} = \frac{8}{3} \approx 2.67 \text{ seconds}$$

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