

1. Answer) Multiprogramming, spooling, and time-sharing.
2. Answer) The CPU processes data faster than it can be transferred between memory and the CPU.
3. Answer) the number of units of information a system can process in a given amount of time.
4. Answer) Multiprogramming is a technique where multiple programs are loaded into memory and executed by the CPU. It improves CPU utilization by allowing the CPU to switch between programs, ensuring that it is always working and not left idle during input/output operations.
5. Answer) A modern general-purpose computer system consists of one or more CPUs, memory, and several I/O devices, all connected through a common bus that allows communication between I/O devices and shared memory.
6. Answer) A device controller is responsible for controlling a specific type of I/O device, managing data movement between the device and its local buffer storage, and interacting with the system's shared memory through the bus.
7. Answer) A device controller typically maintains **local buffer storage** and a set of **special-purpose registers** to assist in controlling data transfer between peripheral devices and its local buffer.
8. Answer) When a process changes state from running state to block state or ready state, the operating system saves all necessary information to its Process Table to continue the process from where it left off when it resumes execution
9. Answer) A pipelined design improves CPU performance by allowing the CPU to perform multiple stages (fetch, decode, and execute) simultaneously. While one instruction is being executed, another instruction can be decoded, and a third can be fetched.
10. Answer) When reading data, the device controller transfers data from the I/O device to its local buffer. After the data transfer is complete, the controller checks for any errors, and then informs the device driver that the data is ready to be processed by the operating system by interrupt.
11. Answer) When the CPU receives an interrupt signal, it stops its current task and immediately transfers execution to a fixed location where the interrupt service routine is located. After handling the interrupt, the CPU resumes the interrupted computation

- 12.** Answer) Interrupts can be triggered by **device controllers** (such as I/O devices) or **hardware faults** (such as memory or processing errors).
- 13.** Answer) The interrupt vector table is used by the operating system to store pointers to interrupt service routines. This table allows the CPU to quickly locate and execute the appropriate service routine when an interrupt occurs. It is typically stored in low memory to ensure fast access.
- 14.** Answer) Modern computers use a system of interrupt priorities to ensure that the most urgent interrupts are handled first.
- 15.** Answer) DMA (Direct Memory Access) allows data to be transferred directly between an I/O device (such as a disk drive) and system memory without involving the CPU. This reduces overhead and speeds up the overall operation of the system, particularly when handling bulk data transfers.
- 16.** Answer) Each CPU has its own set of registers and possibly cache memory. Each CPU performs all tasks including OS functions and user processes. All processors share a common physical memory over the system bus.
- 17.** Answer) Each CPU has its own local memory that is accessed via a small, fast local bus. CPU are connected by a shared system interconnect, so that all CPUs share one physical address space.
- 18.** Answer) In Asymmetric clustering, one machine is in hot-standby mode. Hot-standby host machine does just monitor the active server. If that server fails, the hot-standby host becomes the active server
- 19.** Answer) In Symmetric clustering, two or more hosts are running application and monitoring each other. This model is more efficient but it does require that more than one application be available to run.
- 20.** Answer)
- Mutual exclusion
 - Circular Wait
 - Hold and Wait
 - No Preemption
- 21.** Answer) Increased latency when a CPU must access remote memory across the system interconnect, creating a possible performance penalty

22. Answer) The main role of the process table is to store and manage key information about each process, enabling the operating system to track, schedule, and control processes effectively

23. Answer)

- **Running:** The process is currently being executed by the CPU.
- **Blocked (or Waiting):** The process is waiting for some event, such as I/O completion or resource availability, and cannot proceed.
- **Ready:** The process is prepared to run and is waiting for CPU time but is not currently being executed.

24. Answer) To achieve high reliability, OS is broken into small well-defined module. Only one module (Microkernel) run in kernel mode and the rest run as user mode.

25. Answer)

- Issue I/O commands to devices.
- Catch interrupts from I/O devices.
- Handle errors during I/O operations.