a) It is responsible for moving data between the physical devices and its local buffer storage, as well as sending signals to the OS to indicate readiness for data transfer.

b)

a. **Process & Thread Management**
b. **Memory Management**
c. **File Management**
d. **Deadlock Management**
e. **Input/Output Management**

c) **Based on the architecture, each instruction need move from RAM to CPU. Processor calculation speeds are much faster than data movement between memory and CPU**.

d) **Save the virtual address of the next instruction.**

e) **Similar jobs are collected and save in a magnetic tape and load one by one to the system and implement sequentially.**

f) Several jobs are loaded into RAM and OS provide pseudo-parallelism.

g) Save the address of the top of the stack for the currently running process. (top of stack save local variables)

h)

- **OS stops what currently doing and immediately transfers execution to a fixed location where the service routine for the interrupt is located.**

i)

- **CPU detect interrupt from the interrupt-request line and it reads the interrupt number and jump to the interrupt handler routine**

j)

- **DMA (Direct Memory Access)**

k) Since limited number resources which must be shared between processes.

l)

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.

m)

- **Issue I/O command to devices**
- **catch interrupts from each I/O devices**
- **handle errors**

n)

- **Mutual exclusion**
- **Circular Wait**
- **Hold and Wait**
- **No Preemption**

o)

- **Due to heavy data transfer, bus becomes a bottleneck.**

p)

- **Increased latency when a CPU must access remote memory across the system interconnect, creating a possible performance penalty**

q)

- **Asymmetric clustering- one machine is in hot-standby mode. Hot-standby host machine does just monitoring the active server. If that server fails, the hot-standby host becomes the active server.**
- **Symmetric clustering – two or more hosts are running application and monitoring each other.**

r)

- **Keep track of which parts of memory are currently being used by which process**
- **Allocate and deallocate memory space as needed for each process**
- **Decide which processes are to be loaded into memory when memory space become available.**

s)

- **Mounting and unmounting a device.**
- **Free-space management**
- **Storage allocation**
- **Disk scheduling**
- **Partition**
- **Protection**

t)

- **Non-maskable interrupt line – reserved for event such as unrecoverable hardware error.**
- **Maskable interrupt line – used by device controllers to request service.**

u) **Mechanical component (device itself), electrical component (device controller) and device driver.**

v) jobs for processes (I/O jobs) are saved in a file and executed one by one (i.e. network printer)

w) **process status, snapshot of CPU, scheduling information, memory management information I/O status information**.

x)

a. **Protection between jobs**
b. **Job scheduling**
c. **virtual memory**

y)

Since instruction cycle are three steps: fetch, encoding, and execute

z) **Multiple terminals are connected to a host computer through networks and each user are shared CPU time.**