Sheet 2

1. What is meant by virtualization?

   A technology that simulates hardware and creates multiple VMs on a single server.

2. How is a virtual machine created?

   By using a hypervisor such as Xen or KVM to create a virtual machine. Some of the physical server's resources are allocated to the virtual machine.

3. Compare between physical server and virtual machine.

Physical Server	Virtual Machine
Runs single OS	Runs multiple OSs
Low resource utilization	High resource utilization
Dependent, can't be migrated to different hardware.	Independent, Isolated, and Encapsulated
Faster than VM	Slower than physical server

4. Describe Bare-Metal virtualization.

   A bare-metal hypervisor runs on the hardware directly and does

not need a host OS. The bare-metal hypervisor itself can be seen as a customized host OS which manages the physical resources.

5. Describe Hosted virtualization.

A hosted hypervisor runs on a host OS which manages the physical resources. Hosted hypervisors can't run directly on the hardware.

6. Discuss the virtualization characteristics.

    a. **Partitioned** → Physical resources are partitioned and distributed among virtual machines.

    b. **Isolated** → If one VM crashes, the other VMs are not affected.

    c. **Encapsulation** → The files and resources related to a VM are collected together in a capsule.

    d. **Independent** → The VM is completely independent from the hardware and can be migrated to other hosts easily.

7. Compare between full virtualization and para-virtualization.

In full virtualization, all of the instructions are processed and performed by the host OS. While in para-virtualization, only

some of the instructions are performed by the host OS while others are performed by the guest OS.

8. What are the different I/O virtualization methods?

    a. **Emulation (Full Virtualization)** → Complete simulation of the hardware. Leads to poor performance in some cases.

    b. **Paravirtualization** → Access to hardware drivers is transferred from the I/O frontend to the I/O backend.

    c. **IO-through** → Hardware devices capable of I/O are directly allocated to VMs.

9. Compare between cloud computing and virtualization.

Virtualization is a technology by we can create multiple VMs on a single server and simulate hardware. Cloud computing is a technology that uses virtualization to provide on-demand service to its users.

10.   Compare between the closed source and open-source Virtualization Technologies.

Open source: **Xen** which is a Type 1 Hypervisor that uses PV and **KVM** which is a Type 2 Hypervisor that uses QEMU.

Closed source: **Hyper-V**, **VMware ESXI**, and **Huawei**

**FusionSphere** which is built on top of KVM.

11. <mark>Compare between the Xen and KVM hypervisors.</mark>

Xen is a Type 1 Hypervisor that uses PV while KVM is a Type

2 Hypervisor that uses QEMU.
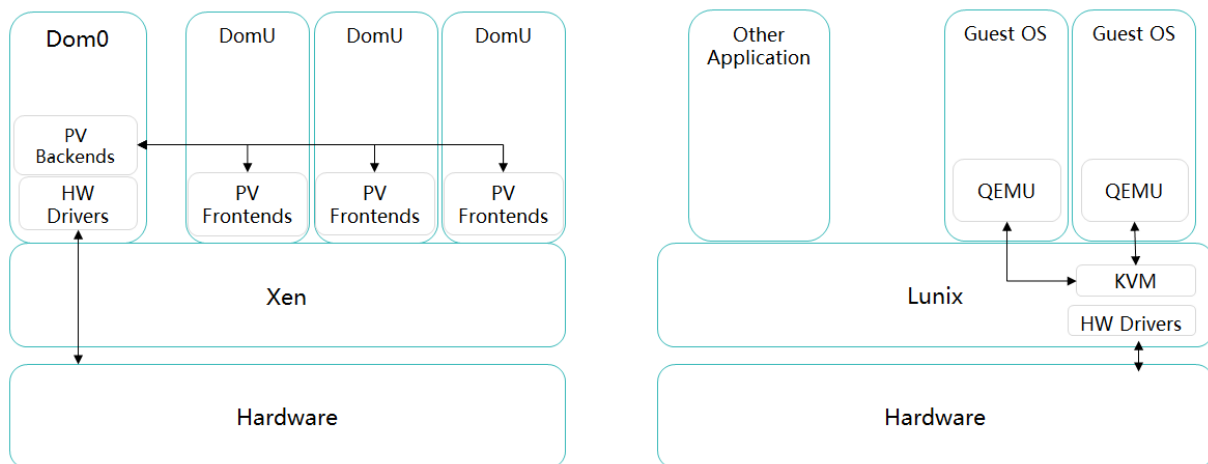
12. <mark>Explain with diagram the KVM I/O Process with the</mark>

<mark>default and Vertio.</mark>

By default, the I/O request is captured by the trap code in the

KVM module. The KVM module notifies QEMU which

simulates the request to perform the real I/O operation. The

result is then returned to the VM.
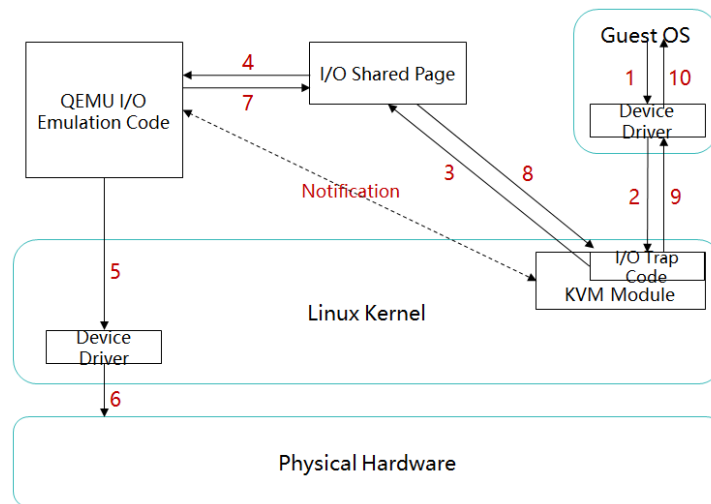
With Vertio, the I/O request is stored in vring between the frontend and backend drivers. The backend driver directly calls the actual physical device driver to perform the I/O operation. The result is then returned to the VM.
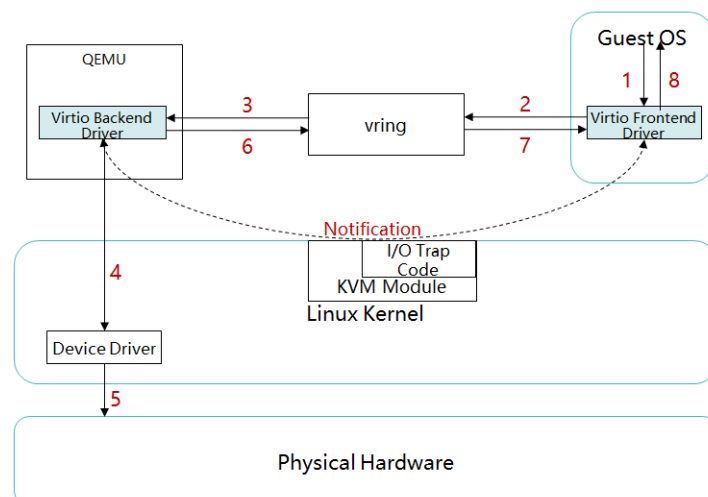
What are the advantages of FusionCompute?

 a. Unified management of virtual and physical resources.

b. Quick VM provisioning.

14. <mark>Describe the FusionCompute components.</mark>

FusionCompute consists of two parts: Computing Node Agent (CNA) and Virtual Resource Manager (VRM). CNA is responsible for providing virtual computing functions, managing VMs on compute nodes, and managing compute, storage, and network resources on compute nodes. VRM is responsible for managing block storage resources in clusters, managing network resources such as IP addresses and VLANs in clusters, and managing the lifecycle of VMs in clusters.