4a. In the system configuration of the VM, explain how changing the number of processors changes the behavior of your VM. Explain a scenario where you want to set this to the minimum, and a scenario where you want to set it to the maximum. Why is setting it to the maximum potentially a bad idea?
Ans:
When we changed the number of processor cores, the performance and speed is changing accordingly. When we use a 2-core processor, the speed is normal. With increase in cores, opening the applications in VM and executing commands in a terminal are super efficient and faster. At the same time, the host OS is being slowed down(precisely fraction of seconds)

I possibly use the minimum number of cores, when I run a simple virtual machine or when I am running multiple virtual machines so that I can allocate equal distribution of resources.
And with minimum setup, the time taken to start the VM for access has taken more time than anticipated. However, the processing time in the terminal is normal.

I use maximum number of processors, when I try to run a load(req-res) test on a server that configured on a virtual machine. But this slows down the host machine.

If we setup all cores to the virtual machine, then the host computer performance decreases. The host OS requires to perform background processes even though there are no active applications running. If we assign all processors to a virtual machine, this stops the tasks from being executed/completed.

4b. In the system configuration of the VM, under the Acceleration Tab, explain the difference between the paravirtualization options: None, Legacy, Minimal, Hyper-V, and KVM. Explain which one would be best to use with Ubuntu Linux, and why.
ANS:
Paravirtualization providers are to make easy efficient execution of software in a virtual machine. It communicates with the guest operating system in order to recognize OS presence and avail the benefits of communicating with the Oracle VM VirtualBox hypervisor.

None:
- Using none explicitly turns off exposing any paravirtualization interface.

Legacy:
- The option "Legacy" is selected for virtual machines which were created using older VirtualBox versions. It picks a paravirtualization interface when starting a virtual machine with VB version 5 and newer.

Minimal:

It gives information about virtualized environment presence. It also reports TSC and APIC frequency to the guest operating system. This is mandatorily used for Mac operating system VB guests.

Hyper-V:
It presents a Microsoft Hyper-V hypervisor interface which is recognized by Windows 7 and newer Windows operating systems. It currently supports paravirtualized clocks, APIC frequency reporting, guest debugging, guest crash reporting and relaxed timer checks.

KVM:
Kernel-based Virtual Machine is a Linux KVM hypervisor interface which is recognized by Linux kernels starting with version 2.6. It currently supports paravirtualized clocks and SMP spinlocks.

KVM is the Linux Kernel's own way to virtualization. It is the lightest, most stable, and most universal virtualization option for Linux systems. While it is not simple to set up with VirtualBox, but it is more efficient and flexible. When pairing KVM with a graphical manager like virt-manager, it is extremely simple to use, and it integrates well with Linux desktop. It is also simple to get VM guests on regular network through bridged networking. This provides a more seamless experience overall.

4c. In storage devices when configuring the VM, there are multiple types of storage controllers: explain the difference between IDE, SATA, and NVMe controller. Give an example for each type of storage controller of a scenario where you may want to use this type of controller.

Ans:
Differences between IDE SATA and NVMe.
IDE (Integrated Drive Electronics) :
- COST: IDE is the least expensive among other controllers.
- Data transfer rate: 133 mbps which is relatively lesser than the other controllers.
- Storage capacity : Comparatively large in size.
- Hot plugging: It does not support hot plugging. It is not possible to remove or add a device while system is running.
- Status : Outdated. Currently not in use.

SATA (Serial advanced technology attachment):
- Data rate and speed: Faster than IDE with a data rate of 6Ghz and latency of just 100 microseconds
- Storage capacity - The queue contains upto 32 outstanding commands.
- COST: It is cheaper compared to the other two controllers.
- Hotplugging: It supports hot plugging as it is possible to add or remove a device while system is running.

- Status: Currently in use.
- These are used in gaming consoles, personal computers, laptops, and also as external storages.

NVMe - Non-Volatile Memory Express
- Data rate and speed: Faster than IDE and SATA with 16ghz and a lower latency of just 20 micro secs. It also increases SSD's speed overall.
- Storage capacity - Way higher number of queues as compared to SATA with 65,535 queues.
- COST: It is cheaper than IDP but expensive than SATA
- Status: currently in use.
- This is used in laptops in the form of M.2.

4d. In the network configuration of the VM, there are multiple types of network adapters: explain the difference between NAT, Bridged Adapter, Internal Network, and Host-only Network. Give an example for each type of network of a scenario where you may want to use this type of network.

Ans:

NAT:

It is used to connect to an external network using the same host identity. The external network can not identify the virtual machine, as the virtual machine uses the same IP of host system. It is mostly used when the virtual machine does not have a separate IP address.

Bridge Adapter:

This helps a virtual machine to have access to the physical network in the same way as the host machine by bridging a virtual NIC to a physical NIC on the host. This will allow the computers in the network access the virtual machine. It is used to create client or server guests like a production environment.

Internal Network:

The internal network is basically an isolated network. Guess systems can communicate with each other only if they are connected to the same internal network. It does not allow outside applications to access the network. We opt for this network when we want do secure testing through a separate and clean network.

Host-only Network:

The host-only network is similar to internal network but it can also provide DHCP services. In this network, guests can access each other. It is possible to create a separate guest network. We can also create a DHCP server. This can be used in a fixed IP system architecture.

4e. For the USB configuration of the VM, explain the difference between USB 1.1, 2.0, and 3.0 controllers.

Ans:

USB(Universal Serial Bus) 1.1, 2.0 and 3.0: The main difference between the three controllers is the data transfer speed. In USB 1.1, the data transfer speed is 12 mbps while the data transfer speed for the other two is 480mbps. USB 1.1 and 2.0 are half duplex as they either receive data or transfer data one at a time. However, USB 3.0 is a full duplex where the transfer of data is two way. USB 1.1 in general supports devices with low bandwidths whereas the other two support higher bandwidth devices.