1. What is an IP address, and why is it important in networking? What are the main functions of an IP address?

An IP (Internet Protocol) address is a unique identifier assigned to each device connected to a network. It allows devices to communicate by identifying their location in the network. IP addresses are essential for data transmission, ensuring that information reaches the correct destination.

Main Functions of an IP Address:

- **Device Identification:** Each device gets a unique IP address, enabling its recognition on the network.
- **Location Addressing:** Identifies the device's location within the network, similar to a home address.
- **Data Routing:** Facilitates the proper routing of data packets from the source to the destination.
- **Security and Control:** Helps network administrators manage access control and security policies.

2. Difference Between IPv4 and IPv6 Addresses

Feature	IPv4	IPv6
Address Length	32-bit; supports about 4.3 billion addresses.	128-bit; supports nearly unlimited addresses.
Format	Written in dotted decimal format (e.g., 192.168.0.1).	Written in hexadecimal with colons (e.g., 2001:db8::1).
Octet Structure	Divided into 4 octets, each separated by a dot (e.g., 192.168.1.1).	Divided into 8 groups of hexadecimal numbers separated by colons (e.g., 2001:0db8::1).
Address Space	Limited and nearing exhaustion.	Vast address space suitable for modern and future networks.
Security	Basic security features; IPsec is optional.	Enhanced security with mandatory IPsec support.
Configuration	Requires manual configuration or DHCP.	Supports auto-configuration for improved scalability.
Performance	May experience delays in larger networks due to NAT.	Faster and more efficient routing without NAT dependency.
Compatibility	Widely used in legacy networks.	Designed for modern infrastructure but requires migration support.

3. Difference Between Public and Private IP Addresses

Aspect	Public IP	Private IP
Scope	Used on the internet	Used within local networks.
Uniqueness	Unique worldwide.	Unique only inside its network.
Range	Assigned by ISPs and can be accessed globally.	Uses specific reserved ranges like 192.168.x.x, 10.x.x.x.
Security	Exposed to online threats; requires robust security measures.	Safer by default; often protected by NAT.
Cost	Requires ISP allocation, often with additional fees.	Free for internal network use.
Visibility	Can be tracked online.	Hidden from the public internet.

4. What Happens if Two Devices on the Same Network Are Assigned the Same IP Address?

If two devices share the same IP address on the same network, an **IP conflict** occurs. This results in network issues such as:

- **Connectivity Loss:** One or both devices may lose internet or network access.
- **Data Misdelivery:** Packets may be sent to the wrong device.
- **Performance Degradation:** Network instability may occur.

To resolve this, network administrators must:

- Identify conflicting devices using IP conflict detection tools.
- Assign a new IP address to one of the conflicting devices.
- Enable DHCP (Dynamic Host Configuration Protocol) to automate IP assignment and avoid conflicts.