1 What is an IP address and why is it important in a network?

An IP address is a unique number assigned to every device on a network. It helps identify the device and allows communication between computers.

2 Difference between IPv4 and IPv6

Address length: IPv4 is 32 bits, IPv6 is 128 bits.  
Notation: IPv4 uses 4 numbers with dots (e.g., 192.168.0.1), IPv6 uses hexadecimal with colons (e.g., 2001:0db8::1).  
Available addresses: IPv4 has about 4 billion addresses. IPv6 has a huge number

3 Binary of 192.168.10.1  
192 = 11000000  
168 = 10101000  
10 = 00001010  
1 = 00000001  
Answer: 11000000.10101000.00001010.00000001

4 Convert binary to decimal:  
11000000.10101000.00000001.00000010  
= 192.168.1.2

5 Class IP ranges:  
Class A= 1.0.0.0 to 126.255.255.255  
Class B=128.0.0.0 to 191.255.255.255  
Class C=192.0.0.0 to 223.255.255.255

6 Class of 172.16.5.4  
It belongs to Class B

7 Public vs Private IP & Private Ranges:  
Private IPs are used in local networks and not routable on the internet. Public IPs are used on the internet.  
Private IP ranges are:  
10.0.0.0 – 10.255.255.255  
172.16.0.0 – 172.31.255.255  
192.168.0.0 – 192.168.255.255

8 Loopback address role:  
The loopback address (127.0.0.1) is used to test your own device’s network setup. It’s like pinging yourself.

9 Static vs Dynamic IP:  
Static IP: Fixed address, manually set. Example: a server with 192.168.1.100.  
Dynamic IP: Automatically given by DHCP. Example: when your phone connects to Wi-Fi, it gets a random IP like 192.168.1.25.

10 Default subnet masks:  
Class A → 255.0.0.0  
Class B → 255.255.0.0  
Class C → 255.255.255.0

Part B – Subnetting Concepts & Calculations

1 What is subnetting and why is it used?  
Subnetting means dividing a big network into smaller ones. It helps organize the network better and save IPs.

A IP: 192.168.1.0/24 → How many total IPs?  
/24 means 256 total IPs. (2⁸ = 256)

B Usable host IPs from /24:  
256 total – 2 = 254 usable (one is network, one is broadcast)

C If you borrow 2 bits from /24:  
New prefix = /26  
2² = 4 subnets

D Borrow 3 bits from /24 → New subnet mask?  
/24 + 3 = /27  
Subnet mask: 255.255.255.224

16 IP: 192.168.10.0/26  
Hosts per subnet = 2⁶ – 2 = 62 hosts  
Subnets = 2² = 4 subnets (since 26 - 24 = 2 bits borrowed)

17 First and last usable in 192.168.10.64/26:  
Range: 192.168.10.64 to 192.168.10.127  
Network = 192.168.10.64  
Broadcast = 192.168.10.127  
First usable = 192.168.10.65  
Last usable = 192.168.10.126

18 Network and broadcast of 10.0.0.0/22  
/22 means 1024 IPs (2¹⁰)  
Network address = 10.0.0.0  
Broadcast address = 10.0.3.255

19 Fill in the blanks:  
CIDR /30 gives 2 usable IPs  
CIDR /28 supports 14 hosts

20 172.16.0.0/20 block and max 510 hosts per subnet:  
We need at least 510 hosts → We need 9 host bits (2⁹ = 512)  
So, subnet mask = /23 (since 32 – 9 = 23)  
Subnet mask: 255.255.254.0  
How many subnets?  
From /20 to /23 → 3 bits borrowed → 2³ = 8 subnets