

Q1) An ISP is granted a block of addresses starting with 190.100.0.0/16. The ISP needs to distribute these addresses to three groups of customers as follows:

- i. The first group has 64 customers; each needs 256 addresses.
- ii. The second group has 128 customers; each needs 128 addresses.
- iii. The third group has 128 customers; each needs 64 addresses.

Solution:

To solve this problem, we need to perform **subnetting** based on customer requirements and efficiently allocate addresses from the given block:

👉 **190.100.0.0/16**

◆ **Step 1: Understand the Total Address Space**

- The CIDR /16 means:
 - IP range = **190.100.0.0 to 190.100.255.255**
 - Total IPs = $2^{(32-16)} = 65,536$ addresses

◆ **Step 2: Understand the Requirements**

Group	No. of Customers	IPs per Customer	Total IPs Required
1	64	256	$64 \times 256 = 16,384$
2	128	128	$128 \times 128 = 16,384$
3	128	64	$128 \times 64 = 8,192$

- **Total required addresses = $16,384 + 16,384 + 8,192 = 40,960$**
 - This is less than the 65,536 available addresses — So allocation is possible.
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◆ **Step 3: Allocate Subnets Group-wise**

Group 1: 64 customers, each needs 256 addresses

- 256 addresses → subnet mask: /24 (since $28=2562^8 = 256$)
- So, each customer gets a /24 subnet.
- Total addresses = $64 \times 256 = 16,384$
- Address range: **190.100.0.0/24 to 190.100.63.0/24**

Group 2: 128 customers, each needs 128 addresses

- 128 addresses → subnet mask: /25 (since $27=1282^7 = 128$)

- Each customer gets a /25 subnet.
- Total addresses = $128 \times 128 = 16,384$
- Address range: **190.100.64.0/25 to 190.100.127.128/25**

Explanation: From 190.100.64.0, the next 128 subnets of size 128 IPs will span:

- Each /25 block takes 128 addresses
- Needed space = $128 \times 128 = 16,384$
- So range = **190.100.64.0 to 190.100.127.255**

Group 3: 128 customers, each needs 64 addresses

- 64 addresses → subnet mask: **/26** (since $2^{26} = 64$)
- Each customer gets a /26 subnet.
- Total addresses = $128 \times 64 = 8,192$
- Address range: **190.100.128.0/26 to 190.100.159.252/26**

Explanation: Starting from 190.100.128.0, 128 blocks of 64 addresses will span:

- $128 \times 64 = 8,192$ IPs
- Final address used: 190.100.159.252

Step 4: Final Address Allocation Summary

Group	Subnet Mask	Address Range Start	Address Range End
1	/24	190.100.0.0	190.100.63.255
2	/25	190.100.64.0	190.100.127.255
3	/26	190.100.128.0	190.100.159.255

- **Remaining addresses in 190.100.160.0 to 190.100.255.255** are unused (for future use or reserved)

Final Notes:

- We used **CIDR** and **VLSM** (Variable Length Subnet Masking) for efficient allocation.
- No IP wastage in each group since requirements match subnet size.
- Unused addresses can be used for future expansion.

Would you like this solution added to the PDF as well?

Q3) A supernet has a first address of 205.16.32.0 and a supernet mask of 255.255.248.0. State the number of blocks are in this are in this supernet and what is the range of addresses?

Solution:

Let's solve the given **supernetting** problem step by step:

 **Given:**

- First Address: **205.16.32.0**
 - Supernet Mask: **255.255.248.0**
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 **Step 1: Convert the Subnet Mask to CIDR**

- $255.255.248.0 = /21$
Because:
 - $255.255.248.0 = 11111111.11111111.1111000.00000000$
 - $\uparrow 21 \text{ bits} \rightarrow /21$
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 **Step 2: Determine Block Size**

- A /21 network leaves **11 bits** for host addressing (since $32 - 21 = 11$).
 - Total IP addresses in the supernet = $2^{11} = 2048$
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 **Step 3: Number of Blocks**

A **supernet** is formed by **combining multiple smaller classful networks**. We assume we're combining **Class C blocks** (which are /24 by default).

- A /24 block has **256 addresses**.
- Supernet has **2048 addresses**.
- Number of Class C blocks in this supernet = $2048/256=8$

 **So, 8 Class C blocks are combined to form this supernet.**

 **Step 4: Address Range of the Supernet**

Starting address = **205.16.32.0**

Each block is 256 IPs, so the full supernet spans **$8 \times 256 = 2048$ IPs**.

► Convert the number of IPs into range:

- Start: **205.16.32.0**
- Add $2048 - 1 = 2047$ IPs

► Calculate Ending Address:

- From 205.16.32.0, add 2047 addresses:

Add to	Result
$32 + (2047 \div 256) = 32 + 7 = 39$ (7 full 256 blocks)	
$2047 \bmod 256 = 255 \rightarrow$ Last host in block	

End Address: **205.16.39.255**

Final Answer:

- Number of Class C Blocks: **8**
 - Address Range:
From **205.16.32.0** to **205.16.39.255**
 - Total IPs: 2048
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Would you like this solution added to the PDF file as well?

Q5) A company is granted the site address 201.70.64.0. The company needs six subnets design the subnets.

Solution:

Let's solve this **subnetting** problem step by step:

 **Given:**

- Site address: **201.70.64.0**
 - The company needs: **6 subnets**
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 **Step 1: Determine Class of the IP**

201.70.64.0 falls in the range 192–223, so it's a **Class C** IP.

- Default subnet mask: **255.255.255.0** or /24

- Total IPs in Class C: $2^8 = 256$
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◆ Step 2: Determine Number of Bits to Borrow

We need at least **6 subnets**.

To calculate how many bits to borrow from the host portion:

- $2^n \geq 6 \geq n \geq 3$
- $n=3$ → $2^3 = 8$ subnets (sufficient)

So we borrow **3 bits** from the host portion.

◆ Step 3: New Subnet Mask

- Original mask: /24 → 255.255.255.0
- New mask after borrowing 3 bits:
 - /27 → $24+3=27$
 - Subnet mask: **255.255.255.224**

Because:

224 in binary = 11100000 → 3 bits borrowed

◆ Step 4: Subnet Details

- Number of subnets = $2^3 = 8$
 - Number of hosts per subnet = $2^5 - 2 = 30$ 30 hosts (5 bits left for hosts)
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◆ Step 5: Subnet Ranges

Since we're using /27 (block size = 32 IPs), calculate subnet blocks:

Subnet	Network Address	First Host	Last Host	Broadcast Address
1	201.70.64.0/27	201.70.64.1	201.70.64.30	201.70.64.31
2	201.70.64.32/27	201.70.64.33	201.70.64.62	201.70.64.63
3	201.70.64.64/27	201.70.64.65	201.70.64.94	201.70.64.95
4	201.70.64.96/27	201.70.64.97	201.70.64.126	201.70.64.127
5	201.70.64.128/27	201.70.64.129	201.70.64.158	201.70.64.159

6	201.70.64.160/27	201.70.64.161	201.70.64.190	201.70.64.191
(extra)	201.70.64.192/27
(extra)	201.70.64.224/27

We only need 6 subnets, so we can use the first 6 of the 8 available.

✓ Final Summary:

- **New subnet mask:** 255.255.255.224 or /27
 - **Number of subnets:** 8 (we use 6)
 - **Number of hosts per subnet:** 30
 - **Usable subnets:**
From **201.70.64.0/27** to **201.70.64.160/27**
-

Q6) Write down the subnet work number of a host with an IP address of 172.16.66.0/21? You need to subnet a network that has 5 subnets, each with at least 16 hosts. State classful subnet mask would you use?

Solution:

Let's solve this problem in **two parts** as asked:

✿ Part 1: Subnet Network Number of Host 172.16.66.0/21



Given:

- IP address: **172.16.66.0/21**

◆ Step 1: Understand the Subnet Mask

- **/21** = 255.255.248.0
Binary:
• 11111111.11111111.1111000.00000000

◆ Step 2: Determine the Subnet Block Size

- A **/21** leaves 11 bits for hosts → $2^{11}=2048$ IPs
- Block size = 2048 addresses
- So, the network increases every 2048 addresses

► Identify where the address 172.16.66.0 falls:

Convert third octet (66) to determine range of block:

- /21 uses 5 bits from 3rd octet (since $248 = 11111000$)
- Block size = $256 - 248 = 8$
- So subnets are:
 - 172.16.64.0/21
 - 172.16.72.0/21
 - ...

172.16.66.0 falls in **172.16.64.0/21**

 **Answer:** The subnet network number is **172.16.64.0/21**

Part 2: You need to subnet a network that has 5 subnets, each with at least 16 hosts

◆ **Step 1: Determine host bits needed**

- Hosts per subnet ≥ 16
- Formula: $2^h - 2 \geq 16$
- $h = 5 \rightarrow 2^5 - 2 = 30$ 

◆ **Step 2: Subnets needed = 5**

Use 3 bits $\rightarrow 2^3 = 8$ subnets (covers 5) 

So, we need:

- 3 bits for subnets
- 5 bits for hosts
- Total = 8 bits

◆ **Step 3: Base Network Class**

Let's assume this is for **Class B** (because 172.16.x.x is in **Class B**)

- Class B default mask = /16
- If we borrow 3 bits:
 - New mask = /19
 - Subnet mask = **255.255.224.0**

 **Answer:**

- Classful mask: **255.255.0.0** (Class B)
 - Subnet mask used: **255.255.224.0** or /19
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Final Answers:

1. Subnet network number of 172.16.66.0/21:

► 172.16.64.0/21

2. For 5 subnets with ≥ 16 hosts each:

- Use 3 bits for subnets
- 5 bits for hosts
- Subnet mask: /19 \rightarrow 255.255.224.0

Would you like this solution added to your compiled PDF?

Q7) Your company has the network ID 165.121.0.0. You are responsible for creating subnets on the network, and each subnet must provide at least 900 host IDs. State the subnet mask which meets the requirement for the minimum number of host IDs and provides the greatest number of subnets? Write down the broadcast address on subnet 32 given a prefix notation of 12.1.0.0/12?

Solution:

Let's solve your problem step by step:

Part 1: Subnetting 165.121.0.0 for ≥ 900 Hosts per Subnet

Given:

- Network ID: 165.121.0.0 (Class B IP)
 - Need: Each subnet must support at least 900 hosts
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Step 1: Determine Host Bits Needed

Use the formula:

$$2^h - 2 \geq 900$$

- Try $h = 10 \rightarrow 2^{10} - 2 = 1022 = 1022$  (works)
- Try $h = 9 \rightarrow 2^9 - 2 = 510 = 510$  (too small)

So, 10 bits needed for host portion.

Step 2: Determine Subnet Mask

Class B default mask: /16 \rightarrow 255.255.0.0

Total host bits available: 16

If 10 bits are reserved for hosts, then:

$32 - 10 = 22$

So, **subnet mask** = /22 = 255.255.252.0

◆ Step 3: Determine Number of Subnets

If 6 bits are left for subnetting (since $16 - 10 = 6$):

$2^6 = 64$ subnets

✓ This gives:

- **At least 900 hosts per subnet**
 - **Maximum possible subnets** with that constraint
-

✓ **Answer (Part 1):**

- **Subnet mask:** /22 → 255.255.252.0
 - **Number of subnets:** 64
 - **Hosts per subnet:** 1022
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✿ Part 2: Broadcast address on subnet 32 of network 12.1.0.0/12

Given:

- **Network:** 12.1.0.0/12
 - Need: **Broadcast address of subnet 32**
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◆ Step 1: Calculate Block Size

- /12 subnet mask = 255.240.0.0
 - This leaves $32 - 12 = 20$ bits for hosts
 - Total IPs = $2^{20} = 1,048,576$
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We want to divide this /12 network into smaller subnets and find **subnet 32**.

Let's assume we're dividing it into **/20** subnets for simplicity:

- /20 → Block size = $2^{12} = 4096$ addresses per subnet
- Each /20 subnet increases by 4096 IPs

Now find **subnet 32**:

Subnet 32 starting IP=12.1.0.0+(32×4096)IPs

◆ Step 2: Convert IP Steps

Each /20 subnet = 4096 IPs → $4096 \div 256 = 16$ blocks (third octet)

So each subnet = **16 increments in third octet**

Starting IP of Subnet 32=12.0.(32×16).0=12.0.512.0 **X** (invalid! third octet can't go over 255)
Starting IP of Subnet 32} = 12.0.(32 × 16).0 = 12.0.512.0 **X** (invalid! third octet can't go over 255)

So let's recalculate properly.

◆ Step 3: Correct IP Range of /12 Network

12.1.0.0/12 covers:

- Range: 12.0.0.0 to 12.15.255.255
- Total IPs = 1,048,576

We want subnet 32 of this block assuming smaller subnets like /20 or /16.

✓ Try dividing 12.0.0.0/12 into /17 subnets (each with 32,768 IPs)

- $2^{17-12}=2^5=32$ subnets
- Each /17 = 32,768 IPs = 128128 blocks in 3rd octet

Subnet 0: 12.0.0.0/17

Subnet 1: 12.0.128.0/17

...

Subnet 31: 12.15.128.0/17

So, **Subnet 32 does not exist** in /17

✓ Try using /20 subnets (4096 IPs)

- Total subnets = $2^{20-12}=2^8=256$
- Subnet 32:

$$32 \times 4096 = 131072^{\text{th}} \text{IP}$$

IP = 12.0.0.0 + 131072 addresses → Convert:

- $131072 \div 256 = 512$ blocks = **12.2.0.0**

So:

- Subnet 32 start = **12.2.0.0**
- Block size = 4096 → End = **12.2.15.255**

- Broadcast Address = 12.2.15.255**
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- Answer (Part 2):**

- **Broadcast address of subnet 32 (assuming /20 subnets): 12.2.15.255**
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Would you like these two problems added to your PDF document as well?

Q8) An organization is granted the blocks 130.56.0.0. The administrator wants to create 1024 fixed length subnets.

- i. **Find the subnet mask.**
- ii. **Find the number of addresses in each subnet.**
- iii. **Find the first and last addresses of the first subnet.**
- iv. **Find the first and last addresses of the last subnet.**

Solution:

Let's solve this **subnetting** problem step by step.

 **Given:**

- Network: **130.56.0.0**
- Total subnets required: **1024 fixed-length subnets**

This is a **Class B** address because 130 is between 128–191.

So the **default subnet mask** is **/16** → 255.255.0.0

- i. Find the Subnet Mask**

We need **1024 subnets**, which is 2^{10} , so we must **borrow 10 bits** from the **host part**.

- Original prefix: **/16**
- New prefix: $16+10=26$

◆ **Subnet Mask = /26**

In dotted-decimal:

$$/26 = 255.255.255.192$$

- ii. Number of addresses per subnet**

With a **/26**, there are:

$2^6=64$ total addresses per subnet

$64-2=62$ usable host addresses per subnet

Each subnet has 64 total addresses (62 usable)

iii. First and Last Addresses of the First Subnet

The **first subnet** is:

- **Network Address:** 130.56.0.0
- Block size: 64 (since /26)

So:

- **First usable IP** = 130.56.0.1
 - **Last usable IP** = 130.56.0.62
 - **Broadcast Address** = 130.56.0.63
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iv. First and Last Addresses of the Last Subnet

- $1024 \text{ subnets} \times 64 \text{ addresses} = \textbf{65536 addresses total}$
- Last subnet starts at:

$$130.56.0.0 + 65536 - 64 = 130.56.255.192$$

So:

- **Network Address of last subnet** = **130.56.255.192**
 - **First usable IP** = 130.56.255.193
 - **Last usable IP** = 130.56.255.254
 - **Broadcast Address** = 130.56.255.255
-

Final Answers:

Part	Answer
i. Subnet Mask	/26 or 255.255.255.192
ii. Addresses per Subnet	64 total (62 usable)
iii. First Subnet	130.56.0.0 to 130.56.0.63 Usable: 130.56.0.1 – 130.56.0.62

iv. Last Subnet	130.56.255.192 to 130.56.255.255	Usable: 130.56.255.193 – 130.56.255.254
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Would you like this explanation added to the same PDF as your other subnetting questions?

Q9) An organization is granted a block of addresses starting with 190.100.0.0/26. The organization needs to have four subnets. Write down the subnet addresses and the range of addresses for each subnets?

Solution:

Let's solve the subnetting problem for:

 **Given:**

- Network block: **190.100.0.0/26**
 - You need: **4 subnets**
-

◆ **Step 1: Understand the Original Block**

- The prefix **/26** means:
 - Subnet mask = 255.255.255.192
 - Number of addresses in the block = $2^6=64$
 - Usable host addresses = $64 - 2 = 62$ per block

But we're not splitting the **entire Class B network**—we are splitting the **/26 block** (which has only 64 IPs).

So we need to divide these **64 IPs into 4 subnets**.

◆ **Step 2: Divide the Block into 4 Subnets**

We need **4 subnets**:

$$2^n=4 \Rightarrow n=2 \text{ bits}$$

Borrow 2 more bits from host → new prefix = /28

- Each **/28** block = $24=16$ addresses (14 usable)

So:

- **Subnet Mask = /28 = 255.255.255.240**
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◆ **Step 3: List All 4 Subnets**

Subnet No	Network Address	Usable IP Range	Broadcast Address
Subnet 1	190.100.0.0/28	190.100.0.1 – 190.100.0.14	190.100.0.15
Subnet 2	190.100.0.16/28	190.100.0.17 – 190.100.0.30	190.100.0.31
Subnet 3	190.100.0.32/28	190.100.0.33 – 190.100.0.46	190.100.0.47
Subnet 4	190.100.0.48/28	190.100.0.49 – 190.100.0.62	190.100.0.63

 **Final Answer:**

► **Subnet Mask: /28 → 255.255.255.240**

► **Each subnet has 16 addresses (14 usable)**

 **Subnet Address Ranges:**

1. **190.100.0.0/28** → 190.100.0.1 – 190.100.0.14
2. **190.100.0.16/28** → 190.100.0.17 – 190.100.0.30
3. **190.100.0.32/28** → 190.100.0.33 – 190.100.0.46
4. **190.100.0.48/28** → 190.100.0.49 – 190.100.0.62

Would you like this solution included in your final PDF file?

Q10) An organization is granted the blocks 130.56.0.0. The administrator wants to create 1024 fixed length subnets.

- i. Find the subnet mask.
- ii. Find the number of addresses in each subnet.
- iii. Find the first and last addresses of the first subnet.
- iv. Find the first and last addresses of the last subnet.

Solution:

 **Given:**

- Network: **130.56.0.0**
- Requirement: **Create 1024 fixed-length subnets**

◆ **Step 1: Understand the IP Class**

- **130.56.0.0** is a **Class B** address (since 130 is between 128–191)

- Default subnet mask for Class B: /16 (i.e., 255.255.0.0)
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i. Find the Subnet Mask

You need **1024 subnets**, so we calculate:

$$2^n \geq 1024 \Rightarrow n = 10 \text{ bits needed}$$

- Borrow 10 bits from the host portion
- New subnet mask = $16 + 10 = 26$

◆ Answer:

- Subnet mask: /26 or **255.255.255.192**
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ii. Find the Number of Addresses in Each Subnet

A /26 subnet leaves **6 bits** for the host part:

$$2^6 = 64 \text{ total addresses}$$

- Usable addresses = $64 - 2 = 62$

◆ Answer:

- Each subnet has **64 addresses (62 usable)**
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iii. First and Last Addresses of the First Subnet

The **first subnet** is:

- **Network Address: 130.56.0.0**
- Block size = 64

Addresses:

- First usable: **130.56.0.1**
- Last usable: **130.56.0.62**
- Broadcast: **130.56.0.63**

◆ Answer:

- First subnet: $130.56.0.0 - 130.56.0.63$
 - Usable range: **130.56.0.1 – 130.56.0.62**
-

iv. First and Last Addresses of the Last Subnet

Total addresses in 1024 subnets = $1024 \times 64 = 65536$

So the last subnet starts at:

$$130.56.0.0 + (65536 - 64) = 130.56.255.192$$

Addresses:

- First usable: **130.56.255.193**
- Last usable: **130.56.255.254**
- Broadcast: **130.56.255.255**

◆ **Answer:**

- Last subnet: $130.56.255.192 - 130.56.255.255$
- Usable range: **130.56.255.193 – 130.56.255.254**

✓ **Final Summary:**

Part	Answer
i. Subnet Mask	/26 (255.255.255.192)
ii. Addresses/Subnet	64 total, 62 usable
iii. First Subnet Range	130.56.0.0 – 130.56.0.63 Usable: 130.56.0.1 – 130.56.0.62
iv. Last Subnet Range	130.56.255.192 – 130.56.255.255 Usable: 130.56.255.193 – 130.56.255.254

Let me know if you want this answer added to your final PDF document.