101LABS®

IP Subnetting

LEARN • BY • DOING

• Paul Browning •

Table of Contents

https://www.101labs.net

ISBN-13: 9781728837659

Published by:
Reality Press Ltd.
15 Triumph Gardens
UK
NN56YH

LEGAL NOTICE
The advice in this book is designed to help you answer any IP subnetting questions in IT exams and technical interviews and troubleshoot live IP subnetting issues. Before you carry out more complex operations, it is advisable to seek the advice of experts or your equipment vendor.

The practical scenarios in this book are meant to illustrate only a technical point and should be used only on your privately owned equipment, never on a live network. They are not to be taken as installation instructions, network design templates, or configuration guidelines.

About the Author

Paul Browning worked as a police officer in the UK for 12 years before changing careers and becoming a helpdesk technician. He passed several IT certifications and began working for Cisco Systems doing WAN support for large enterprise customers.

He started an IT consulting company in 2002 and helped to design, install, configure, and troubleshoot global networks for small to large companies. He started teaching IT courses soon after that and through his classroom courses, online training, and study guides has helped tens of thousands of people pass their IT exams and enjoy successful careers in the IT industry.

In 2006 Paul started the online IT training portal **www.howtonetwork.com**, which has grown to become one of the leading IT certification websites.

In 2013 Paul moved to Brisbane with his family. In his spare time he plays the guitar, reads, drinks coffee, and practices Brazilian jiu-jitsu.

Introduction–101 Labs

Welcome to your 101 Labs book.

When I started teaching IT courses back in 2002, I was shocked to discover that most training manuals were almost exclusively dedicated to theoretical knowledge. Apart from a few examples of commands to use or configuration guidelines, you were left to plow through without ever knowing how to apply what you learned to live equipment or to the real world.

Fast forward 16 years and little has changed. I still wonder how, when around 50% of your exam marks are based on hands-on skills and knowledge, most books give little or no regard to equipping you with the skills you need to both pass the exam and then make money in your chosen career as a network, security, or cloud engineer (or whichever career path you choose).

101 Labs is NOT a theory book: it's here to transform what you have learned in your study guides into valuable skills you will be using from day one on your job as a network engineer. I don't teach DHCP, for example; instead, I show you how to configure a DHCP server, which addresses you shouldn't use, and which parameters you can allocate to hosts. If the protocol isn't working, I show you what the probable cause is. Sound useful? I certainly hope so.

I choose the most relevant parts of the exam syllabus and use free software or free trials to walk you through configuration and troubleshooting commands step by step. As your confidence grows, I increase the difficulty level. If you want to be an exceptional IT engineer, you can make your own labs up, add other technologies, try to break them, fix them, and do it all over again.

101 Labs–IP Subnetting

Ask any IT student or network engineer which subject they find the hardest to understand and you will almost always hear them say 'subnetting'. In fact, when I was consulting, I spoke to network engineers working at a major UK airport, who admitted they didn't know how to subnet. They relied on subnet calculators!

IP subnetting is hard, partly due to the fact that it's all based on binary math and hexadecimal but mostly because of the way it's taught. I tried to learn IP subnetting using a popular Cisco CCNA study guide in 2001 and I failed the exam miserably. The problem is that most IT teachers and authors are extremely geeky. That's all good, until they try to teach you what they know.

Watch any YouTube video on 'easy subnetting' and you'll see for yourself. It quickly descends into a maze of binary, addition, multiplication, and several steps before you find the answer.

Even if you do understand their method, try using it in an IT exam where you have around 60 seconds to find the answer. Try using it when your network is down and your customers and boss are standing over you waiting for you to fix everything.

For my job interview at Cisco Systems in 2002 I was grilled on subnetting questions for an hour by two senior network engineers. They wrote a problem on a whiteboard and I had to answer it. I had to answer around 30 questions in total and all I had was a pen and paper.

101 Labs—IP Subnetting will teach you the exact method I use to answer any subnetting question. By the end of the book you will be at guru level on subnetting, network design, VLSM, and route summarization. You will find yourself as the go-to person for subnetting at work, and you will be able to breeze through any subnetting question in an IT exam or technical job interview.

We will cover IPv6 subnetting with a couple of examples, and the last portion of the book is me throwing a ton of exam and job interview style questions at you.

If you don't have a good-quality IP subnetting study guide to teach you the theory, then please check out my book on Amazon, *IP Subnetting—Zero to Guru*.

Instructions

1. Please follow the labs from start to finish. If you get stuck, do the next lab and come back to the problem lab later. There is a good chance you will work out the solution as you gain confidence and experience in using the method.
2. Before you attempt these labs, please use the free resources and other tips at **www.101labs.net/resources**
3. Please DO NOT configure these addresses on a live network or on equipment belonging to private companies or individuals.
4. You MUST be reading or have read a suitable study guide. I don't explain any theory in this book; it's all hands-on labs. I presume you know (for example) binary math and address classes.
5. It's impossible for me to give individual support to the thousands of readers of this book (sorry!), so please don't contact me for tech support. Each lab has been tested by several tech editors from beginner to expert.

Video Training

Each 101 Labs book has an associated video training course. You can watch the instructor configure each lab and talk you through the entire process step by step as well as share helpful tips for the real world of IT. Each course also has 200 exam-style questions to prepare you for the real thing. It's certainly not necessary to take that course, but if you do, please use the coupon code '101subnetting' at the checkout page to get a big discount as a thank you for buying this

book.

https://www.101labs.net

Also from Reality Press Ltd.

Cisco CCNA Simplified
Cisco CCDA Simplified
Cisco CCDP Simplified
Cisco CCNA in 60 Days
IP Subnetting—Zero to Guru
101 Labs—CompTIA A+ (due 2019)
101 Labs—CompTIA Network+
101 Labs—IP Subnetting
101 Labs—Cisco CCNA
101 Labs—Cisco CCNP (due 2019)
101 Labs—Wireshark WCNA (due 2019)

Tech Editors

Thanks to all the tech editors who donated their time to check all the labs and give feedback.

Charles Pacheco
Mark Lehmann
Ron Myers
Terry Buckingham
Mario Arturo Salinas Rodriguez
John S. Galliano
Roy Thelin
Arnold Palmares
Carol Wood
Elmarine Jimenez
Zoran Vujovic
Jim Myers
James Hill
Jim Myers
Glen Millard
Tariq Khan
Harvey Collman
Rodrigo Bittencourt Calderon
Alexandru Stefan Marinescu
Ellsworth Wilson
David Gonzales

Marcus Herstik
Mark Musciano
Samuel N. Taylor
Dante Alarcón
John DeGennaro
Michael J. Moeller
Sam Gonzales
Eric Fields
Joshua Prom
Desmond Rooplal
Lee Freeman
Arvinder Singh
Dolan Hoffman
Tim Peel
James Marsh
Frank Faith
Michael A. Sisson
Jeff Echano
Bryant Schaper
Patrina Scott
David Parris
Gemoh Maliva Tihfon
Simon Shtipelman
Beverly Simpson
Thierry Merle
Ivan Rajic

Class C Subnetting

Lab 1. Subnetting 192.168.1.1/26

Lab Objective:
Learn how to answer an easy subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to an easy Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 192.168.1.1/26 in?

For the first few labs you will be learning how to use the Subnetting Cheat Chart to solve subnetting questions. As you progress through the labs, your confidence will grow.

/26 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 26 from 24 you need to add 2. Tick two places across the top row to see that your subnets go up in increments of 64. You are allowed to start with subnet 0, and your last subnet will be whatever /26 is.

To work that out, tick two down the Subnets column. You can see that you have subnet 192 or in 255.255.255.192 in full.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2									
4									
8									
16									
32									
64									
128									
256									
512									

The design element of the chart is included above for reference, but we don't need to use it for 'which subnet is IP address *X* in?' type questions.

So what do we know so far? We know that our subnets go up in increments of 64, and we know we can start at zero and we end at 192. So we have this:

192.168.1.0 ← **Host 192.168.1.1 is in this subnet.**
192.168.1.64
192.168.1.128
192.168.1.192

Not that we were asked this question, but we have four subnets. We'll cover how to work out our host addresses and broadcast addresses later. Don't make the mistake of working out extra stuff in your exam. You were asked which subnet the host is in, and you already have the information you need.

Host 192.168.1.1 is in subnet 192.168.1.0.

Notes:
The Subnetting Cheat Chart will help you answer any subnetting or design question. After some time you will learn it by heart and be able to answer subnetting questions in your head.

Lab 2. Subnetting 192.168.1.100/26

Lab Objective:
Learn how to answer another easy subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to an easy Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 192.168.1.100/26 in?

This question has the same subnet mask as Lab 1, but this time we are looking for a different host address. I don't want to launch into tougher questions until we build up your confidence in the Subnetting Cheat Chart a bit.

/26 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 26 from 24 you need to add 2. Tick two places across the top row to see that your subnets go up in increments of 64. You are allowed to start with subnet 0, and your last subnet will be whatever /26 is.

To work that out, tick two down the Subnets column. You can see that you have subnet 192, or in full 255.255.255.192.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 64, and we know we can start at zero and we end at 192. So we have this so far:

192.168.1.0
192.168.1.64 ← **Host 192.168.1.100 is in this subnet.**
192.168.1.128
192.168.1.192

Hey, presto! The second subnet contains our host IP address.

Host 192.168.1.100 is in subnet 192.168.1.64.

Notes:
The Subnetting Cheat Chart comes to the rescue once again! It will help you answer easy questions such as this one as well as far more complicated ones, which we will progress onto.

Lab 3. Subnetting 192.168.1.100/27

Lab Objective:
Learn how to answer another easy subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to an easy Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 192.168.1.100/27 in?

IP addresses are just part of the equation. Network devices such as routers apply the subnet mask to the IP address (using binary) in order to determine which subnet it's in. This is how they can generate error messages such as:

```
Router(config)#int f0/0
Router(config-if)#ip add 192.168.1.4 255.255.255.252
Bad mask /30 for address 192.168.1.4
```

The router applied the mask to the IP address and quickly determined that you are trying to apply the subnet address to an interface (which is illegal).

/27 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 27 from 24 you need to add 3. Tick three places across the top row to see that your subnets go up in increments of 32. You are allowed to start with subnet 0, and your last subnet will be whatever /27 is.

To work that out, tick three down the Subnets column. You can see that you have subnet 255.255.255.224.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 32, and we know we can start at zero and we end at 224. So we have this so far:

192.168.1.0
192.168.1.32
192.168.1.64
192.168.1.96 ← **Host 192.168.1.100 is in this subnet.**
192.168.1.128
192.168.1.160
192.168.1.192
192.168.1.224

Just by adding one more bit to the subnet (going from /26 to /27) we've jumped from four subnets to eight. You will see that we will soon have too many to list; we will use a shortcut method to save time and space.

Host 192.168.1.100 is in subnet 192.168.1.96.

Notes:
The Subnetting Cheat Chart comes to the rescue once again! It will help you answer easy questions such as this one as well as far more complicated ones, which we will progress onto.

Lab 4. Subnetting 192.168.1.211/27

Lab Objective:
Learn how to answer another easy subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to an easy Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 192.168.1.211/27 in?

I know that our questions have been similar so far. It's more important you get some confidence using my subnetting method before we start increasing the difficulty. This is why we started with Class C.

/27 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 27 from 24 you need to add 3. Tick three places across the top row to see that your subnets go up in increments of 32. You are allowed to start with subnet 0, and your last subnet will be whatever /27 is.

To work that out, tick three down the Subnets column. You can see that you have subnet 224, (255.255.255.224 in full).

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 32, and we know we can start at zero and we end at 224. So we have this so far:

192.168.1.0
192.168.1.32
192.168.1.64
192.168.1.96
192.168.1.128
192.168.1.160
192.168.1.192 ← **Host 192.168.1.211 is in this subnet.**
192.168.1.224

Remember that we are just being asked to identify the correct subnet. There is nothing to be gained by doing further working out, such as how many subnets and hosts-per-subnet we get or what the host range and broadcast address are. We can work this all out later.

Host 192.168.1.211 is in subnet 192.168.1.192.

Notes:
The Subnetting Cheat Chart is all about ticking boxes and adding up.

Lab 5. Subnetting 192.168.1.77/28

Lab Objective:
Learn how to answer another easy subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to an easy Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 192.168.1.77/28 in?

We are increasing the difficulty here a bit. Having said that, all we are still doing is ticking boxes and adding up!

/28 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 28 from 24 you need to add 4. Tick four places across the top row to see that your subnets go up in increments of 16. You are allowed to start with subnet 0, and your last subnet will be whatever /28 is.

To work that out, tick four down the Subnets column. You can see that you have subnet 240 (for the last octet) or 255.255.255.240.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 16, and we know we can start at zero and we end at 240. We might well be at the point where we don't want to write out every subnet. If we count up in increments of 16 (starting at 0), we get 16 subnets, which means we take up a lot of room. We'll count up until we reach the subnet AFTER the host address is found. This is just to make sure we have the right one.

So we have this so far:

192.168.1.0
192.168.1.16
192.168.1.32
192.168.1.48
192.168.1.64 ← **Host 192.168.1.77 is in this subnet.**
192.168.1.80

If you were asked to list every subnet, you would simply keep adding 16 to the subnet number until you reached 240, i.e. 192.168.1.240.

Host 192.168.1.77 is in subnet 192.168.1.64.

Note:
More bits that are stolen from the standard subnet mask means more work for us because we have to count up in smaller increments.

Lab 6. Subnetting 192.168.1.210/28

Lab Objective:
Learn how to answer another easy subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to an easy Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 192.168.1.210/28 in?

This is the same subnet ask as in the previous lesson; however, the host number here is higher. Now we will use the jump method to save time!

/28 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 28 from 24 you need to add 4. Tick four places across the top row to see that your subnets go up in increments of 16. You are allowed to start with subnet 0, and your last subnet will be whatever /28 is.

To work that out, tick four down the Subnets column. You can see that you have subnet 240 (for the last octet) or 255.255.255.240.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 16, and we know we can start at zero and we end at 240. We also know that our host number is 192.168.1.210. If you are in an exam, writing in increments of 16 to get to the correct subnet will waste precious time. Find a number you can use to jump, but stay in the increment count. If the count is 8, you can jump to 80; if it is 4, you can also jump to 80 or 140 so long as you choose a multiple of the count.

IMPORTANT—It's so easy under the pressure of an exam to lose your place. You must jump using a multiple of the increment AND then resume the count up using the increment. Don't jump from .4 to .40 and then start counting up in increments of 8. This is mostly done by mistake when you take an increment and double it twice, such as 8 to 80 to 160. Students panic and start counting up in increments of 16 from there when it should be 8.

So we have this so far:

192.168.1.0
192.168.1.16 ← **Apply a jump here to 160.**
192.168.1.160 ← **Resume the 16 increment count.**
192.168.1.176
192.168.1.192
192.168.1.208 ← **Host 192.168.1.210 is in this subnet.**
192.168.1.224

You have probably shaved off 30–60 seconds by jumping. You can use that time toward harder questions in your exam.

Host 192.168.1.210 is in subnet 192.168.1.208.

Note:
Apply jumping whenever you have a small increment and a high IP address.

Lab 7. Subnetting 200.100.100.30/29

Lab Objective:
Learn how to answer a harder subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 200.100.100.30/29 in?

We've changed both the subnet and the mask. Don't let this deter you. The process is always the same: count from the standard mask, tick across and down, and then add up in the increment (and jump if you need to).

/29 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 29 from 24 you need to add 5. Tick five places across the top row to see that your subnets go up in increments of 8. You are allowed to start with subnet 0, and your last subnet will be whatever /29 is in longhand.

To work that out, tick five down the Subnets column. You can see that you have subnet 248 (for the last octet) or 255.255.255.248.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 8 and we need to keep counting up until we find the subnet our host address of 200.100.100.30 belongs to. You may have noticed that I chose a low number this time to avoid having to jump.

Don't make the rookie mistake of counting 0, 8, 16, 32. It looks normal of course, but we should be counting in increments of 8, so it's 0, 8, 16, 24! Not only can we let nerves get the better of us in regard to subnetting in exams, but we can get overconfident and rush ahead.

So we have this so far:

200.100.100.0
200.100.100.8
200.100.100.16
200.100.100.24 ← **Host 200.100.100.30 is in here.**
200.100.100.32 ← **Stop here. We have already found our host address.**

Host 200.100.100.30 is in subnet 200.100.100.24.

Notes:
Always sanity-check your working out. Have you skipped a subnet by accident?

Lab 8. Subnetting 200.100.100.250/29

Lab Objective:
Learn how to answer a harder subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart and jumping to answer a Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 200.100.100.250/29 in?

Oh dear. It's a high number and we already know that the increment is fairly small, but we also know we can jump!

/29 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 29 from 24 you need to add 5. Tick five places across the top row to see that your subnets go up in increments of 8. You are allowed to start with subnet 0, and your last subnet will be whatever /29 is in longhand.

To work that out, tick five down the Subnets column. You can see that you have subnet 248 (for the last octet) or 255.255.255.248.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 8 and we need to keep counting up until we find the subnet our host address of 200.100.100.250 belongs to.

Let's start with 0, add the first 8 subnet, and then just use our jump strategy. Any increment of 8 will work.

200.100.100.0
200.100.100.8 ← **Jump to 80.**
200.100.100.80 ← **Jump to 160.**
200.100.100.160 ← **Add another 80.**
200.100.100.240 ← **Back to adding 8 increments.**
200.100.100.248 ← **Host 200.100.100.250 is here.**

Host 200.100.100.250 is in subnet 200.100.100.248.

Notes:
Typical that our host is in the last subnet, but with the jump strategy you saved writing out all 32 subnets. You would only EVER do that if you were in charge of allocating subnets in your company OR if you were designing a network addressing scheme. For that you would have months, weeks, or days. In the exam you usually have around 90 minutes to answer 60 or so questions!

Lab 9. Subnetting 193.200.100.41/30

Lab Objective:
Learn how to answer a harder subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 193.200.100.41/30 in?

We have been slowly creeping up in subnet value. As your confidence grows, you will no longer care about the presented values; you will just follow the process and get the result—usually in under 30 seconds.

/30 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 30 from 24 you need to add 6. Tick six places across the top row to see that your subnets go up in increments of 4. You are allowed to start with subnet 0, and your last subnet will be whatever /30 is in longhand.

To work that out, tick six down the Subnets column. You can see that you have subnet 252 (for the last octet) or 255.255.255.252.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓		
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254									
255									

So what do we know so far? We know that our subnets go up in increments of 4 and we need to keep counting up until we find the subnet our host address of 193.200.100.41 belongs to.

Let's start with 0, add the first 4 subnet, and then just use our jump strategy. Any increment of 4 will work. In fact, I bet you already know the answer to the subnetting question?

193.200.100.0
193.200.100.4 ← **Jump to 40.**
193.200.100.40 ← **Host 193.200.100.41 is in here.**
193.200.100.44 ← **Next subnet.**

Host 193.200.100.41 is in subnet 193.200.100.40.

Notes:
It's always a good idea to write the subnet after the one you think the host is in. This is especially true if you are working with small subnets.

Lab 10. Subnetting 193.200.100.41/31

Lab Objective:
Learn how to answer a harder subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 193.200.100.41/31 in?

No, I haven't gone mad. You CAN use /31 subnet masks. They are used on point-to-point links, where only two IP addresses are required and there is no broadcast capability. There is a specific RFC for them in fact:

https://tools.ietf.org/html/rfc3021

Each point-to-point link consumes two and not four IP addresses.

/31 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 31 from 24 you need to add 7. Tick seven places across the top row to see that your subnets go up in increments of 2 (we don't actually have subnets and broadcasts with /31). You are allowed to start with subnet 0, and your last subnet will be whatever /31 is in longhand.

To work that out, tick seven down the Subnets column. You can see that you have subnet 254 (for the last octet) or 255.255.255.254.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓	✓	
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254	✓								
255									

So what do we know so far? We know that our subnets go up in increments of 2 and we need to keep counting up until we find the subnet our host address of 193.200.100.41 belongs to. Let's use our jump strategy. Any increment of 2 will work. In fact, I bet you already know the answer to the subnetting question?

193.200.100.0
193.200.100.2
193.200.100.4 ← **Jump to 40.**
193.200.100.40 ← **Host 41 is in here.**
193.200.100.42 ← **Next subnet.**

Host 193.200.100.41 is in subnet 193.200.100.40. Technically, there is no 'subnet', just hosts .40 and .41.

Note:
It's not likely you would be asked this question in an exam, but part of my job is to prepare you for the real world too, so you need to know this stuff.

Lab 11. Subnetting 210.200.100.145/25

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class C subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 210.200.100.145/25 in?

We've gone back down to the first available subnet value (if we are using VLSM). If you just add one bit to the standard subnet mask, you get two subnets. This gives you the most host numbers available but the lowest number of subnets.

/25 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 25 from 24 you need to add 1. Tick one place across the top row to see that your subnets go up in increments of 128. You are allowed to start with subnet 0, and your last subnet will be whatever /25 is in longhand.

To work that out, tick one down the Subnets column. You can see that you have subnet 128 (for the last octet) or 255.255.255.128.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 128 and we need to keep counting up until we find the subnet our host address of 210.200.100.145 belongs to.

Let's start with 0 because this is our first subnet. We can then add our second and the location of the host address will be pretty obvious.

210.200.100.0
210.200.100.128 ← **Host 210.200.100.145 is in here.**

Host 210.200.100.145 is in subnet 210.200.100.128.

Note:
The /25 subnet is pretty easy once you understand subnetting principles.

Lab 12. Subnetting 200.20.10.45/26

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class C subnetting problem. Find the broadcast address for the subnet.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 200.20.10.45/26 in? What is the broadcast address?

This is all the same stuff, so don't be put off. You already have all the information you need, but you just need to take a few extra seconds to glean the relevant information.

/26 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 26 from 24 you need to add 2. Tick two places across the top row to see that your subnets go up in increments of 64. You are allowed to start with subnet 0, and your last subnet will be whatever /26 is in longhand.

To work that out, tick two down the Subnets column. You can see that you have subnet 192 (for the last octet) or 255.255.255.192.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 64 and we need to keep counting up until we find the subnet our host address of 200.20.10.45 belongs to.

Let's start with 0 because this is our first subnet. We can then add up in increments of 64. We will have to add the host range and broadcast address this time because of the question. If you have a lot of subnets, then just do this after you find the correct subnet.

200.20.10.0 – hosts 200.20.10.1 to 200.20.10.62 – broadcast 200.20.10.63 ← **Host is in here.**
200.20.10.64 – hosts 200.20.10.65 to 200.20.10.126 – broadcast 200.20.10.127
200.20.10.128 – hosts 200.20.10.129 to 200.20.10.190 – broadcast 200.20.10.191
200.20.10.192 – hosts 200.20.10.193 to 200.20.10.254 – broadcast 200.20.10.255

Host 200.20.10.45 is in subnet 200.20.10.0; the broadcast address is 200.20.10.63.

Notes:
I wrote out all of the subnets, hosts, and broadcast addresses to show you how it's done. Just remember that in the exam, you won't have time for that, so just target the correct subnet and work out the hosts and broadcast address for that one.

Host numbers are always sandwiched between the subnet and the broadcast address. You can't allocate the subnet or broadcast address to interfaces, which is why we always take two numbers away when calculating hosts-per-subnet. We cover design later.

Lab 13. Subnetting 220.20.10.199/27

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class C subnetting problem. Find the broadcast address for the subnet.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 220.20.10.199/27 in? What is the broadcast address?

Same thing again. Once you master subnetting, questions become almost boring.

/27 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 27 from 24 you need to add 3. Tick three places across the top row to see that your subnets go up in increments of 32. You are allowed to start with subnet 0, and your last subnet will be whatever /27 is in longhand.

To work that out, tick three down the Subnets column. You can see that you have subnet 224 (for the last octet) or 255.255.255.224.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 32. I'm also going

to have to skip the hosts/broadcast for every subnet because we have eight to deal with. Feel free to work them out yourself though.

Let's start with 0 because this is our first subnet. We can then add up in increments of 32. We will have to add the host range and broadcast address this time because of the question, but only to the one our host is in.

220.20.10.0
200.20.10.32
200.20.10.64 ← **Jump here (double this and add 32).**
200.20.10.160
200.20.10.192 – hosts 200.20.10.193 to 200.20.10.222 – broadcast 200.20.10.223 ← **Host is in here.**
200.20.10.224

Host 200.20.10.199 is in subnet 200.20.10.192. The broadcast address is 200.20.10.223.

Notes:
The quickest way to work out the broadcast address is to write out the next subnet and then take 1 away. For our question, 224 minus 1 is 223, which is the broadcast address for the 192 subnet.

Lab 14. Subnetting 199.99.10.87/28

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class C subnetting problem. Find the broadcast address for the subnet.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 199.99.10.87/28 in? What is the broadcast address?

Same thing again. Once you master subnetting, questions become almost boring.

/28 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 28 from 24 you need to add 4. Tick four places across the top row to see that your subnets go up in increments of 16. You are allowed to start with subnet 0, and your last subnet will be whatever /28 is in longhand.

To work that out, tick four down the Subnets column. You can see that you have subnet 240 (for the last octet) or 255.255.255.240.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 16. I'm also going to have to skip the hosts/broadcast for every subnet because we have 16 to deal with. Feel free to work them out yourself though.

Let's start with 0 because this is our first subnet. We can then add up in increments of 16. We will have to add the host range and broadcast address this time because of the question, but only to the one our host is in. I think I'll also apply the jump strategy because our host address is 199.99.10.87. I know that if I keep adding 16, I'll get to 64, so I'll jump to that.

199.99.10.0
199.99.10.16 ← **Jump here (double this and double again).**
199.99.10.64
199.99.10.80 – hosts 81 to 94 – broadcast 95 ← **Host 199.99.10.87 is in this subnet.**
199.99.10.96

Host 199.99.10.87 is in subnet 199.99.10.80. The broadcast address is 199.99.10.95.

Notes:
This should all be clicking for you now. Just keep doing the process over and over.

Lab 15. Subnetting 200.99.30.171/29

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class C subnetting problem. Find the broadcast address for the subnet.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 200.99.30.171/29 in? What is the first host, last host, and broadcast address?

You know the drill by now.

/29 isn't the standard mask for Class C IP addresses; /24 is. You can easily see that to get to 29 from 24 you need to add 5. Tick five places across the top row to see that your subnets go up in increments of 8. You are allowed to start with subnet 0, and your last subnet will be whatever /29 is in longhand.

To work that out, tick five down the Subnets column. You can see that you have subnet 248 (for the last octet) or 255.255.255.248.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 8. I'm also going to have to skip the hosts/broadcast for every subnet because we have 32 subnets to deal with. Feel free to work them out yourself though.

Let's start with 0 because this is our first subnet. We can then add up in increments of 8. We will have to add the host range and broadcast address this time because of the question, but only to the one our host is in. I think I'll also apply the jump strategy because our host address is 200.99.30.171. I know that if I keep adding 8, I'll get to 80 and then 160, so I'll jump to that.

200.99.30.0
200.99.30.8 ← **Jump here.**
200.99.30.80 ← **Jump here (double this).**
200.99.30.160
200.99.30.168 ← **hosts 169 to 174 – broadcast 175**
200.99.30.176

Host 200.99.30.171 is in subnet 200.99.30.168. The first host is 169, and the broadcast address is 175.

Notes:
You have to keep repeating subnetting questions until they become boring. Then you will be reaching master level.

Class B Subnetting

Lab 16. Subnetting 172.16.100.100/17

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 172.16.100.100/17 in?

This might be a bit tougher. Class B addresses give us two octets for hosts, whereas Class C gives us only one. This gives us more scope for confusion and mistakes. In this instance, our network is 172.16 and our host is 100.100. If you have spent all your time working on Class C addresses, you may make the mistake of thinking that .100 is the host.

/17 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 17 from 16 you need to add 1. Tick one place across the top row to see that your subnets go up in increments of 128. You are allowed to start with subnet 0, and your last subnet will be whatever /17 is in longhand.

To work that out, tick one down the Subnets column. You can see that you have subnet 128 or 255.255.128.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 128 and we are trying to reach host 172.16.100.100.

Let's start with 0.0, which is the first subnet; our second will be 128.0.

172.16.0.0 ← **Host 172.16.100.100 is in here.**
172.16.128.0

Host 172.16.100.100 is in subnet 172.16.0.0. Not that you were asked, but for your information, the first host is 0.1, the last host is 127.254, and the broadcast address is 127.255.

Notes:
We'll ease into Class B. It isn't so much that it is harder as you just need to get your head around subnetting for two octets. Your eyes may start to deceive you, but trust the process here.

Lab 17. Subnetting 172.16.200.100/17

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 172.16.200.100/17 in?

Yes, I know you already know the answer here, but I promised to ease you into Class B subnetting. It will get harder, trust me.

/17 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 17 from 16 you need to add 1. Tick one place across the top row to see that your subnets go up in increments of 128. You are allowed to start with subnet 0, and your last subnet will be whatever /17 is in longhand.

To work that out, tick one down the Subnets column. You can see that you have subnet 128 or 255.255.128.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 128 and we are trying to reach host 172.16.200.100.

Let's start with 0.0, which is the first subnet; our second will be 128.0.

172.16.0.0
172.16.128.0 ← **Host 172.16.200.100 is in here.**

Host 172.16.200.100 is in subnet 172.16.128.0. Not that you were asked, but for your information, the first host is 128.1, the last host is 255.254, and the broadcast address is 255.255.

Note:
As we progress, we will slowly increase the level of difficulty.

Lab 18. Subnetting 128.160.22.111/18

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 128.160.22.111/18 in?

We've moved up a subnet, but the process is always the same.

/18 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 18 from 16 you need to add 2. Tick two places across the top row to see that your subnets go up in increments of 64. You are allowed to start with subnet 0, and your last subnet will be whatever /18 is in longhand.

To work that out, tick two down the Subnets column. You can see that you have subnet 192 or 255.255.192.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 64 and we are

trying to reach host 128.160.22.111.

Let's start with 0.0, which is the first subnet; our second will be 64.0 and so on. I don't mind listing them all because there are only four in this example.

128.160.0.0 ← **Host 128.160.22.111 is in here.**
128.160.64.0
128.160.128.0
128.160.192.0

Host 128.160.22.111 is in subnet 128.160.0.0. Not that you were asked, but for your information, the first host is 0.1, the last host is 63.254, and the broadcast is 63.255.

Notes:
Hopefully you are keeping up with the process. It's always the same: tick and then count up.

Lab 19. Subnetting 130.160.222.1/18

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 130.160.222.1/18 in?

We are still using /18 for our subnet, but I've changed the IP address. I want to build your confidence slowly but also stop you from getting complacent. Even after 18 years of doing subnetting, I still always double-check my answers (and so should you).

/18 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 18 from 16 you need to add 2. Tick two places across the top row to see that your subnets go up in increments of 64. You are allowed to start with subnet 0, and your last subnet will be whatever /18 is in longhand.

To work that out, tick two down the Subnets column. You can see that you have subnet 192 or 255.255.192.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 64 and we are trying to reach host 130.160.222.1.

Let's start with 0.0, which is the first subnet; our second will be 64.0 and so on. I don't mind listing them all because there are only four in this example.

130.160.0.0
130.160.64.0
130.160.128.0
130.160.192.0 ← **Host 130.160.222.1 is in here.**

Host 130.160.222.1 is in subnet 130.160.192.0. Not that you were asked, but for your information, the first host is 192.1, the last host is 255.254, and the broadcast is 255.255.

Notes:
Hopefully you are keeping up with the process. It's always the same: tick and then count up.

Lab 20. Subnetting 140.60.212.12/19

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 140.60.212.12/19 in?

We are now using /19 for our subnet. We know that we will have more subnets and fewer hosts-per-subnet.

/19 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 19 from 16 you need to add 3. Tick three places across the top row to see that your subnets go up in increments of 32. You are allowed to start with subnet 0, and your last subnet will be whatever /19 is in longhand.

To work that out, tick three down the Subnets column. You can see that you have subnet 224 or 255.255.224.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 32 and we are trying to reach host 140.60.212.12.

Let's start with 0.0, which is the first subnet; our second will be 32.0 and so on. We will need to jump because we have too many subnets to write out.

140.60.0.0
140.60.32.0 ← **Jump here.**
140.60.128.0
140.60.160.0
140.60.192.0 ← **Host 140.60.212.12 is in here.**
140.60.224.0

Host 140.60.212.12 is in subnet 140.60.192.0. Not that you were asked, but for your information, the first host is 192.1, the last host is 223.254, and the broadcast is 223.255.

Note:
We ended up in the 192 subnet, the same subnet as in the last question, but we got there a different way.

Lab 21. Subnetting 160.160.160.160/20

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 160.160.160.160/20 in?

We are now using /20 for our subnet. We know that we will have more subnets and fewer hosts-per-subnet.

/20 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 20 from 16 you need to add 4. Tick four places across the top row to see that your subnets go up in increments of 16. You are allowed to start with subnet 0, and your last subnet will be whatever /20 is in longhand.

To work that out, tick four down the Subnets column. You can see that you have subnet 240 or 255.255.240.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 16 and we are

trying to reach host 160.160.160.160.

Let's start with 0.0, which is the first subnet; our second will be 16.0 and so on. We will need to jump because we have too many subnets to write out. Notice that I stop counting up subnets when I get one past the subnet our host address is in. There is no point in doing this when you are taking an exam.

160.160.0.0
160.160.16.0 ← **Jump here.**
160.160.160.0 ← **Host 160.160.160.160 is in here.**
160.160.176.0

Host 160.160.160.160 is in subnet 160.160.160.0. Not that you were asked, but for your information, the first host is 160.1, the last host is 175.254, and the broadcast is 175.255.

Note:
Hopefully you can see that the process works no matter what the question asks you.

Lab 22. Subnetting 190.1.150.110/21

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 190.1.150.110/21 in?

We are now using /21 for our subnet. We know that we will have more subnets and fewer hosts-per-subnet.

/21 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 21 from 16 you need to add 5. Tick five places across the top row to see that your subnets go up in increments of 8. You are allowed to start with subnet 0, and your last subnet will be whatever /21 is in longhand.

To work that out, tick five down the Subnets column. You can see that you have subnet 248 or 255.255.248.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 8 and we are trying to reach host 190.1.150.110.

Let's start with 0.0, which is the first subnet; our second will be 8.0 and so on. We will need to jump because we have too many subnets to write out. Notice that I stop counting up subnets when I get one past the subnet our host address is in. There is no point in doing this when you are taking an exam.

190.1.0.0
190.1.8.0 ← **Jump here.**
190.1.80.0 ← **Jump here (add 40).**
190.1.120.0
190.1.128.0
190.1.136.0
190.1.144.0 ← **Host 190.1.150.110 is in here.**
190.1.152.0

Host 190.1.150.110 is in subnet 190.1.144.0. Not that you were asked, but for your information, the first host is 144.1, the last host is 151.254, and the broadcast is 151.255.

Notes:
I actually got this one wrong the first time! I jumped from 80.0 to 140.0, which looked right to my eyes but isn't a multiple of 8! Personally, I'd jump from 80.0 to 160.0 and then count back to 152.0 then to 144.0.

Lab 23. Subnetting 191.100.15.1/22

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 191.100.15.1/22 in?

We are now using /22 for our subnet. We know that we will have more subnets and fewer hosts-per-subnet.

/22 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 22 from 16 you need to add 6. Tick six places across the top row to see that your subnets go up in increments of 4. You are allowed to start with subnet 0, and your last subnet will be whatever /22 is in longhand.

To work that out, tick six down the Subnets column. You can see that you have subnet 252 or 255.255.252.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓		
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254									
255									

So what do we know so far? We know that our subnets go up in increments of 4 and we are trying to reach host 191.100.15.1.

Let's start with 0.0, which is the first subnet; our second will be 4.0 and so on. We won't need to jump because the third octet starts with a low number.

191.100.0.0
191.100.4.0
191.100.8.0
191.100.12.0 ← **Host 191.100.15.1 is in here.**
191.100.16.0

Host 191.100.15.1 is in subnet 191.100.12.0. Not that you were asked, but for your information, the first host is 12.1, the last host is 15.254, and the broadcast is 15.255.

Notes:
Hopefully you are getting pretty comfortable with the process. You want to be more than comfortable if you are to pass exams and technical interviews. You want to be an expert in fact.

Lab 24. Subnetting 128.100.19.11/23

Lab Objective:
Learn how to answer an easy Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 128.100.19.11/23 in?

We are now using /23 for our subnet. We know that we will have more subnets and fewer hosts-per-subnet.

/23 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 23 from 16 you need to add 7. Tick seven places across the top row to see that your subnets go up in increments of 2. You are allowed to start with subnet 0, and your last subnet will be whatever /23 is in longhand.

To work that out, tick seven down the Subnets column. You can see that you have subnet 254 or 255.255.254.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓	✓	
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254	✓								
255									

So what do we know so far? We know that our subnets go up in increments of 2 and we are trying to reach host 128.100.19.11.

Let's start with 0.0, which is the first subnet; our second will be 2.0 and so on. We will need to jump because although the third octet starts with a low number, our subnets go up in increments of 2, which is a pretty low value to count in.

128.100.0.0
128.100.2.0 ← **Jump here.**
128.100.18.0 ← **Host 128.100.19.11 is in here.**
128.100.20.0

Host 128.100.19.11 is in subnet 128.100.18.0. Not that you were asked, but for your information, the first host is 18.1, the last host is 19.254, and the broadcast is 19.255.

Notes:
We are almost at the end of subnetting on the third octet. Then things get a little bit harder, but the process stays exactly the same.

Lab 25. Subnetting 136.10.40.111/24

Lab Objective:
Learn how to answer a hard Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 136.10.40.111/24 in?

We are now using /24 for our subnet. This might look a bit weird now, but it's perfectly acceptable to use a Class C mask with a Class B address. In fact, this and the following Class B questions will all do this.

/24 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 24 from 16 you need to add 8. Tick eight places across the top row to see that your subnets go up in increments of 1. You are allowed to start with subnet 0, and your last subnet will be whatever /24 is in longhand.

To work that out, tick eight down the Subnets column. You can see that you have subnet 255 or 255.255.255.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓	✓	✓
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254	✓								
255	✓								

So what do we know so far? We know that our subnets go up in increments of 1 and we are trying to reach host 136.10.40.111.

Let's start with 0.0, which is the first subnet; our second will be 1.0 and so on. We will need to jump because although the third octet starts with a low number, our subnets go up in increments of 1, which is a pretty low value to count in.

136.10.0.0
136.10.1.0
136.10.2.0 ← **Jump here (we are counting up in 1s).**
136.10.40.0 ← **Host 136.10.40.111 is in here.**
136.10.41.0

Host 136.10.40.111 is in subnet 136.10.40.0. Not that you were asked, but for your information, the first host is 40.1, the last host is 40.254, and the broadcast is 40.255.

Note:
Stick to the process no matter what the question asks you.

Lab 26. Subnetting 186.30.30.41/25

Lab Objective:
Learn how to answer a hard Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 186.30.30.41/25 in?

We are now using /25 for our subnet. When I created the Subnetting Cheat Chart, I thought it would all fall apart here, but it still worked. The chart shifts over to the fourth octet now. Your subnets will still start at 186.30.0.0, but when faced with exam questions, we just want to get the answer fast.

/25 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 25 from 16 you need to add 9. Tick nine places across the top row to see that your subnets go up in increments of 128. You are allowed to start with subnet 0, and your last subnet will be whatever /25 is in longhand.

IMPORTANT—I've dropped a +8 into the Subnetting Cheat Chart. You don't have to, but I wanted it to be a memory jogger that we have stolen eight bits from the third octet and they have spilled over into the fourth. Otherwise we would have to write out two charts side by side.

To work that out, tick one down the Subnets column (you already would have ticked down eight in the third octet, so they are spilling over). You can see that you have subnet 128 or 255.255.255.128.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									

This is actually the hardest combination you can have. We are looking at an IP address in decimal, but network equipment looks at it in binary. What looks weird to our eyes actually makes sense in binary. You are now counting up in increments of 128, and you are allowed to have a zero value in the third octet if there is a bit active in the fourth octet. All zeros in the host values tell the router that the address is a subnet address.

So what do we know so far? We know that our subnets go up in increments of 128 and we are trying to reach host 186.30.30.41.

Let's start with 0.0, which is the first subnet; our second will be 0.128 and so on. We will need to jump because counting up in small increments will take a long time.

186.30.0.0
186.30.0.128
186.30.1.0
186.30.1.128 ← **Jump here (we are counting up in 1s/128s).**
186.30.30.0 ← **Host 186.30.30.41 is in here.**
186.30.30.128
186.30.31.0

Host 186.30.30.41 is in subnet 186.30.30.0. Not that you were asked, but for your information, the first host is 30.1, the last host is 30.126, and the broadcast is 30.127.

Notes:
I strongly advise you to move on from this example and come back to it later. It's hard to get your head around it I'm afraid, because (as I've said) binary is behind all of this. It's also not likely to come up in an exam question.

You do need to know this because if you were designing a network using a Class B address and needed 512 subnets with 126 hosts-per-subnet, you would choose this mask.

Lab 27. Subnetting 150.130.20.121/26

Lab Objective:
Learn how to answer a hard Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 150.130.20.121/26 in?

We are now using /26 for our subnet. /26 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 26 from 16 you need to add 10. Tick 10 places across the top row to see that your subnets go up in increments of 64. You are allowed to start with subnet 0, and your last subnet will be whatever /26 is in longhand.

IMPORTANT—I've dropped a +8 into the Subnetting Cheat Chart. You don't have to, but I wanted it to be a memory jogger that we have stolen eight bits from the third octet and they have spilled over into the fourth. Otherwise we would have to write out two charts side by side.

To work that out, tick two down the Subnets column (you already would have ticked down eight in the third octet, so they are spilling over). You can see that you have subnet 192 or 255.255.255.192.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									

This is another hard one (because of binary of course). We can see that our increment is 64, but more than this, we can count up on the fourth octet using this value as you will see below.

So what do we know so far? We know that our subnets go up in increments of 64 and we are trying to reach host 150.130.20.121.

Let's start with 0.0, which is the first subnet; our second will be 0.64 and so on. We will need to jump because counting up in small increments will take a long time.

150.130.0.0
150.130.0.64
150.130.0.128
150.130.0.192
150.130.1.0
150.130.1.64
150.130.1.128
150.130.1.192 ← **Jump here (we are counting up in 1s/64s).**
150.130.20.0
150.130.20.64 ← **Host 150.130.20.121 is in here.**
150.130.20.128

Host 150.130.20.121 is in subnet 150.130.20.64. Not that you were asked, but for your information, the first host is 20.65, the last host is 20.126, and the broadcast is 20.127.

Notes:
If you write out the IP address and subnet mask in binary, you will see each subnet address, the hosts, and then the broadcast address. There is no time for this in the exam though.

Lab 28. Subnetting 131.60.50.1/27

Lab Objective:
Learn how to answer a hard Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 131.60.50.1/27 in?

We are now using /27 for our subnet. /27 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 27 from 16 you need to add 11. Tick 11 places across the top row to see that your subnets go up in increments of 32. You are allowed to start with subnet 0, and your last subnet will be whatever /27 is in longhand.

To work that out, tick three down the Subnets column (you already would have ticked down eight in the third octet, so they are spilling over). You can see that you have subnet 224 or 255.255.255.224.

IMPORTANT – I've dropped a +8 into the Subnetting Cheat Chart. You don't have to, but I wanted it to be a memory jogger that we have stolen eight bits from the third octet and they have spilled over into the fourth. Otherwise we would have to write out two charts side by side.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									

Okay. It's time to bring in a massive cheat. I wanted you to see how to count up properly, but now we are going to drill right into the answer. Turning bits on and off is fine if you have the time, but you don't. We are now going to pretend that we are doing a plain Class C subnet question.

Let's fix the IP address as if it were Class C, and just focus on the last octet.

So what do we know so far? We know that our subnets go up in increments of 32 and we are trying to reach host 131.60.50.1. We are treating this question as if the .1 is the host address on subnet 131.60.50.

Let's start with 0, which is the first subnet; our second will be 32 and so on.

131.60.50.0 ← **Host 130.60.50.1 is in here.**
131.60.50.32

Host 131.60.50.1 is in subnet 131.60.50.0. Not that you were asked, but for your information, the first host is 1, the last host is 30, and the broadcast is 31.

Notes:
If you really want to count subnets, you would do this:

131.60.0.0
131.60.0.32
131.60.0.64

But this mask generates 2048 subnets, each with 30 hosts. It would take you many hours to write them all out.

Lab 29. Subnetting 142.160.40.35/28

Lab Objective:
Learn how to answer a hard Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 142.160.40.35/28 in?

We are now using /28 for our subnet. /28 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 28 from 16 you need to add 12. Tick 12 places across the top row to see that your subnets go up in increments of 16. You are allowed to start with subnet 0, and your last subnet will be whatever /28 is in longhand.

To work that out, tick four down the Subnets column (you already would have ticked down eight in the third octet, so they are spilling over). You can see that you have subnet 240 or 255.255.255.240.

IMPORTANT – I've dropped a +8 into the Subnetting Cheat Chart. You don't have to, but I wanted it to be a memory jogger that we have stolen eight bits from the third octet and they have spilled over into the fourth. Otherwise we would have to write out two charts side by side.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									

Shall we carry on cheating? I think so. Let's fix the IP address as if it were Class C, and just focus on the last octet.

So what do we know so far? We know that our subnets go up in increments of 16 and we are trying to reach host 142.160.40.35 (35 is the target number). Let's start with 0, which is the first subnet; our second will be 16 and so on.

142.160.40.0
142.160.40.16
142.160.40.32 ← **Host 142.160.40.35 is in here.**
142.160.40.48

Host 142.160.40.35 is in subnet 142.160.40.32. Not that you were asked, but for your information, the first host is 33, the last host is 46, and the broadcast is 47.

Notes:
If you really want to count subnets, you would have 16 values for every value in the third octet. It's just impossibly hard and laborious to write all 4096 subnets out in longhand.

Lab 30. Subnetting 128.10.10.54/29

Lab Objective:
Learn how to answer a hard Class B subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class B subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 128.10.10.54/29 in?

We are now using /29 for our subnet. /29 isn't the standard mask for Class B IP addresses; /16 is. You can easily see that to get to 29 from 16 you need to add 13. Tick 13 places across the top row to see that your subnets go up in increments of 8. You are allowed to start with subnet 0, and your last subnet will be whatever /29 is in longhand.

To work that out, tick five down the Subnets column (you already would have ticked down eight in the third octet, so they are spilling over). You can see that you have subnet 248 or 255.255.255.248.

IMPORTANT – I've dropped a +8 into the Subnetting Cheat Chart. You don't have to, but I wanted it to be a memory jogger that we have stolen eight bits from the third octet and they have spilled over into the fourth. Otherwise we would have to write out two charts side by side.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									

Shall we carry on cheating? I think so. Let's fix the IP address as if it were Class C, and just focus on the last octet.

So what do we know so far? We know that our subnets go up in increments of 8 and we are trying to reach host 128.10.10.54. Let's start with 0, which is the first subnet; our second will be 8 and so on.

128.10.10.0
128.10.10.8 ← **Jump here (6 × 8 = 48).**
128.10.10.48 ← **Host 128.10.10.54 is in here.**
128.10.10.56

Host 128.10.10.54 is in subnet 128.10.10.48. Not that you were asked, but for your information, the first host is 49, the last host is 54, and the broadcast is 55.

Note:
There are over 8000 subnets here and each has six hosts.

Class A Subnetting

Lab 31. Subnetting 10.10.10.54/9

Lab Objective:
Learn how to answer an easy Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 10.10.10.54/9 in?

Back to easy street! Class A addresses have the first octet reserved for the network and the rest for hosts.

To work that out, tick one across the top row to get your increment and one down to get the subnet value. You can see that you have subnet 128 or 255.128.0.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 128 and we are trying to reach host 10.10.10.54. Let's start with 0.0.0, which is the first subnet; our second will be 128.0.0 and so on.

10.0.0.0 ← **Host 10.10.10.54 is in here.**

10.128.0.0

Host 10.10.10.54 is in subnet 10.0.0.0. Not that you were asked, but for your information, the first host is 10.0.0.1, the last host is 10.127.255.254, and the broadcast is 10.127.255.255.

Notes:
Two subnets are generated from this subnet mask, but each has over 800,000 hosts. It would never be used on a commercial network.

Lab 32. Subnetting 20.100.11.11/10

Lab Objective:
Learn how to answer an easy Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Let's keep it easy. (This will change soon though!)

Which subnet is host 20.100.11.11/10 in?

To work that out, tick two across the top row to get your increment and two down to get the subnet value. You can see that you have subnet 192 or 255.192.0.0.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 64 and we are trying to reach host 20.100.11.11. Let's start with 0.0.0, which is the first subnet; our second will be 64.0.0 and so on.

20.0.0.0
20.64.0.0 ← **Host 20.100.11.11 is in here.**
20.128.0.0
20.192.0.0

Host 20.100.11.11 is in subnet 20.64.0.0. Not that you were asked, but for your information, the first host is 20.64.0.1, the last host is 20.127.255.254, and the broadcast is 20.127.255.255.

Note:
It's pretty easy to write all the subnets out here because there are only four of them.

Lab 33. Subnetting 40.50.101.121/12

Lab Objective:
Learn how to answer an easy Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 40.50.101.121/12 in?

It should be /8 for Class A addresses and we have /12, so to work that out, tick four across the top row to get your increment and four down to get the subnet value. You can see that you have subnet 240 or 255.240.0.0. Our increment for subnets is 16.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									

So what do we know so far? We know that our subnets go up in increments of 16 and we are trying to reach host 40.50.101.121. Let's start with 0.0.0, which is the first subnet; our second will be 16.0.0 and so on.

40.0.0.0
40.16.0.0
40.32.0.0

40.48.0.0 ← **Host 40.50.101.121 is in here.**
40.64.0.0

Host 40.50.101.121 is in subnet 40.48.0.0. Not that you were asked, but for your information, the first host is 40.48.0.1, the last host is 40.63.255.254, and the broadcast is 40.63.255.255.

Note:
This is just straight Class A addressing with a mask in the first octet, so easy enough.

Lab 34. Subnetting 120.150.1.2/14

Lab Objective:
Learn how to answer an easy Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 120.150.1.2/14 in?

It should be /8 for Class A addresses and we have /14, so to work that out, tick six across the top row to get your increment and six down to get the subnet value. You can see that you have subnet 252 or 255.252.0.0. Our increment for subnets is 4.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓		
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254									
255									

So what do we know so far? We know that our subnets go up in increments of 4 and we are trying to reach host 120.150.1.2. Let's start with 0.0.0, which is the first subnet; our second will be 4.0.0 and so on.

120.0.0.0
120.4.0.0 ← **Jump to subnet 40.**
120.40.0.0

120.44.0.0
120.48.0.0 ← **Jump to subnet 144. (48 x 3)**
120.144.0.0
120.148.0.0 ← **Host 120.150.1.2 is in here.**
120.152.0.0

Host 120.150.1.2 is in subnet 120.148.0.0. Not that you were asked, but for your information, the first host is 120.148.0.1, the last host is 120.151.255.254, and the broadcast is 120.151.255.255.

Note:
This is just straight Class A addressing with a mask in the first octet, so easy enough. Note also, that I sometimes use a shorthand method and just refer to the subnet octets or host octets so above I could have said host 150.1.2. I mention this because you may well see other engineers do this at work.

Lab 35. Subnetting 10.10.14.25/16

Lab Objective:
Learn how to answer an easy Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 10.10.14.25/16 in?

It should be /8 for Class A addresses and we have /16, so to work that out, tick eight across the top row to get your increment and eight down to get the subnet value. You can see that you have subnet 255 or 255.255.0.0. Our increment for subnets is 1.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓	✓	✓
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254	✓								
255	✓								

So what do we know so far? We know that our subnets go up in increments of 1 and we are trying to reach host 10.10.14.25. Let's start with 0.0.0, which is the first subnet; our second will be 1.0.0 and so on.

10.0.0.0
10.1.0.0
10.2.0.0 ← **Jump to subnet 10.**

10.10.0.0 ← **Host 10.10.14.25 is in here.**
10.11.0.0

Host 10.10.14.25 is in subnet 10.10.0.0. Not that you were asked, but for your information, the first host is 10.10.0.1, the last host is 10.10.255.254, and the broadcast is 10.10.255.255.

Note:
This one couldn’t be much easier!

Lab 36. Subnetting 10.23.4.2/18

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 10.23.4.2/18 in?

It should be /8 for Class A addresses and we have /18, so to work that out, tick 10 across the top row to get your increment and 10 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +8 in the corner and continue from there, giving us two to add. You can see that you have subnet 192 or 255.255.192.0. Our increment for subnets is 64.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									

It's time to cheat again. We want to get to the answer and not merely create a chart for our business. Let's treat this as a Class B address with a Class B mask.

So what do we know so far? We know that our subnets go up in increments of 64 and we are trying to reach host 10.23.4.2 (host 4.2 on subnet 10.23). Let's start with 0.0, which is the first subnet; our second will be 64.0 and so on.

10.23.0.0 ← **Host 10.23.4.2 is in here.**
10.23.64.0
10.23.128.0

Host 10.23.4.2 is in subnet 10.23.0.0. Not that you were asked, but for your information, the first host is 10.23.0.1, the last host is 10.23.63.254, and the broadcast is 10.23.63.255.

Notes:
Your subnets are going up from:

10.0.0.0
10.0.64.0
10.0.128.0
10.0.192.0

There are 1024 subnets and over 16,000 hosts-per-subnet. No time to work all this out in the exam.

Lab 37. Subnetting 110.120.140.29/18

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 110.120.140.29/18 in?

It should be /8 for Class A addresses and we have /18, so to work that out, tick 10 across the top row to get your increment and 10 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +8 in the corner and continue from there, giving us two to add. You can see that you have subnet 192 or 255.255.192.0. Our increment for subnets is 64.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									

It's time to cheat again. We want to get to the answer and not merely create a chart for our business. Let's treat this as a Class B address with a Class B mask.

So what do we know so far? We know that our subnets go up in increments of 64 and we are trying to reach host 110.120.140.29. Let's start with 0.0, which is the first subnet; our second will be 64.0 and so on.

110.120.0.0
110.120.64.0
110.120.128.0 ← **Host 110.120.140.29 is in here.**
110.120.192.0

Host 110.120.140.29 is in subnet 110.120.128.0. Not that you were asked, but for your information, the first host is 110.120.128.1, the last host is 110.120.191.254, and the broadcast is 110.120.191.255.

Note:
So we are ignoring the fact that we could start at 10.0.0.0 and count up thousands of subnets, and pretending that the first two octets are already fixed.

Lab 38. Subnetting 124.60.190.25/20

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 124.60.190.25/20 in?

It should be /8 for Class A addresses and we have /20, so to work that out, tick 12 across the top row to get your increment and 12 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +8 in the corner and continue from there, giving us four to add. You can see that you have subnet 240 or 255.255.240.0. Our increment for subnets is 16.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									

It's time to keep cheating. We want to get to the answer and not merely create a chart for our business. Let's treat this as a Class B address with a Class B mask. Fix 124.60 and we can subnet the rest.

So what do we know so far? We know that our subnets go up in increments of 16 and we are trying to reach host 124.60.190.25. Let's start with 0.0, which is the first subnet; our second will

be 16.0 and so on. Also, we will need to jump.

124.60.0.0
124.60.16.0 ← **Jump here (16 × 10 = 160).**
124.60.160.0
124.60.176.0 ← **Host 124.60.190.25 is in here.**
124.60.192.0

Host 124.60.190.25 is in subnet 124.60.176.0. Not that you were asked, but for your information, the first host is 124.60.176.1, the last host is 124.60.191.254, and the broadcast is 124.60.191.255.

Note:
So we are ignoring the fact that we could start at 124.0.0.0 and count up thousands of subnets, and pretending that the first two octets are already fixed. This is the only sane way to answer this question if you are in an exam or technical interview.

Lab 39. Subnetting 14.40.140.85/22

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 14.40.140.85/22 in?

It should be /8 for Class A addresses and we have /22 so to work that out, tick 14 across the top row to get your increment and 14 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +8 in the corner and continue from there, giving us six to add. You can see that you have subnet 252 or 255.255.252.0. Our increment for subnets is 4.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓		
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254									
255									

It's time to keep cheating. We want to get to the answer and not merely create a chart for our business. Let's treat this as a Class B address with a Class B mask. Fix 14.40 and we can subnet the rest.

So what do we know so far? We know that our subnets go up in increments of 4 and we are trying to reach host 140.85 in subnet 14.40. Let's start with 0.0, which is the first subnet; our

second will be 4.0 and so on. Also, we will need to jump.

14.40.0.0
14.40.4.0 ← **Jump here (35 × 4 = 140).**
14.40.140.0 ← **Host 14.40.140.85 is in here.**
14.40.144.0

Host 14.40.140.85 is in subnet 14.40.140.0. Not that you were asked, but for your information, the first host is 14.40.140.1, the last host is 14.40.143.254, and the broadcast is 14.40.143.255.

Notes:
You can only pass the exam by using this method. Otherwise it will be a countfest of thousands of subnets.

Lab 40. Subnetting 30.20.10.89/24

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 30.20.10.89/24 in?

It should be /8 for Class A addresses and we have /24, so to work that out, tick 16 across the top row to get your increment and 16 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +8 in the corner and continue from there, giving us eight to add. You can see that you have subnet 255 or 255.255.255.0. Our increment for subnets is 1.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓	✓	✓
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254	✓								
255	✓								

This couldn't be easier for us. We will treat this as a Class B address. Fix 30.20 and we can subnet the rest. You could start at 30.0.0.0 if you wish, but you'll be here until Christmas working that all out in longhand.

So what do we know so far? We know that our subnets go up in increments of 1 and we are trying to reach host 30.20.10.89. Let's start with 0.0, which is the first subnet; our second will be

1.0 and so on. Also, we will need to jump.

30.20.0.0
30.20.1.0 ← **Jump here.**
30.20.10.0 ← **Host 30.20.10.89 is in here.**
30.20.11.0

Host 30.20.10.89 is in subnet 30.20.10.0. Not that you were asked, but for your information, the first host is 30.20.10.1, the last host is 30.20.10.254, and the broadcast is 30.20.10.255.

Notes:
You are subnetting on the third octet, so it would usually be:

30.0.0.0
30.0.1.0
30.0.2.0

But there are over 65,000 subnets, so let's not do that!

Lab 41. Subnetting 3.210.30.177/25

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 3.210.30.177/25 in?

It should be /8 for Class A addresses and we have /25, so to work that out, tick 17 across the top row to get your increment and 17 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +16 in the corner and continue from there, giving us one to add. You can see that you have subnet 128 or 255.255.255.128. Our increment for subnets is 128.

Subnetting Cheat Chart

+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									

This couldn't be easier for us (again). We will treat this as a Class C address. Fix 3.210.30 and we can subnet the rest. You could start at 3.0.0.0 if you wish, but that is too much work.

So what do we know so far? We know that our subnets go up in increments of 128 and we are trying to reach host 3.210.30.177. Let's start with 0, which is the first subnet; our second will be

128 and so on.

3.210.30.0
3.210.30.128 ← **Host 3.210.30.177 is in here.**
3.210.31.0
3.210.31.128

Host 3.210.30.177 is in subnet 3.210.30.128. Not that you were asked, but for your information, the first host is 3.210.30.129, the last host is 3.210.30.254, and the broadcast is 3.210.30.255.

Notes:
I told you before that /25 masks are a pain. If you were fluent in binary, it would make perfect sense. Hopefully you have a good-quality subnetting book to explain this in more detail. My job is to get you through your exam or technical interview.

Lab 42. Subnetting 125.10.250.221/27

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 125.10.250.221/27 in?

It should be /8 for Class A addresses and we have /27, so to work that out, tick 19 across the top row to get your increment and 19 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +16 in the corner and continue from there, giving us three to add. You can see that you have subnet 224 or 255.255.255.224. Our increment for subnets is 32.

Subnetting Cheat Chart

+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									

Forget about address classes—we will treat this as a Class C address. Fix 125.10.250 and we can subnet the rest. You could start at 125.0.0.0 if you wish, but that is too much work. Just count up on the last octet in increments of 32 until we find our host.

So what do we know so far? We know that our subnets go up in increments of 32 and we are

trying to reach host 221 in subnet 125.10.250. Let's start with 0, which is the first subnet; our second will be 32 and so on.

125.10.250.0
125.10.250.32
125.10.250.64
125.10.250.96 ← **Jump here (double 96).**
125.10.250.192 ← **Host 125.10.250.221 is in here.**
125.10.250.224

Host 125.10.250.221 is in subnet 125.10.250.192. Not that you were asked, but for your information, the first host is 125.10.250.193, the last host is 125.10.250.222, and the broadcast is 125.10.250.223.

Note:
Hopefully this one wasn't too difficult.

Lab 43. Subnetting 100.100.210.46/28

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 100.100.210.46/28 in?

It should be /8 for Class A addresses and we have /28, so to work that out, tick 20 across the top row to get your increment and 20 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +16 in the corner and continue from there, giving us four to add. You can see that you have subnet 240 or 255.255.255.240. Our increment for subnets is 16.

Subnetting Cheat Chart

+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									

Forget about address classes—we will treat this as a Class C address. Fix 100.100.210 and we can subnet the rest. You could start at 100.0.0.0 if you wish, but that is too much work. Just count up on the last octet in increments of 16 until we find our host.

So what do we know so far? We know that our subnets go up in increments of 16 and we are

trying to reach host 46 in subnet 100.100.210. Let's start with 0, which is the first subnet; our second will be 16 and so on.

100.100.210.0
100.100.210.16
100.100.210.32 ← **Host 100.100.210.46 is in here.**
100.100.210.48
100.100.210.64

Host 100.100.210.46 is in subnet 100.100.210.32. Not that you were asked, but for your information, the first host is 100.100.210.33, the last host is 100.100.210.46, and the broadcast is 100.100.210.47.

Note:
You can see that, for exams at least, it's much better to look at the subnet mask and subnet on the octet the last number is on.

Lab 44. Subnetting 90.10.22.17/29

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 90.10.22.17/29 in?

It should be /8 for Class A addresses and we have /29, so to work that out, tick 21 across the top row to get your increment and 21 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +16 in the corner and continue from there, giving us five to add. You can see that you have subnet 248 or 255.255.255.248. Our increment for subnets is 8.

Subnetting Cheat Chart

+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									

Forget about address classes—we will treat this like a Class C address. Fix 90.10.22 and we can subnet the rest. You could start at 90.0.0.0 if you wish, but that is too much work. Just count up on the last octet in increments of 8 until we find our host.

So what do we know so far? We know that our subnets go up in increments of 8 and we are

trying to reach host 17 in subnet 90.10.22. Let's start with 0, which is the first subnet; our second will be 8 and so on.

90.10.22.0
90.10.22.8
90.10.22.16 ← **Host 90.10.22.17 is in here.**
90.10.22.24

Host 90.10.22.17 is in subnet 90.10.22.16. Not that you were asked, but for your information, the first host is 90.10.22.17, the last host is 90.10.22.22, and the broadcast is 90.10.22.23.

Note:
I'm hoping that subnetting is all falling into place for you now.

Lab 45. Subnetting 70.100.212.85/30

Lab Objective:
Learn how to answer a Class A subnetting problem.

Lab Purpose:
Learn how to apply the subnetting chart to answer a Class A subnetting problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet is host 70.100.212.85/30 in?

It should be /8 for Class A addresses and we have /30, so to work that out, tick 22 across the top row to get your increment and 22 down to get the subnet value. Clearly, we can't do that with our Subnetting Cheat Sheet, so let's add +16 in the corner and continue from there, giving us six to add. You can see that you have subnet 252 or 255.255.255.252. Our increment for subnets is 4.

Subnetting Cheat Chart

+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓		
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254									
255									

Forget about address classes—we will treat this as a Class C address. Fix 70.100.212 and we can subnet the rest. You could start at 70.0.0.0 if you wish, but that is too much work. Just count up on the last octet in increments of 4 until we find our host.

So what do we know so far? We know that our subnets go up in increments of 4 and we are

trying to reach host 85. Let's start with 0, which is the first subnet; our second will be 8 and so on. We also need to use the jump strategy.

70.100.212.0
70.100.212.4
70.100.212.8 ← **Jump here.**
70.100.212.80
70.100.212.84 ← **Host 70.100.212.85 is in here.**
70.100.212.88

Host 70.100.212.85 is in subnet 70.100.212.84. Not that you were asked, but for your information, the first host is 70.100.212.85, the last host is 70.100.212.86, and the broadcast is 70.100.212.87.

Notes:
It's our last Class A address. It can easily be worked out if you apply the system to the problem.

Network Design

Lab 46. Design 192.168.1.0 2/126

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 192.168.1.0 will generate two subnets and 126 hosts-per-subnet?

Typically in the exam the question will be something like, 'Your boss is giving you network 192.168.1.0 and wants you to create *X* subnets each having *Y* hosts. Which subnet mask do you use?' It's the same thing: you just use the design portion of the Subnetting Cheat Chart, tick the boxes, and get the answer.

I've done the chart upside down just this once. I've put the design part at the top. All we do is tick boxes. We tick until we get the numbers we are looking for—in this instance, two subnets and 126 hosts-per-subnet. We have to take two host numbers away from 128, one belonging to the subnet and one to the broadcast.

I'm hoping that your study guide has told you that each subnet is really made up of eight binary bits. If we take one of those bits to create subnets, we are left with seven bits for hosts. This is the entire premise of VLSM.

Subnetting Cheat Chart

Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4		✓							
8		✓							
16		✓							
32		✓							
64		✓							
128		✓							
256									
512									
+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									

I had to tick down one place in the Subnets column to get to the value of two subnets. This left me with seven bits for hosts. I ticked down seven bits to get to 128 and took two away (one for the subnet and one for the broadcast), leaving me with 126 hosts-per-subnet.

You already know (I'm sure) that we are working with a Class C network, so the default mask is /24. We just add the one subnet bit to that to get the answer of /25. In the exam they may ask you to write it out in longhand, so in that case, tick one place down the subnet value we've been using for over 40 examples and you will see our last subnet value is 128. The full answer is 192.168.1.0 255.255.255.128.

Notice that they didn't ask you to list the subnets created. If they ever do, you already know this process. Subnets start at 0 and go up in increments of 128. Each subnet will have 126 host addresses you can use.

192.168.1.0
192.168.1.128

You can also work out the host addresses and broadcast if you wish. I've never seen an exam question asking you to do both. Perhaps only a network design exam might, such as Cisco Certified Design Associate (CCDA).

Notes:
It's not always the case that the question asks you for the exact number of subnets/hosts-per-subnet. You have to get as close as possible (as we will see).

Lab 47. Design 192.168.1.0 4/62

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 192.168.1.0 will generate four subnets and 62 hosts-per-subnet?

I know we are very close to the last example, but I want to do this all slowly with you. This time I've put the Subnetting Cheat Chart back in the correct order. You fill in the design part (bottom) first and then tick the top part after that (if you need to).

All you need to do is tick until you reach the answer. If you are looking for some complicated system of calculations and formulas, then I can't help you. I only know the easy way to subnet!

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8		✓							
16		✓							
32		✓							
64		✓							
128									
256									
512									

I had to tick down two places to get to four subnets. That leaves me six bits for hosts-per-subnet, generating 64, from which we have to take 2 away to get 62.

You can add the two bits to the default mask of /24 to get /26, or if you need to do it in longhand, then tick two in the upper Subnets column to reveal /192, or in full 255.255.255.192. So the answer is 192.168.1.0/26.

Just for fun, we will write out the subnets, but we won't do this again in the design section because you have done this so many times by now. You have ticked two, so tick across two to generate an increment of 64. Here are your subnets:

192.168.1.0
192.168.1.64
192.168.1.128
192.168.1.192

You can also work out the host addresses and broadcast if you wish. I've never seen an exam question asking you to do both. Perhaps only a network design exam might, such as Cisco Certified Design Associate (CCDA).

Notes:
I've been in IT for 18 years and never found a simpler method than mine. I had to invent it after struggling for weeks to work out subnetting and network design to pass a Cisco exam. I've been teaching this method to my students ever since. And now I'm showing you.

Lab 48. Design 200.18.2.0 8/30

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 200.18.2.0 will generate eight subnets and 30 hosts-per-subnet?

It's actually pretty rare in exam questions to be given routable networks to apply VLSM to. They tend to stick to private addresses, but it's all the same process either way. All you need to do is tick until you reach the answer. By the end of this book you will find this all boring, and I will have achieved my goal.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16		✓							
32		✓							
64									
128									
256									
512									

I had to tick down three places to get to eight subnets. That leaves me five bits for hosts-per-subnet, generating 32, from which we have to take 2 away to get 30.

You can add the three bits to the default mask of /24 to get /27, or if you need to do it in longhand, then tick three in the upper Subnets column to reveal /224, or in full 255.255.255.224. Apply this mask to your network address to get 8 subnets each with 30 hosts.

Applying this subnet mask to the given network will create eight subnets each containing 30 hosts. This would be ideal for many LANs I'm sure.

Note:
I'll start increasing the difficulty soon, but as you will see, if you can tick boxes, you can design network addressing.

Lab 49. Design 221.1.22.0 16/14

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 221.1.22.0 will generate 16 subnets and 14 hosts-per-subnet?

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓				
128	✓								
192	✓								
224	✓								
240	✓								
248									
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32									
64									
128									
256									
512									

I had to tick down four places to get to 16 subnets. That leaves me four bits for hosts-per-subnet, generating 16, from which we have to take 2 away to get 14.

You can add the four bits to the default mask of /24 to get /28, or if you need to do it in longhand, then tick three in the upper Subnets column to reveal /240, or in full 255.255.255.240.

Notes:
If you do this enough times, you will actually be able to look at the question and know the answer. /28 always gives you 16 subnets and 14 hosts-per-subnet (for Class C networks).

Lab 50. Design 198.10.122.0 30/6

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 198.10.122.0 will generate 30 subnets and 6 hosts-per-subnet?

Now we need to be careful. You can't alter what the numbers give you. Read the exam question carefully and it will specify which is most important, the number of subnets or the number of hosts. Often, your boss or customer won't understand VLSM rules.

Almost always, you have to hit the required number of subnets, so you have to choose a number which gives you the number of subnets you need but no less. Whatever number of hosts-per-subnet you are left with I'm afraid you are stuck with.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									
Powers of Two	**Subnets**	**Hosts Minus 2**							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓								
32	✓								
64									
128									
256									
512									

I had to tick down five places to get to 32 subnets. If I choose the previous one (one less), I'll be stuck with 16, and if I tick one more, I'll have too many at 64. That leaves me three bits for hosts-per-subnet, generating 8, from which we have to take 2 away to get 6.

You can add the five bits to the default mask of /24 to get /29, or if you need to do it in longhand, then tick five in the upper Subnets column to reveal /248, or in full 255.255.255.248.

Notes:

What you need won't always match up with the requirements. All you can tell customers is what is available using the math VLSM works on.

Lab 51. Design 210.100.12.0 ?/2

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 210.100.12.0 will generate two hosts-per-subnet?

Not all questions will ask you to generate *X* subnets; some will want to have a host-based solution. This will probably be used for point-to-point links, which require only two host addresses. You already know this from the subnetting examples we have done.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓		
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓								
16	✓								
32	✓								
64	✓								
128									
256									
512									

Ticking down two places (in the Hosts Minus 2 column) will give us two hosts-per-subnet. Well, we get four, but as you know, we can't use two of the numbers. We have six remaining bits left for the Subnets column, generating 64 subnets and a mask of 255.255.255.252, or /30.

Note:
Always think /30 masks when you have questions about point-to-point links or two hosts being required.

Lab 52. Design 172.16.0.0 4/?

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 172.16.0.0 will generate four subnets? How many hosts-per-subnet will this leave you?

Note that we are using a Class B address here. Class B networks have 16 bits reserved, which means you have 16 bits for hosts and you can use these host bits for VLSM. Also note that I've had to add more addresses to the design portion of the Subnetting Cheat Chart because we are using two octets.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓						
128	✓								
192	✓								
224									
240									
248									
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8		✓							
16		✓							
32		✓							
64		✓							
128		✓							
256		✓							
512		✓							
1024		✓							
2048		✓							
4096		✓							
8192		✓							
16384		✓							

I had to tick down two places in the Subnets column to get to four subnets. There are two octets for a Class B network, so we have 14 host address bits to tick down. Fourteen ticks give us 16,384 – 2 hosts-per-subnet, so 16,382. Your mask would be 255.255.192.0; in CIDR your answer is 172.16.0.0/18.

Note:

This subnet is too big to use for most networks, but in the exam they are more concerned with testing your knowledge than with creating feasible solutions.

Lab 53. Design 172.20.0.0 32/?

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 172.20.0.0 will generate 32 subnets? How many hosts-per-subnet will this leave you?

As usual, just tick down until you reach 32 and use the remaining bits for hosts.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32	✓	✓							
64		✓							
128		✓							
256		✓							
512		✓							
1024		✓							
2048		✓							
4096									
8192									
16384									

I had to tick down five places in the Subnets column to get to 32 subnets. That leaves 11 bits for hosts, which is 2046 hosts-per-subnet. Five bits on the third octet gives you 255.255.248.0, or /21.

Notes:

There is no mystery here. Just tick until you hit the right numbers.

Lab 54. Design 132.30.0.0 60/?

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 132.30.0.0 will generate as close as possible to 60 subnets each supporting up to 1000 hosts?

You might think it's a vague question, but it isn't really. You can see that any number of subnets as you tick up the values won't be enough and of course 128 is too many. In fact, if you tick up to 128 subnets, you won't have enough hosts-per-subnet left.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓		
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32	✓	✓							
64	✓	✓							
128		✓							
256		✓							
512		✓							
1024		✓							
2048									
4096									
8192									
16384									

Sixty-four subnets are as close as you can get to the requirement. Any value above or below is just not adequate. This means you are using six bits for subnets and have 10 left for hosts. Ticking down 10 places gives you 1022 hosts-per-subnet. Your subnet mask is 255.255.252.0, or /22 in CIDR.

Note:
Just tick until you hit the right numbers.

Lab 55. Design 190.100.0.0 128/500

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 190.100.0.0 will generate 128 subnets each supporting at least 500 hosts?

I've gone back to specific values here. At least for the required subnets, the host part is a requirement for AT LEAST 500 hosts.

Subnetting Cheat Chart

	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓	✓	
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254	✓								
255									
Powers of Two	**Subnets**	**Hosts Minus 2**							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32	✓	✓							
64	✓	✓							
128	✓	✓							
256		✓							
512		✓							
1024									
2048									
4096									
8192									
16384									

One hundred twenty-eight subnets are the requirement. This means you are using seven bits for subnets and have nine left for hosts. Ticking down nine places gives you 510 hosts-per-subnet. Your subnet mask is 255.255.254.0, or /23 in CIDR.

Lab 56. Design 191.40.0.0 512/100

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 191.40.0.0 will generate 512 subnets each supporting up to 100 hosts?

I've gone back to specific values here. At least for the required subnets, the host part is a requirement for AT LEAST 100 hosts. Don't work out fewer than this (of course), but don't look to go higher than the number which provides this quantity.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32	✓	✓							
64	✓	✓							
128	✓	✓							
256	✓								
512	✓								
1024									
2048									
4096									
8192									
16384									

Five hundred twelve subnets are the requirement. This means you are using nine bits for subnets and have seven left for hosts. Ticking down nine places gives you 512 subnets, and seven host ticks give you 126 hosts-per-subnet. Your subnet mask is 255.255.255.128, or /25 in CIDR.

Note:

We have gone into the fourth octet but are using a Class B address, so you will note the +8 in the Subnets column.

Lab 57. Design 181.70.0.0 2000/30

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Which subnet mask applied to 181.70.0.0 will generate as close to 2000 subnets as possible with each subnet supporting up to 30 hosts?

It might look somewhat wooly, but think about it. You have to supply 2000 subnets. Really, this is all you should think about to start with. The person who designed the question will already know what the correct values of subnets/hosts-per-subnet are.

Subnetting Cheat Chart

+8	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓					
128	✓								
192	✓								
224	✓								
240									
248									
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32	✓	✓							
64	✓								
128	✓								
256	✓								
512	✓								
1024	✓								
2048	✓								
4096									
8192									
16384									

Two thousand subnets are the requirement. This means you are using 11 bits for subnets and have 5 left for hosts. Ticking down 11 places gives you 2048 subnets, and five host ticks give you 30 hosts-per-subnet. Your subnet mask is 255.255.255.224, or /27 in CIDR.

Note:

We have gone into the fourth octet but are using a Class B address, so you will note the +8 in the Subnets column.

Lab 58. Design 10.0.0.0/21

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Your boss hands you subnet 10.0.0.0/21 and asks you to work out how many subnets and hosts-per-subnet this will generate. What do you tell her?

No need to panic—just tick the boxes in the design section.

Subnetting Cheat Chart

+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓			
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32	✓	✓							
64	✓	✓							
128	✓	✓							
256	✓	✓							
512	✓	✓							
1024	✓	✓							
2048	✓	✓							
4096	✓								
8192	✓								
16384									

You know that it's a Class A address from the network number. You know then that it will have eight bits of subnetting for the network. Next, starting from that value you tick down the Subnets column in the design section to get you to a 21-bit subnet mask. You would tick 13 places down to get your total of 21. This leaves 11 bits for hosts (since there are 32 bits in a subnet mask). That generates 8192 subnets with 2046 hosts-per-subnet.

Notes:

It's the same process, but I asked a different question. It might throw you off to start with, but just tick how many bits are borrowed for the subnet and you will be fine.

Lab 59. Design 10.0.0.0/23

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
You have taken over a network from another network designer. You can see that 10.0.0.0/23 has been allocated. How many subnets and hosts-per-subnet has this generated?

Subnetting Cheat Chart

+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓	✓	✓	✓	✓	✓	✓	
128	✓								
192	✓								
224	✓								
240	✓								
248	✓								
252	✓								
254	✓								
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32	✓	✓							
64	✓	✓							
128	✓	✓							
256	✓	✓							
512	✓	✓							
1024	✓								
2048	✓								
4096	✓								
8192	✓								
16384	✓								
32768	✓								

The default mask will be /8 and we have /23, so we have added 15 bits for subnetting. Tick down 15 and we can see we have 32,768 subnets. There are nine bits left for hosts, which generate 510 hosts-per-subnet.

Your subnet mask if you had to write it out in longhand is 255.255.254.0

Note:
I'm making these Class A questions fairly easy because you could end up ticking into millions of host addresses otherwise.

Lab 60. Design 10.0.0.0/17

Lab Objective:
Learn how to use VLSM to create a network addressing design.

Lab Purpose:
Learn how to apply the subnetting chart to answer a network design problem.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
You have taken over a network from another network designer. You can see that 10.0.0.0/17 has been allocated. How many subnets and hosts-per-subnet has this generated?

Subnetting Cheat Chart

+16	Bits	128	64	32	16	8	4	2	1
Subnets		✓							
128	✓								
192									
224									
240									
248									
252									
254									
255									
Powers of Two	Subnets	Hosts Minus 2							
2	✓	✓							
4	✓	✓							
8	✓	✓							
16	✓	✓							
32	✓	✓							
64	✓	✓							
128	✓	✓							
256	✓	✓							
512	✓	✓							
1024		✓							
2048		✓							
4096		✓							
8192		✓							
16384		✓							
32768		✓							

The default mask will be /8 and we have /17, so we have added nine bits for subnetting. Tick down nine and we can see we have 512 subnets. There are 15 bits left for hosts, which generate 32,766 hosts-per-subnet.

Your subnet mask if you had to write it out in longhand is 255.255.128.0

Route Summarization

Lab 61. Route Summarization 1

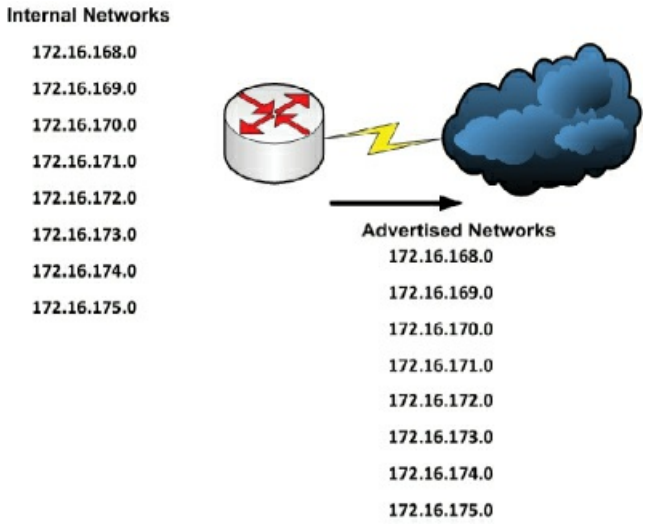
Lab Objective:
Advertise a network summary.

Lab Purpose:
Learn how to send a summary of your subnetting networks to the internet.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Your boss hands you the below diagram of your network and asks you to work out which summary route you can advertise.



You send summary network routes in order to save bandwidth and CPU cycles. This will happen after careful planning so that you are running an efficient network. If you used a random numbering and addressing system, such as 172.20.0.0, 10.0.0.0, and 192.169.1.0 for the below network, you would see a huge surge in traffic, most of which would be routing protocol updates.

Unfortunately, the only way to know you are advertising the correct summary route is to use

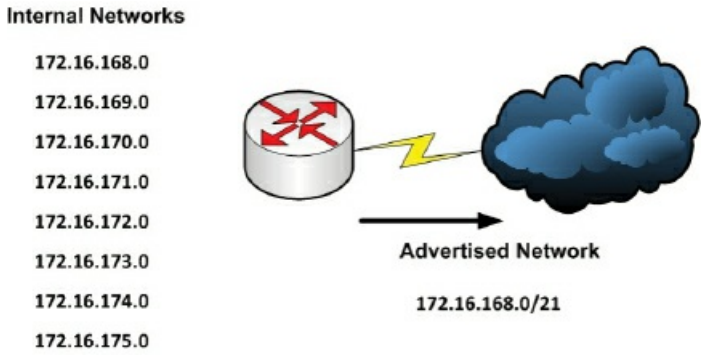
binary math. You have to do this in order to move away from what your eyes see in decimal. The good news is that you can effectively ignore any non-subnetted octets, which in our case number just 10.

This leaves us three octets to write in binary. We then count up how many binary bits match and use that as our summary address/mask. I'll list each network and underline all the matching binary bits.

172.16.168.0 – 10101100.00010000.10101000.00000000
172.16.169.0 – 10101100.00010000.10101001.00000000
172.16.170.0 – 10101100.00010000.10101010.00000000
172.16.171.0 – 10101100.00010000.10101011.00000000
172.16.172.0 – 10101100.00010000.10101100.00000000
172.16.173.0 – 10101100.00010000.10101101.00000000
172.16.174.0 – 10101100.00010000.10101110.00000000
172.16.175.0 – 10101100.00010000.10101111.00000000

Can we agree that when we compare every network in binary, 21 of the bits match? I hope so because in this case we can summarize all of these networks into one route advertisement. Network technology is smart enough to determine that any network or any host inside these networks will reside on or downstream from the router sending this advertisement.

Now we can advertise the summary route 172.16.168.0/21. Isn't this much more efficient?



Notes:
Hopefully you can see why careful planning is required during the network design phase. It allows us to create a very efficient network design and send out summary routes. I've seen this on live networks where entry-level routers were running at a constant 100% CPU usage. This dropped to under 5% when we changed to an efficient design.

Depending upon your vendor, this process may be called route aggregation, route summarization, or supernetting.

Lab 62. Route Summarization 2

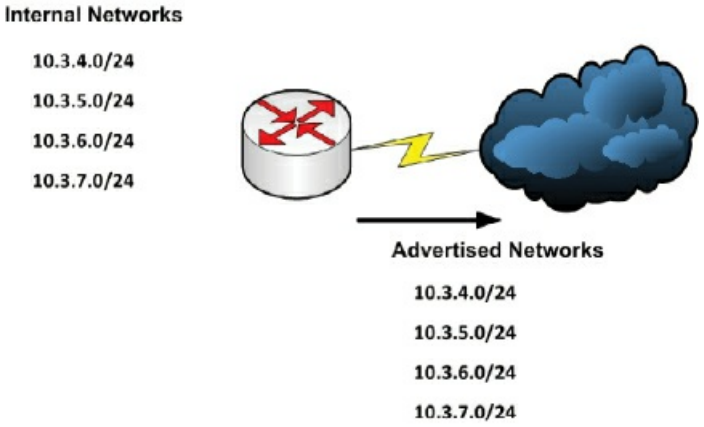
Lab Objective:
Advertise a network summary.

Lab Purpose:
Learn how to send a summary of your subnetting networks to the internet.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Your boss hands you the below diagram of your network and asks you to work out which summary route you can advertise.

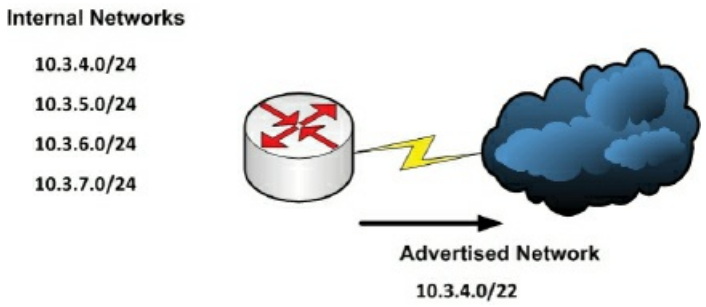


We will follow the same process. You can effectively ignore the 10.3 if you wish because you know that these two octets will match every time.

10.3.4.0/24 – 00001010.00000011.00000100.00000000
10.3.5.0/24 – 00001010.00000011.00000101.00000000
10.3.6.0/24 – 00001010.00000011.00000110.00000000
10.3.7.0/24 – 00001010.00000011.00000111.00000000

Can we agree that when we compare every network in binary, 22 of the bits match? I hope so because in this case we can summarize all of these networks into one route advertisement. Network technology is smart enough to determine that any network or any host inside these networks will reside on or downstream from the router sending this advertisement.

Now we can advertise the summary route 10.3.4.0/22, or 255.255.252.0



Notes:
I don't teach binary in this guide because it's a lab book, but if you want some extra homework, then convert the binary back to decimal. It's interesting to see how it all comes together.

VLSM

Lab 63. VLSM 1

Lab Objective:
Apply VLSM to an existing network.

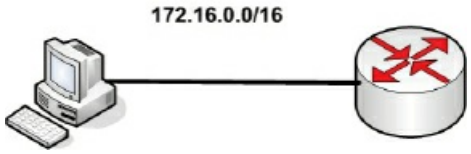
Lab Purpose:
Learn how to create subnets using VLSM.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:

Your boss hands you network 172.16.0.0/16 and tells you that you need to apply VLSM to create two networks. The current topology is just one network which had the 172.16.0.0 network applied.



We know by now that we have one network and with 16 bits available for hosts we have 65,534 hosts available for this subnet. This sort of addressing is used all over the world by lazy network engineers—presumably because private IP addressing space is free to use.

We now have to carve two subnets out of this network. Now, this isn't a lesson on network design, which is a career path in its own right. There are a number of ways to answer this problem, but I'll just stick to what the boss asked for.

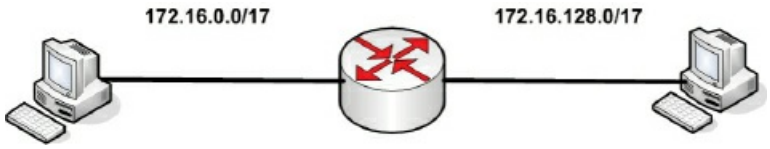
172.16.0.0 – 10101100.00010000.00000000.00000000
255.255.0.0 – 11111111.11111111.00000000.00000000 (original design)

Stealing one bit from the host's bits and using it for subnetting gives us two subnets:

172.16.0.0 – 10101100.00010000.0000000.00000000
255.255.128.0 – 11111111.11111111.10000000.00000000

172.16.128.0 – 10101100.00010000.1**0000000**.00000000
255.255.128.0 – 11111111.11111111.1**0000000**.00000000

We can effectively turn that stolen subnet bit on and off in the host address, giving us subnets 172.16.0.0 and 172.16.128.0.



Notes:
I don't teach binary in this guide because it's a lab book, but if you want some extra homework, then convert the binary back to decimal. It's interesting to see how it all comes together.

Lab 64. VLSM 2

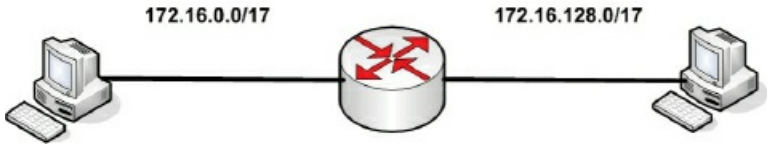
Lab Objective:
Apply VLSM to an existing network.

Lab Purpose:
Learn how to create subnets using VLSM.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Your boss who gave you the VLSM 1 challenge hands you another one. This time the 172.16.0.0/17 network is being split. Three subnets are required in total (including the 172.16.128.0 subnet). You need to leave subnet 172.16.128.0 unchanged.



We now have to carve two subnets out of the 172.16.0.0/17 network. Now, this isn't a lesson on network design, which is a career path in its own right, but it is a VLSM challenge. There are a number of ways to answer this problem, but I'll just stick to what the boss asked for.

Stealing one more bit from the host's bits and using it for subnetting gives us this:

172.16.0.0 – 10101100.00010000.00000000.00000000
255.255.192.0 – 11111111.11111111.11000000.00000000

The stolen bits can be in any combination of on and off—i.e., 00, 01, 10, 11—which I make to be four possible values (there is no way to get three, but 128/192 is effectively in use already). I know we aren't teaching binary, but you have been doing this all so far using the Subnetting Cheat Chart:

00000000 = 0
01000000 = 64

10000000 = 128 – in use already
11000000 = 192 – in use already

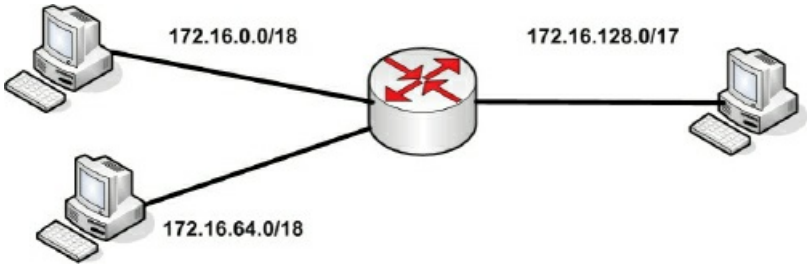
To save time and effort we just tick across two places on the Subnetting Cheat Chart to find an increment of 64 and tick down two places to find the subnet value of 192. For this problem we are interested in the first two subnets we got from the initial 0 value, which are:

172.16.0.0
172.16.64.0

Remember that the below network is currently in use and our boss has asked us not to make any changes to this.

172.16.128.0 – 10101100.00010000.10000000.00000000
255.255.128.0 – 11111111.11111111.00000000.00000000

We can effectively turn the two stolen subnet bits on and off in the host address, giving us subnets 172.16.0.0/18 and 172.16.64.0/18 (we can't use the next two). Don't be tempted to use bits from the 172.16.192.0 subnet because this is still actually part of the 128 subnet.



Notes:
You can carve up your networks and subnets in any way you wish so long as the math works. One thing you CANNOT do ever is use the same IP address twice.

Lab 65. VLSM 3

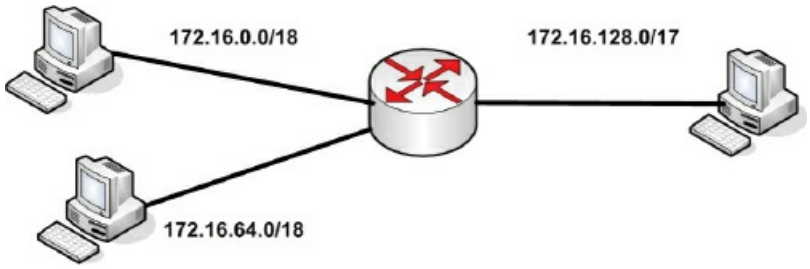
Lab Objective:
Apply VLSM to an existing network.

Lab Purpose:
Learn how to create subnets using VLSM.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Your boss who gave you the VLSM 1 and 2 challenge hands you another one. This time the 172.16.0.0/18 network is being split. Four more subnets are required in total, and they mustn't interfere with subnets 172.16.64.0 and 172.16.128.0, which must stay unchanged.



If you use your design knowledge, you will see that applying /19 produces subnet increments of 32:

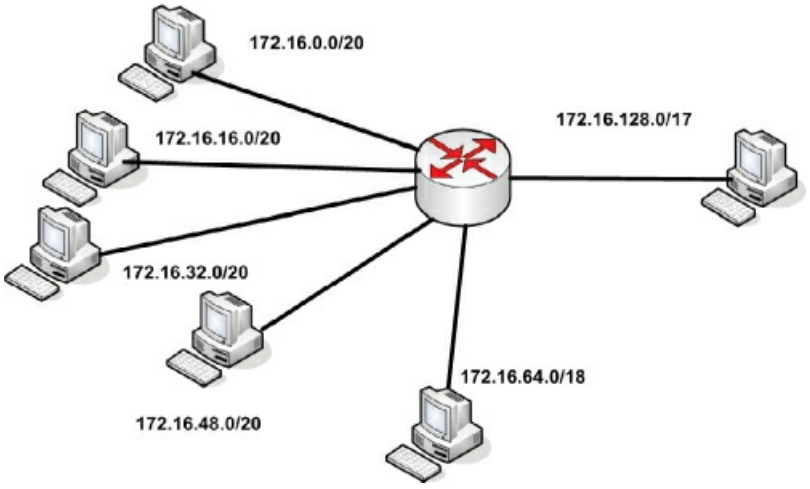
172.16.0.0
172.16.32.0
172.16.64.0 – in use already

That won't work because we can only use 0.0 and 32.0 and we need four. Stealing another bit gives us an increment of 16 (please do write out the Subnetting Cheat Chart to confirm this yourself). If we apply /20, our increment is 16, and so we generate the following subnets:

172.16.0.0
172.16.16.0

172.16.32.0
172.16.48.0
172.16.64.0 – in use and everything after it as well

This works. We can use all the available subnets up to and including 48 because they are not in use. Everything after is in use.



Notes:
Every VLAN and router interface needs to be in its own subnet. Check your theory guide for more information.

Please refer back to the subnetting and design labs to see how ticking the boxes will also help you solve these issues. This is a sort of inverse way of designing networks, whereby you work out the requirements and then carve smaller and smaller subnets from a network.

Also, bear in mind that there are other ways you can answer this question by choosing different subnets.

Lab 66. VLSM 4

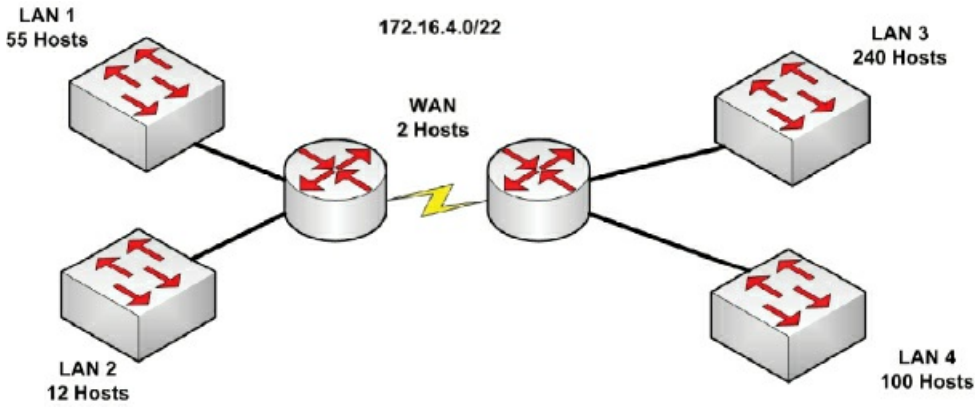
Lab Objective:
Apply VLSM to an existing network.

Lab Purpose:
Learn how to create subnets using VLSM.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Your boss hands you a network design and asks you to work out an addressing scheme from 172.16.4.0/22 which has been allocated by HQ as part of an internal addressing scheme. You must conserve as many addresses as possible in case of future expansion.



You can see that we have five subnets required (if you include the WAN link):

LAN 1 – 55 hosts
LAN 2 – 12 hosts
LAN 3 – 240 hosts
LAN 4 – 100 hosts
WAN – 2 hosts

172.16.4.0/22 is one subnet giving us 1022 host addresses.

If you go back to our design examples, you will see that our subnet is one of many which have already been allocated to the company. A /22 mask applied to 172.16.0.0 creates:

172.16.0.0
172.16.4.0
172.16.8.0 and so on

We can use the range available under our subnet, which is:

172.16.4.0 – 172.16.7.255

If you start out by ticking how many host bits we need for the largest network, we see it's 240. Tick down eight places, which generates 254 available hosts. The /22 mask won't work, but if we apply a /24 subnet mask, we will have created some subnets and have enough host bits. Our subnets now go up in increments of 1 (tick across eight bits on the subnet increments to see a value of 1).

Subnet 1 – 172.16.4.0 (254 hosts)
Subnet 2 – 172.16.5.0 (254 hosts)
Subnet 3 – 172.16.6.0 (254 hosts)
Subnet 4 – 172.16.7.0 (254 hosts)

We can't use subnet 172.16.8.0 because it is allocated elsewhere. We will allocate subnet 1 to LAN 3, which requires 240 hosts.

LAN 4 is our next largest subnet and requires 100 hosts. Take subnet 2 and apply a /25 mask to generate two smaller subnets each with 126 usable hosts. Remember that we have used the /25 mask previously and it does this:

Subnet 1 – 172.16.5.0 (126 hosts)
Subnet 2 – 172.16.5.128 (126 hosts)

We assign subnet 1 to LAN 4.

If we borrow one more bit and apply it to our 172.16.5.128 subnet, we get 62 hosts-per-subnet. Our mask is 172.16.5.128/26 and the subnets will be:

172.16.5.0 (in use now)
172.16.5.64 (in use now)
Subnet 1 – 172.16.5.128 (62 hosts)
Subnet 2 – 172.16.5.192 (62 hosts)
172.16.6.0 (not used at the moment)

We will assign subnet 1 to LAN 1. We still need 12 hosts for our last LAN. We need four bits, which generate 14 hosts-per-subnet. We start with 172.16.5.192 and apply the /28 mask to it, giving us:

Subnet 1 – 172.16.5.192 (14 hosts)

Subnet 2 – 172.16.5.208 (14 hosts)
Subnet 3 – 172.16.5.224 (14 hosts)
Subnet 4 – 172.16.5.240 (14 hosts)

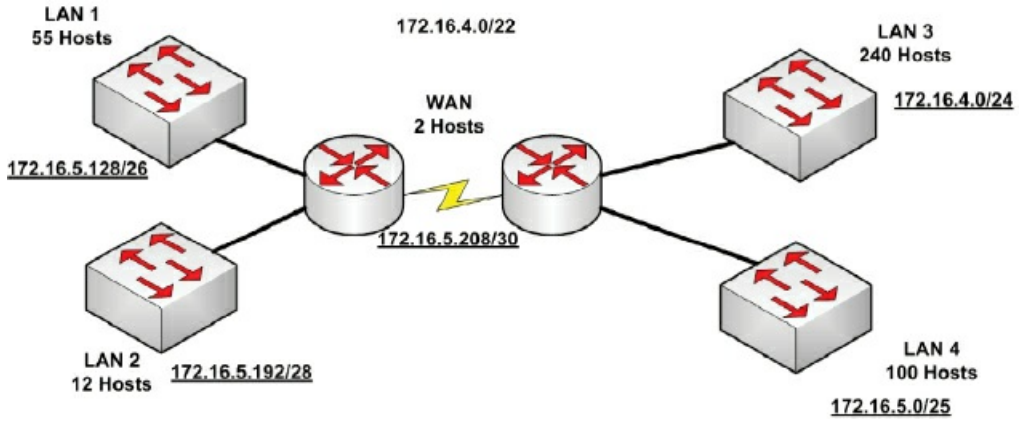
We will allocate subnet 1 to LAN 2.

Now we can apply an addressing scheme to our WAN link, which requires only two addresses. Take the 172.16.5.208 subnet and apply a /30 mask, which we know generates two host addresses.

Subnet 1 – 172.16.5.208 (2 hosts)
Subnet 2 – 172.16.5.212 (2 hosts)
Subnet 3 – 172.16.5.216 (2 hosts)
Subnet 4 – 172.16.5.220 (2 hosts)

Allocate subnet 1 to the WAN link.

By doing this, we have carved up a very efficient network design and left a number of subnets available should we need to add more LAN or WAN links.



Notes:
This is a hard example using all of the principles we have covered previously. I suggest you come back to it later and when you do, use the Subnetting Cheat Chart and work out all the available subnets/hosts-per-subnet. When you do this, you will see why I stopped where I did.

This is advanced stuff, so please take your time.

IPv6 Subnetting

Lab 67. Subnetting IPv6

Lab Objective:
Work out your IPv6 subnets.

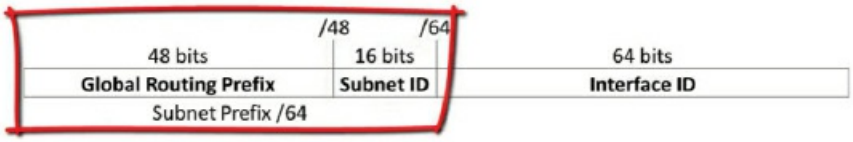
Lab Purpose:
Learn how to create subnets using IPv6 addressing.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Important Note—I've stated elsewhere that this isn't a study guide; it's a lab guide, so I presume you are here to apply any theory you have read.

The IPv6 address is usually made up of the below components:



Your boss hands you an IPv6 network assignment allocated by your ISP. He asks you to allocate the first 16 subnets. The assigned address is 2001:db8:1234::/48.

You would usually allocate a /64 CIDR to this network and use hex to count up your subnets. By doing so you can create 65,536 /64 networks, each having 2^{64} (18,446,744,073,709,551,616) addresses.

If you can count up (in hex), then you can create your IPv6 subnets. Your network portion is fixed, so it's on the subnet ID portion you will count up.

2001:db8:1234:0::/64 – Subnet 1
2001:db8:1234:1::/64 – Subnet 2
2001:db8:1234:2::/64 – Subnet 3
2001:db8:1234:3::/64 – Subnet 4
2001:db8:1234:4::/64 – Subnet 5
2001:db8:1234:5::/64 – Subnet 6
2001:db8:1234:6::/64 – Subnet 7
2001:db8:1234:7::/64 – Subnet 8
2001:db8:1234:8::/64 – Subnet 9
2001:db8:1234:9::/64 – Subnet 10
2001:db8:1234:A::/64 – Subnet 11
2001:db8:1234:B::/64 – Subnet 12
2001:db8:1234:C::/64 – Subnet 13
2001:db8:1234:D::/64 – Subnet 14
2001:db8:1234:E::/64 – Subnet 15
2001:db8:1234:F::/64 – Subnet 16

Notes:
In many ways, knowing IPv4 well is a disadvantage when it comes to IPv6 because there are no similarities. Not only that, using IPv6 requires a different mindset. You can steal host bits to subnet further than the standard allocation, but with an almost infinite number of available addresses there is no need. In fact the creators specifically discourage it, so feel free to waste millions of IPv6 addresses on your point-to-point links!

IPv6 has no broadcast traffic for us to separate via VLANs or routers; there are no shortage issues either. Using /64 allows you to take advantage of IPv6 auto address allocation features also. If you fail to use this prefix, you will break many of the plug-and-play features of IPv6.

Lab 68. Subnetting IPv6 2

Lab Objective:
Work out your IPv6 subnets.

Lab Purpose:
Learn how to create subnets using IPv6 addressing.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Walkthrough:
Your boss hands you an IPv6 network assignment allocated by your HQ network admin. He asks you to use this and the next 16 subnets. The assigned address is 2001:db8:1234:19:/64.

If you can count up (in hex), then you can create your IPv6 subnets. Your network portion is fixed, so it's on the subnet ID portion you will count up.

2001:db8:1234:19::/64 – Subnet 1
2001:db8:1234:1A::/64 – Subnet 2
2001:db8:1234:1B::/64 – Subnet 3
2001:db8:1234:1C::/64 – Subnet 4
2001:db8:1234:1D::/64 – Subnet 5
2001:db8:1234:1E::/64 – Subnet 6
2001:db8:1234:1F::/64 – Subnet 7
2001:db8:1234:20::/64 – Subnet 8
2001:db8:1234:21::/64 – Subnet 9
2001:db8:1234:22::/64 – Subnet 10
2001:db8:1234:23::/64 – Subnet 11
2001:db8:1234:24::/64 – Subnet 12
2001:db8:1234:25::/64 – Subnet 13
2001:db8:1234:26::/64 – Subnet 14
2001:db8:1234:27::/64 – Subnet 15
2001:db8:1234:28::/64 – Subnet 16

Notes:
19 in hex is actually 25 in decimal: 1 in the 16 column plus 9 in the 1 column. Please refer to your study guide.

Practice Questions 1

Lab 69. Practice 1

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Which subnet is host 200.99.30.117/27 in?

No more clues. Please do a couple of things for every challenge up to the end. Write out the Subnetting Cheat Chart and then apply your knowledge by ticking across/down to get the correct answer. Please don't cheat by peeking at the answer.

If you get it wrong, don't kick yourself. I still make mistakes myself and I'm supposed to be the expert!

Answer:
200.99.30.96

Lab 70. Practice 2

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Which subnet is host 10.9.10.17/17 in?

Answer:
10.9.0.0

Lab 71. Practice 3

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Which subnet is host 100.99.30.1/18 in?

Answer:
100.99.0.0

Lab 72. Practice 4

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Which subnet is host 100.99.121.1/18 in?

Answer:
100.99.64.0

Lab 73. Practice 5

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Which subnet is host 192.100.0.222/27 in?

Answer:
192.100.0.192

Lab 74. Practice 6

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Which subnet is host 192.200.2.111/28 in?

Answer:
192.200.2.96 (it’s the broadcast address)

Lab 75. Practice 7

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Which subnet is host 192.200.2.110/29 in?

Answer:
192.200.2.104

Lab 76. Practice 8

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Which subnet is host 172.20.141.1/17 in?

Answer:
172.20.128.0

Lab 77. Practice 9

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the broadcast address for the subnet that host 172.20.141.1/18 is in?

Answer:
172.20.191.255

Lab 78. Practice 10

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the broadcast address for the subnet that host 182.20.11.11/19 is in?

Answer:
182.20.31.255

Lab 79. Practice 11

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the last host address for the subnet that host 130.100.0.147/20 is in?

Answer:
130.100.15.254

Lab 80. Practice 12

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the usable host range for subnet 200.10.2.0/29?

Answer:
200.10.2.1 – 200.10.2.6

Lab 81. Practice 13

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the usable host range for subnet 10.16.0.0/12?

Answer:
10.16.0.1 – 10.31.255.254

Lab 82. Practice 14

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the usable host range for subnet 172.10.128.0/17?

Answer:
172.10.128.1 – 172.10.255.254

Lab 83. Practice 15

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the usable host range for subnet 172.10.128.0/23?

Answer:
172.10.128.1 – 172.10.129.254

Lab 84. Practice 16

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the usable host range for subnet 192.10.128.0/29?

Answer:
192.10.128.1 – 192.10.128.6

Lab 85. Practice 17

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
What is the usable host range for subnet 192.10.128.160/27?

Answer:
192.10.128.161 – 192.10.128.190

Practice Questions 2

Lab 86. Practice 18

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
How many subnets and hosts-per-subnet are generated from 192.10.128.0/27?

Answer:
8 subnets / 30 hosts-per-subnet

Lab 87. Practice 19

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
How many subnets and hosts-per-subnet are generated from 192.200.12.0/28?

Answer:
16 subnets / 14 hosts-per-subnet

Lab 88. Practice 20

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
How many subnets and hosts-per-subnet are generated from 202.200.1.0/29?

Answer:
32 subnets / 6 hosts-per-subnet

Lab 89. Practice 21

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
How many subnets and hosts-per-subnet are generated from 10.0.0.0/17?

Answer:
512 subnets / 32,766 hosts-per-subnet

Lab 90. Practice 22

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
How many subnets and hosts-per-subnet are generated from 10.0.0.0/19?

Answer:
2048 subnets / 8190 hosts-per-subnet

Lab 91. Practice 23

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
How many subnets and hosts-per-subnet are generated from 172.10.0.0/20?

Answer:
16 subnets / 4094 hosts-per-subnet

Lab 92. Practice 24

Lab Objective:
Learn how to answer a hard subnetting problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
How many subnets and hosts-per-subnet are generated from 192.168.1.0/30?

Answer:
64 subnets / 2 hosts-per-subnet

Lab 93. Practice 25

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 192.168.1.0 to 192.168.10.0 /24.

Answer:
192.168.0.0/20

Lab 94. Practice 26

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 192.168.16.0 to 192.168.20.0/24.

Answer:
192.168.16.0/21

Lab 95. Practice 27

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 10.0.0.0 to 10.10.0.0/24.

Answer:
10.0.0.0/12

Lab 96. Practice 28

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 172.16.0.0 to 172.20.0.0/24.

Answer:
172.16.0.0/13

Lab 97. Practice 29

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 200.10.10.0 to 200.10.20.0/24.

Answer:
200.10.0.0/19

Lab 98. Practice 30

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 171.199.0.0 to 171.199.5.0/24.

Answer:
171.199.0.0/21

Lab 99. Practice 31

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 200.110.128.0 to 200.110.130.0/24.

Answer:
200.110.128.0/22

Lab 100. Practice 32

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 177.107.212.0 to 177.107.215.0/24.

Answer:
177.107.212.0/22

Lab 101. Practice 33

Lab Objective:
Learn how to answer a hard route summarization problem.

Lab Purpose:
Put your knowledge into practice.

Lab Tool:
Pen and paper.

Lab Topology:
NA

Lab Question:
Write the summary route for networks 192.168.10.96 to 192.168.10.100/30.

Answer:
192.168.10.96/29