

IP Addressing and Subnetting

Workbook
Version 2.0

11111110

10010101

00011011

11010011

10000110

Student Name:

IP Address Classes

Class A	1 – 127	(Network 127 is reserved for loopback and internal testing)	Leading bit pattern	0	00000000.00000000.00000000.00000000 Network . Host . Host . Host
Class B	128 – 191	Leading bit pattern	10	10000000.00000000.00000000.00000000 Network . Network . Host . Host	
Class C	192 – 223	Leading bit pattern	110	11000000.00000000.00000000.00000000 Network . Network . Network . Host	
Class D	224 – 239	(Reserved for multicast)			
Class E	240 – 255	(Reserved for experimental, used for research)			

Private Address Space

Class A	10.0.0.0 to 10.255.255.255
Class B	172.16.0.0 to 172.31.255.255
Class C	192.168.0.0 to 192.168.255.255

Default Subnet Masks

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

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Workbooks included in the series:

IP Addressing and Subnetting Workbooks
ACLs - Access Lists Workbooks
VLSM Variable-Length Subnet Mask Workbooks

Binary To Decimal Conversion

128	64	32	16	8	4	2	1	Answers	Scratch Area
1	0	0	1	0	0	1	0	<u>146</u>	<u>128</u> <u>16</u> <u>32</u> <u>2</u> <u>146</u> <u>4</u> <u>2</u> <u>1</u>
0	1	1	1	0	1	1	1	<u>119</u>	<u>64</u> <u>16</u> <u>16</u> <u>4</u>
1	1	1	1	1	1	1	1	_____	<u>2</u>
1	1	0	0	0	1	0	1	_____	<u>1</u>
1	1	1	1	0	1	1	0	_____	
0	0	0	1	0	0	1	1	_____	
1	0	0	0	0	0	0	1	_____	
0	0	1	1	0	0	0	1	_____	
0	1	1	1	1	0	0	0	_____	
1	1	1	1	0	0	0	0	_____	
0	0	1	1	1	0	1	1	_____	
0	0	0	0	0	1	1	1	_____	
								00011011	_____
								10101010	_____
								01101111	_____
								11111000	_____
								00100000	_____
								01010101	_____
								00111110	_____
								00000011	_____
								11101101	_____
								11000000	_____

Decimal To Binary Conversion

Use all 8 bits for each problem

128	64	32	16	8	4	2	1	= 255	Scratch Area
/	/	/	0	1	/	/	0	238	$\begin{array}{r} 238 \\ -128 \\ \hline 110 \\ -64 \\ \hline 46 \\ -32 \\ \hline 14 \\ -8 \\ \hline 6 \\ -4 \\ \hline 2 \\ -2 \\ \hline 0 \end{array}$
0	0	1	0	0	0	/	0	34	$\begin{array}{r} 34 \\ -32 \\ \hline 2 \end{array}$
								123	$\begin{array}{r} 123 \\ -32 \\ \hline 91 \\ -64 \\ \hline 27 \\ -24 \\ \hline 3 \\ -2 \\ \hline 1 \end{array}$
								50	$\begin{array}{r} 50 \\ -48 \\ \hline 2 \end{array}$
								255	$\begin{array}{r} 255 \\ -252 \\ \hline 3 \end{array}$
								200	$\begin{array}{r} 200 \\ -192 \\ \hline 8 \\ -8 \\ \hline 0 \end{array}$
								10	$\begin{array}{r} 10 \\ -8 \\ \hline 2 \\ -2 \\ \hline 0 \end{array}$
								138	
								1	
								13	
								250	
								107	
								224	
								114	
								192	
								172	
								100	
								119	
								57	
								98	
								179	
								2	

Address Class Identification

Address	Class
10.250.1.1	<u>A</u>
150.10.15.0	<u>B</u>
192.14.2.0	-----
148.17.9.1	-----
193.42.1.1	-----
126.8.156.0	-----
220.200.23.1	-----
230.230.45.58	-----
177.100.18.4	-----
119.18.45.0	-----
249.240.80.78	-----
199.155.77.56	-----
117.89.56.45	-----
215.45.45.0	-----
199.200.15.0	-----
95.0.21.90	-----
33.0.0.0	-----
158.98.80.0	-----
219.21.56.0	-----

Network & Host Identification

Circle the network portion
of these addresses:

177.100.18.4

119.18.45.0

209.240.80.78

199.155.77.56

117.89.56.45

215.45.45.0

192.200.15.0

95.0.21.90

33.0.0.0

158.98.80.0

217.21.56.0

10.250.1.1

150.10.15.0

192.14.2.0

148.17.9.1

193.42.1.1

126.8.156.0

220.200.23.1

Circle the host portion of
these addresses:

10.15.123.50

171.2.199.31

198.125.87.177

223.250.200.222

17.45.222.45

126.201.54.231

191.41.35.112

155.25.169.227

192.15.155.2

123.102.45.254

148.17.9.155

100.25.1.1

195.0.21.98

25.250.135.46

171.102.77.77

55.250.5.5

218.155.230.14

10.250.1.1

Network Addresses

Using the IP address and subnet mask shown write out the network address:

188.10.18.2
255.255.0.0

188 . 10 . 0 . 0

10.10.48.80
255.255.255.0

10 . 10 . 48 . 0

192.149.24.191
255.255.255.0

150.203.23.19
255.255.0.0

10.10.10.10
255.0.0.0

186.13.23.110
255.255.255.0

223.69.230.250
255.255.0.0

200.120.135.15
255.255.255.0

27.125.200.151
255.0.0.0

199.20.150.35
255.255.255.0

191.55.165.135
255.255.255.0

28.212.250.254
255.255.0.0

Host Addresses

Using the IP address and subnet mask shown write out the host address:

188.10.18.2
255.255.0.0

0 . 0 . 18 . 2

10.10.48.80
255.255.255.0

0 . 0 . 0 . 80

222.49.49.11
255.255.255.0

128.23.230.19
255.255.0.0

10.10.10.10
255.0.0.0

200.113.123.11
255.255.255.0

223.169.23.20
255.255.0.0

203.20.35.215
255.255.255.0

117.15.2.51
255.0.0.0

199.120.15.135
255.255.255.0

191.55.165.135
255.255.255.0

48.21.25.54
255.255.0.0

Default Subnet Masks

Write the correct default subnet mask for each of the following addresses:

177.100.18.4	<u>255 . 255 . 0 . 0</u>
119.18.45.0	<u>255 . 0 . 0 . 0</u>
191.249.234.191	<u>255.255.0.0</u>
223.23.223.109	<u>255.255.255.0</u>
10.10.250.1	<u>255.0.0.0</u>
126.123.23.1	<u>255.0.0.0</u>
223.69.230.250	<u>255.255.255.0</u>
192.12.35.105	<u>255.255.255.0</u>
77.251.200.51	<u>255.0.0.0</u>
189.210.50.1	<u>255.255.0.0</u>
88.45.65.35	<u>255.0.0.0</u>
128.212.250.254	<u>255.255.0.0</u>
193.100.77.83	<u>255.255.255.0</u>
125.125.250.1	<u>255.0.0.0</u>
1.1.10.50	<u>255.0.0.0</u>
220.90.130.45	<u>255.255.255.0</u>
134.125.34.9	<u>255.255.0.0</u>
95.250.91.99	<u>255.0.0.0</u>

ANDING With Default subnet masks

Every IP address must be accompanied by a subnet mask. By now you should be able to look at an IP address and tell what class it is. Unfortunately your computer doesn't think that way. For your computer to determine the network and subnet portion of an IP address it must "AND" the IP address with the subnet mask.

Default Subnet Masks:

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

ANDING Equations:

$$\begin{aligned}1 \text{ AND } 1 &= 1 \\1 \text{ AND } 0 &= 0 \\0 \text{ AND } 1 &= 0 \\0 \text{ AND } 0 &= 0\end{aligned}$$

Sample:

What you see...

IP Address: 192 . 100 . 10 . 33

What you can figure out in your head...

Address Class: C
Network Portion: 192 . 100 . 10 . 33
Host Portion: 192 . 100 . 10 . 33

In order for your computer to get the same information it must AND the IP address with the subnet mask in binary.

	Network	Host	
IP Address:	1 1 0 0 0 0 0 0 . 0 1 1 0 0 1 0 0 . 0 0 0 0 1 0 1 0 .	0 0 1 0 0 0 0 1	(192 . 100 . 10 . 33)
Default Subnet Mask:	1 1 1 1 1 1 1 1 . 0 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 .	0 0 0 0 0 0 0 0	(255 . 255 . 255 . 0)
AND:	1 1 0 0 0 0 0 0 . 0 1 1 0 0 1 0 0 . 0 0 0 0 1 0 1 0 .	0 0 0 0 0 0 0 0	(192 . 100 . 10 . 0)

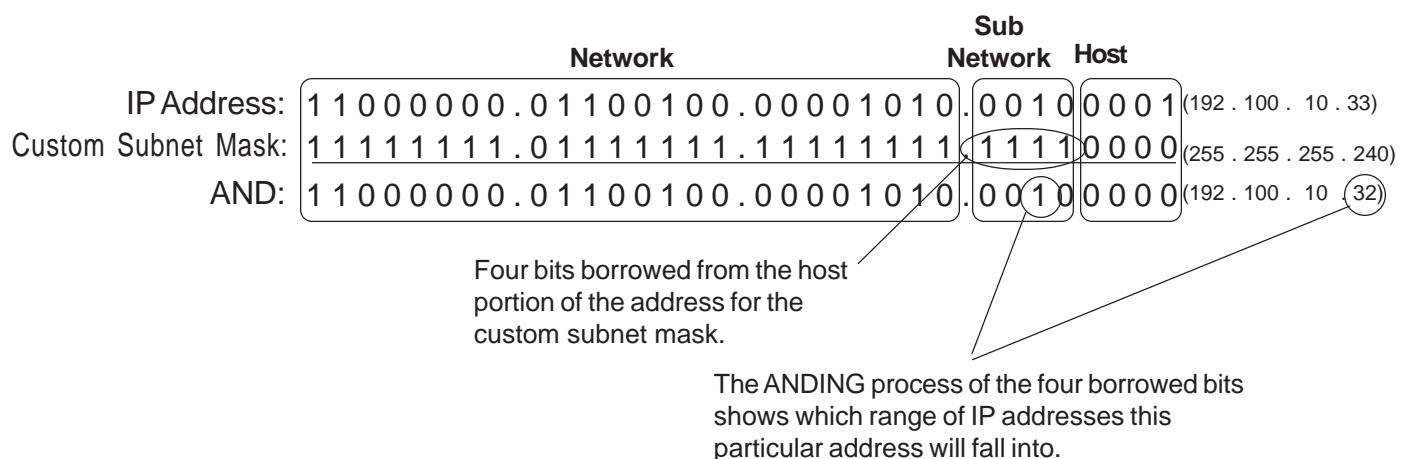
ANDING with the default subnet mask allows your computer to figure out the network portion of the address.

ANDING With Custom subnet masks

When you take a single network such as 192.100.10.0 and divide it into five smaller networks (192.100.10.16, 192.100.10.32, 192.100.10.48, 192.100.10.64, 192.100.10.80) the outside world still sees the network as 192.100.10.0, but the internal computers and routers see five smaller subnetworks. Each independent of the other. This can only be accomplished by using a custom subnet mask. A custom subnet mask borrows bits from the host portion of the address to create a subnetwork address between the network and host portions of an IP address. In this example each range has 14 usable addresses in it. The computer must still AND the IP address against the custom subnet mask to see what the network portion is and which subnetwork it belongs to.

IP Address: 192 . 100 . 10 . 0
Custom Subnet Mask: 255.255.255.240

Address Ranges: 192.10.10.0 to 192.100.10.15
192.100.10.16 to 192.100.10.31
192.100.10.32 to 192.100.10.47 (Range in the sample below)
192.100.10.48 to 192.100.10.63
192.100.10.64 to 192.100.10.79
192.100.10.80 to 192.100.10.95
192.100.10.96 to 192.100.10.111
192.100.10.112 to 192.100.10.127
192.100.10.128 to 192.100.10.143
192.100.10.144 to 192.100.10.159
192.100.10.160 to 192.100.10.175
192.100.10.176 to 192.100.10.191
192.100.10.192 to 192.100.10.207
192.100.10.208 to 192.100.10.223
192.100.10.224 to 192.100.10.239
192.100.10.240 to 192.100.10.255



In the next set of problems you will determine the necessary information to determine the correct subnet mask for a variety of IP addresses.

How to determine the number of subnets and the number of hosts per subnet

Two formulas can provide this basic information:

$$\text{Number of subnets} = 2^s \quad (\text{Second subnet formula: Number of subnets} = 2^s - 2)$$

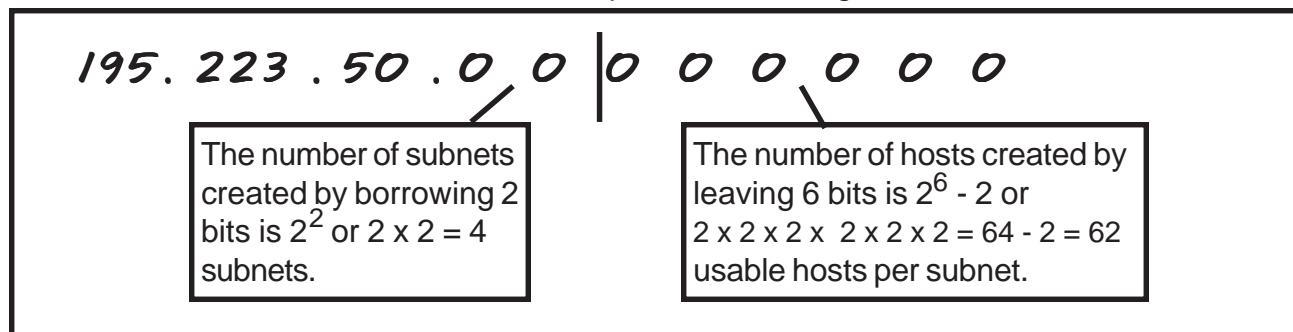
$$\text{Number of hosts per subnet} = 2^h - 2$$

Both formulas calculate the number of hosts or subnets based on the number of binary bits used. For example if you borrow three bits from the host portion of the address use the *number of subnets* formula to determine the total number of subnets gained by borrowing the three bits. This would be 2^3 or $2 \times 2 \times 2 = 8$ subnets

To determine the number of hosts per subnet you would take the number of binary bits used in the host portion and apply this to the *number of hosts per subnet* formula If five bits are in the host portion of the address this would be 2^5 or $2 \times 2 \times 2 \times 2 \times 2 = 32$ hosts.

When dealing with the *number of hosts per subnet* you have to subtract two addresses from the range. The first address in every range is the subnet number. The last address in every range is the broadcast address. These two addresses cannot be assigned to any device in the network which is why you have to subtract two addresses to find the number of usable addresses in each range.

For example if two bits are borrowed for the network portion of the address you can easily determine the number of subnets and hosts per subnets using the two formulas.



What about that second subnet formula:

$$\text{Number of subnets} = 2^s - 2$$

In some instances the first and last subnet range of addresses are reserved. This is similar to the first and last host addresses in each range of addresses.

The first range of addresses is the **zero subnet**. The subnet number for the zero subnet is also the subnet number for the classful subnet address.

The last range of addresses is the **broadcast subnet**. The broadcast address for the last subnet in the broadcast subnet is the same as the classful broadcast address.

Class C Address unsubnetted:

195. 223 . 50 . 0

195.223.50.0 to 195.223.50.255

Class C Address subnetted (2 bits borrowed):

195. 223 . 50 . 0 0 | 0 0 0 0 0 0
(Invalid range) (0) 195.223.50.0 to 195.223.50.63
(1) 195.223.50.64 to 195.223.50.127
(2) 195.223.50.128 to 195.223.50.191
(Invalid range) (3) 195.223.50.192 to 195.223.50.255

Notice that the subnet and broadcast addresses match.

The primary reason the zero and broadcast subnets were not used had to do primarily with the broadcast addresses. If you send a broadcast to 195.223.255 are you sending it to all 255 addresses in the classful C address or just the 62 usable addresses in the broadcast range?

The **CCNA** and **CCENT** certification exams may have questions which will require you to determine which formula to use, and whether or not you can use the first and last subnets. Use the chart below to help decide.

When to use which formula to determine the number of subnets	
Use the $2^s - 2$ formula and <u>don't use</u> the zero and broadcast ranges if...	Use the 2^s formula and <u>use</u> the zero and broadcast ranges if...
Classful routing is used	Classless routing or VLSM is used
RIP version 1 is used	RIP version 2, EIGRP, or OSPF is used
The no ip subnet zero command is configured on your router	The ip subnet zero command is configured on your router (default setting)
	No other clues are given

Bottom line for the CCNA exams; if a question does not give you any clues as to whether or not to allow these two subnets, assume you can use them.

This workbook has you use the number of subnets = 2^s formula.

Custom Subnet Masks

Problem 1

Number of needed subnets **14**

Number of needed usable hosts **14**

Network Address **192.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

Show your work for Problem 1 in the space below.

Number of Subnets	256	128	64	32	16	8	4	2	-	Number of Hosts
-	2	4	8	16	32	64	128	256		
	128	64	32	16	8	4	2	1	-	Binary values
192 . 10 . 10 . 0	0									

$$\begin{array}{r} 128 \\ 64 \\ 32 \\ +16 \\ \hline 240 \end{array}$$

Add the binary value numbers to the left of the line to create the custom subnet mask.

$$\begin{array}{r} 16 \\ -2 \\ \hline 14 \end{array}$$

Observe the total number of hosts.
Subtract 2 for the number of usable hosts.

Custom Subnet Masks

Problem 2

Number of needed subnets **1000**

Number of needed usable hosts **60**

Network Address **165.100.0.0**

Address class _____ B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets _____ 1,024

Total number of host addresses _____ 64

Number of usable addresses _____ 62

Number of bits borrowed _____ 10

Show your work for Problem 2 in the space below.

Custom Subnet Masks

Problem 3

Network Address **148.75.0.0 /26**

/26 indicates the total number of bits used for the network and subnetwork portion of the address. All bits remaining belong to the host portion of the address.

Address class _____ B

Default subnet mask 255.255.0.0

Custom subnet mask 255.255.255.192

Total number of subnets _____

Total number of host addresses 64

Number of usable addresses _____ 62

Number of bits borrowed _____ **10**

Show your work for Problem 3 in the space below.

Custom Subnet Masks

Problem 4

Number of needed subnets **6**

Number of needed usable hosts **30**

Network Address **195.85.8.0**

Address class **C**

Default subnet mask **255.255.255.0**

Custom subnet mask **255.255.255.224**

Total number of subnets **8**

Total number of host addresses **32**

Number of usable addresses **30**

Number of bits borrowed **3**

Show your work for Problem 5 in the space below.

Number of Subnets	256	128	64	32 16 8 4 2 -	Number of Hosts	
	-	2	4			
	128	64	32			
195 . 85 . 8 . 0	0	0	0	0	0	0

Binary values

Custom Subnet Masks

Problem 5

Number of needed subnets **6**

Number of needed usable hosts **30**

Network Address **210.100.56.0**

Address class **C** _____

Default subnet mask **255.255.255.0** _____

Custom subnet mask **255.255.255.224** _____

Total number of subnets **8** _____

Total number of host addresses **32** _____

Number of usable addresses **30** _____

Number of bits borrowed **3** _____

Show your work for Problem 4 in the space below.

Number of Subnets	256	128	64	Number of Hosts					
	-	2	4	8	16	32	64	128	256
	128	64	32	16	8	4	2	1	- Binary values
210 . 100 . 56 . 0 0 0				0 0 0 0 0					

Custom Subnet Masks

Problem 6

Number of needed subnets **126**

Number of needed usable hosts **131,070**

Network Address **118.0.0**

Address class A _____

Default subnet mask 255.0.0.0

Custom subnet mask 255.254.0.0

Total number of subnets 128

Total number of host addresses 131,072

Number of usable addresses 131,070

Number of bits borrowed 7

Show your work for Problem 6 in the space below.

Custom Subnet Masks

Problem 7

Number of needed subnets **2000**

Number of needed usable hosts **15**

Network Address **178.100.0.0**

Address class **B**

Default subnet mask **255.255.0.0**

Custom subnet mask **255.255.255.224**

Total number of subnets **2048**

Total number of host addresses **32**

Number of usable addresses **30**

Number of bits borrowed **11**

Show your work for **Problem 7** in the space below.

Number of Hosts	-	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2	1
Number of Subnets	-	2	4	8	16	32	64	128	256.	512	1024	2048	4096	8192	16384	32768	65536	1
Binary values	-	128	64	32	16	8	4	2	1.	128	64	32	16	8	4	2	1	
178	.	100	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Custom Subnet Masks

Problem 8

Number of needed subnets **3**

Number of needed usable hosts **45**

Network Address **200.175.14.0**

Address class **C** _____

Default subnet mask **255.255.255.0** _____

Custom subnet mask **255.255.255.192** _____

Total number of subnets **4** _____

Total number of host addresses **64** _____

Number of usable addresses **62** _____

Number of bits borrowed **2** _____

Show your work for Problem 8 in the space below.

Custom Subnet Masks

Problem 9

Number of needed subnets **60**

Number of needed usable hosts **1,000**

Network Address **128.77.0.0**

Address class **B** _____

Default subnet mask **255.255.0.0** _____

Custom subnet mask **255.255.252.0** _____

Total number of subnets **64** _____

Total number of host addresses **1024** _____

Number of usable addresses **1022** _____

Number of bits borrowed **6** _____

Show your work for Problem 9 in the space below.

Custom Subnet Masks

Problem 10

Number of needed usable hosts **60**

Network Address **198.100.10.0**

Address class **C**

Default subnet mask **255.255.255.0**

Custom subnet mask **255.255.255.192**

Total number of subnets **4**

Total number of host addresses **64**

Number of usable addresses **62**

Number of bits borrowed **2**

Show your work for Problem 10 in the space below.

Custom Subnet Masks

Problem 11

Number of needed subnets **250**

Network Address **101.0.0.0**

Address class **A** _____

Default subnet mask **255.0.0.0** _____

Custom subnet mask **255.255.0.0** _____

Total number of subnets **256** _____

Total number of host addresses **65,536** _____

Number of usable addresses **65,534** _____

Number of bits borrowed **8** _____

Show your work for Problem 11 in the space below.

Custom Subnet Masks

Problem 12

Number of needed subnets **5**

Network Address **218.35.50.0**

Address class **C**

Default subnet mask **255.255.255.0**

Type text here Custom subnet mask **255.255.255.224**

Total number of subnets **8**

Total number of host addresses **32**

Number of usable addresses **30**

Number of bits borrowed **3**

Show your work for Problem 12 in the space below.

Custom Subnet Masks

Problem 13

Number of needed usable hosts **25**

Network Address **218.35.50.0**

Address class **C** _____

Default subnet mask **255.255.255.0** _____

Custom subnet mask **255.255.255.224** _____

Total number of subnets **8** _____

Total number of host addresses **32** _____

Number of usable addresses **30** _____

Number of bits borrowed **3** _____

Show your work for Problem 13 in the space below.

Custom Subnet Masks

Problem 14

Number of needed subnets **10**

Network Address **172.59.0.0**

Address class **B**

Default subnet mask **255.255.0.0**

Custom subnet mask **255.255.240.0**

Total number of subnets **16**

Total number of host addresses **4096**

Number of usable addresses **4094**

Number of bits borrowed **4**

Show your work for Problem 14 in the space below.

Custom Subnet Masks

Problem 15

Number of needed usable hosts **50**

Network Address **172.59.0.0**

Address class **B** _____

Default subnet mask **255.255.0.0** _____

Custom subnet mask **255.255.255.192** _____

Total number of subnets **1024** _____

Total number of host addresses **64** _____

Number of usable addresses **62** _____

Number of bits borrowed **10** _____

Show your work for Problem 15 in the space below.

Custom Subnet Masks

Problem 16

Number of needed usable hosts **29**

Network Address **23.0.0.0**

Address class **A** _____

Default subnet mask **255.0.0.0** _____

Custom subnet mask **255.255.255.224** _____

Total number of subnets **524,288** _____

Total number of host addresses **32** _____

Number of usable addresses **30** _____

Number of bits borrowed **19** _____

Show your work for Problem 16 in the space below.

Subnetting

Problem 1

Number of needed subnets **14**

Number of needed usable hosts **14**

Network Address **192.10.10.0**

Address class C

Default subnet mask 255.255.255.0

Custom subnet mask 255.255.255.240

Total number of subnets 16

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

What is the 4th
subnet range? 192.10.10.48 to 192.10.10.63

What is the subnet
number for the 8th subnet?
192.10.10.112

What is the subnet
broadcast address for
the 13th subnet?
192.10.10.207

What are the assignable
addresses for the 9th
subnet? 192.10.10.129 to 192.10.10.142

Show your work for Problem 1 in the space below.

Number of Subnets	256	128	64	32	16	8	4	2	-	Number of Hosts
	-	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	-	Binary values
192.10.10.0 0 0 0 0	0	0	0	0	0	0	0	0	0	

$ \begin{array}{r} 128 \\ 64 \\ 32 \\ +16 \\ \hline \text{Custom subnet mask} \quad 240 \end{array} $	$ \begin{array}{r} 16 \\ -2 \\ \hline 14 \end{array} \quad \text{Usable subnets} $	$ \begin{array}{r} 16 \\ -2 \\ \hline 14 \end{array} \quad \text{Usable hosts} $
----------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------

The binary value of the last bit borrowed is the range. In this problem the range is 16.

The first address in each subnet range is the subnet number.

The last address in each subnet range is the subnet broadcast address.

Subnetting

Problem 2

Number of needed subnets **1000**

Number of needed usable hosts **60**

Network Address **165.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 15th
subnet range? 165.100.3.128 to 165.100.3.191

What is the subnet
number for the 6th subnet? 165 . 100 . 1 . 64

What is the subnet
broadcast address for
the 6th subnet? 165 . 100 . 1 . 127

What are the assignable
addresses for the 9th
subnet? 165.100.2.1 to 165.100.0.62

Show your work for Problem 2 in the space below.

Subnetting

Problem 3

Number of needed subnets **2**

Network Address **195.223.50.0**

Hint: It is possible to borrow one bit to create two subnets.

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 2nd
subnet range? _____

What is the subnet number
for the 2nd subnet? _____

What is the subnet
broadcast address for
the 1st subnet? _____

What are the assignable
addresses for the 1st
subnet? _____

Show your work for Problem 3 in the space below.

Number of Subnets	256	128	64	32	16	8	4	2	-	Number of Hosts
	-	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	-	Binary values

195. 223 . 50 . 0 0 0 0 0 0 0 0 0

Subnetting

Problem 4

Number of needed subnets **750**

Network Address **190.35.0.0**

Address class **B**

Default subnet mask **255.255.0.0**

Custom subnet mask **255.255.255.192**

Total number of subnets **1024**

Total number of host addresses **64**

Number of usable addresses **62**

Number of bits borrowed **10**

What is the 15th
subnet range? **190.35.3.128 - 190.35.3.191**

What is the subnet number
for the 13th subnet? **190.35.3.0**

What is the subnet
broadcast address for
the 10th subnet? **190.35.2.127**

What are the assignable
addresses for the 6th
subnet? **190.35.1.65 - 190.35.1.126**

Show your work for **Problem 4** in the space below.

Subnetting

Problem 5

Number of needed usable hosts **6**

Network Address **126.0.0.0**

Address class **A**

Default subnet mask **255.0.0.0**

Custom subnet mask **255.255.255.248**

Total number of subnets **2,097,152**

Total number of host addresses **8**

Number of usable addresses **6**

Number of bits borrowed **21**

What is the 2nd
subnet range? **126.0.0.8 - 126.0.0.15**

What is the subnet number
for the 5th subnet? **126.0.0.32**

What is the subnet
broadcast address for
the 7th subnet? **126.0.0.55**

What are the assignable
addresses for the 10th
subnet? **126.0.0.73 - 126.0.0.78**

Show your work for Problem 5 in the space below.

Subnetting

Problem 6

Number of needed subnets **10**

Network Address **192.70.10.0**

Address class **C**

Default subnet mask **255.255.255.0**

Custom subnet mask **255.255.255.240**

Total number of subnets **16**

Total number of host addresses **16**

Number of usable addresses **14**

Number of bits borrowed **4**

What is the 9th
subnet range? **192.70.10.128 - 192.70.10.143**

What is the subnet number
for the 4th subnet? **192.70.10.48**

What is the subnet
broadcast address for
the 12th subnet? **192.70.10.191**

What are the assignable
addresses for the 10th
subnet? **192.70.10.145 - 192.70.10.158**

Show your work for Problem 6 in the space below.

Subnetting

Problem 7

Network Address **10.0.0.0 /16**

Address class A _____

Default subnet mask 255.0.0.0 _____

Custom subnet mask 255.255.0.0 _____

Total number of subnets 256 _____

Total number of host addresses 65,536 _____

Number of usable addresses 65,534 _____

Number of bits borrowed 8 _____

What is the 11th
subnet range? 10.10.0.0 - 10.10.255.255 _____

What is the subnet number
for the 6th subnet? 10.5.0.0 _____

What is the subnet
broadcast address for
the 2nd subnet? 10.1.255.255 _____

What are the assignable
addresses for the 9th
subnet? 10.8.0.1 - 10.8.255.254 _____

Show your work for Problem 7 in the space below.

Subnetting

Problem 8

Number of needed subnets **5**

Network Address **172.50.0.0**

Address class **B**

Default subnet mask **255.255.0.0**

Custom subnet mask **255.255.224.0**

Total number of subnets **8**

Total number of host addresses **8192**

Number of usable addresses **8190**

Number of bits borrowed **3**

What is the 4th
subnet range? **172.50.96.0 - 172.50.127.255**

What is the subnet number
for the 5th subnet? **172.50.128.0**

What is the subnet
broadcast address for
the 6th subnet? **172.50.191.255**

What are the assignable
addresses for the 3rd
subnet? **172.50.64.1 - 172.50.95.254**

Show your work for Problem 8 in the space below.

Subnetting

Problem 9

Number of needed usable hosts **28**

Network Address **172.50.0.0**

Address class **B**

Default subnet mask **255.255.0.0**

Custom subnet mask **255.255.255.224**

Total number of subnets **2048**

Total number of host addresses **32**

Number of usable addresses **30**

Number of bits borrowed **11**

What is the 2nd
subnet range? **172.50.0.32 - 172.50.0.63**

What is the subnet number
for the 10th subnet? **172.50.1.32**

What is the subnet broadcast
address for
the 4th subnet? **172.50.0.127**

What are the assignable
addresses for the 6th
subnet? **172.50.0.161 - 172.50.0.190**

Show your work for Problem 9 in the space below.

Subnetting

Problem 10

Number of needed subnets **45**

Network Address **220.100.100.0**

Address class **C**

Default subnet mask **255.255.255.0**

Custom subnet mask **255.255.255.252**

Total number of subnets **64**

Total number of host addresses **4**

Number of usable addresses **2**

Number of bits borrowed **6**

What is the 5th
subnet range? **220.100.100.16 - 220.100.100.19**

What is the subnet number
for the 4th subnet? **220.100.100.12**

What is the subnet
broadcast address for
the 13th subnet? **220.100.100.51**

What are the assignable
addresses for the 12th
subnet? **220.100.100.45 - 220.100.100.46**

Show your work for Problem 10 in the space below.

Subnetting

Problem 11

Number of needed usable hosts **8,000**

Network Address **135.70.0.0**

Address class **B**

Default subnet mask **255.255.0.0**

Custom subnet mask **255.255.224.0**

Total number of subnets **8**

Total number of host addresses **8192**

Number of usable addresses **8190**

Number of bits borrowed **3**

What is the 6th
subnet range? **135.70.160.0 - 135.70.191.255**

What is the subnet number
for the 7th subnet? **135.70.192.0**

What is the subnet
broadcast address for
the 3rd subnet? **135.70.95.255**

What are the assignable
addresses for the 5th
subnet? **135.70.128.1 - 135.70.159.254**

Show your work for Problem 11 in the space below.

Subnetting

Problem 12

Number of needed usable hosts **45**

Network Address **198.125.50.0**

Address class **C**

Default subnet mask **255.255.255.0**

Custom subnet mask **255.255.255.192**

Total number of subnets **4**

Total number of host addresses **64**

Number of usable addresses **62**

Number of bits borrowed **6**

What is the 2nd
subnet range? **198.125.50.64 - 198.125.50.127**

What is the subnet number
for the 2nd subnet? **198.125.50.64**

What is the subnet
broadcast address for
the 4th subnet? **198.125.50.255**

What are the assignable
addresses for the 3rd
subnet? **198.125.50.129 - 198.125.50.190**

Show your work for Problem 12 in the space below.

Subnetting

Problem 13

Network Address **165.200.0.0 /26**

Address class **B**

Default subnet mask **255.255.0.0**

Custom subnet mask **255.255.255.192**

Total number of subnets **1024**

Total number of host addresses **64**

Number of usable addresses **62**

Number of bits borrowed **10**

What is the 10th
subnet range? **165.200.2.64 - 165.200-2.127**

What is the subnet number
for the 11th subnet? **165.200.2.128**

What is the subnet
broadcast address for
the 1023rd subnet? **165.200.255.191**

What are the assignable
addresses for the 1022nd
subnet? **165.200.255.65 - 165.200.255.126**

Show your work for Problem 13 in the space below.

Subnetting

Problem 14

Number of needed usable hosts **16**

Network Address **200.10.10.0**

Address class **C**

Default subnet mask **255.255.255.0**

Custom subnet mask **255.255.255.224**

Total number of subnets **8**

Total number of host addresses **32**

Number of usable addresses **30**

Number of bits borrowed **3**

What is the 7th
subnet range? **200.10.10.192 - 200.10.10.223**

What is the subnet number
for the 5th subnet? **200.10.10.128**

What is the subnet
broadcast address for
the 4th subnet? **200.10.10.127**

What are the assignable
addresses for the 6th
subnet? **200.10.10.161 - 200.10.10.190**

Show your work for Problem 14 in the space below.

Subnetting

Problem 15

Network Address **93.0.0.0** \19

Address class **A** _____

Default subnet mask **255.0.0.0** _____

Custom subnet mask **255.255.224.0** _____

Total number of subnets **2048** _____

Total number of host addresses **8192** _____

Number of usable addresses **8190** _____

Number of bits borrowed **11** _____

What is the 15th
subnet range? **93.1.192.0 - 93.1.223.255** _____

What is the subnet number
for the 9th subnet? **93.1.0.0** _____

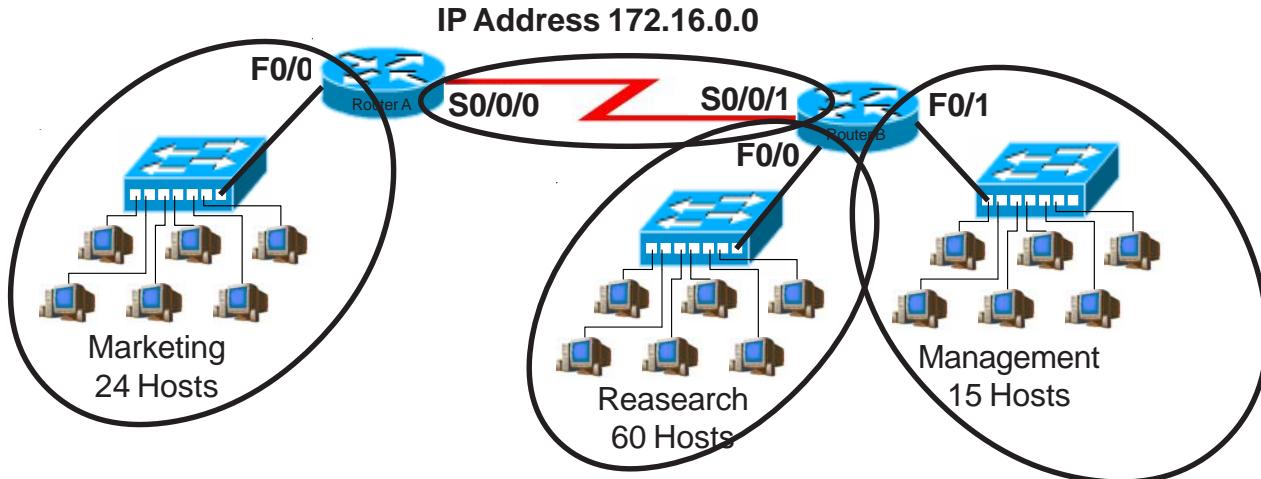
What is the subnet
broadcast address for
the 7th subnet? **93.0.223.255** _____

What are the assignable
addresses for the 12th
subnet? **93.1.96.1 - 93.1.127.254** _____

Show your work for Problem 15 in the space below.

Practical Subnetting 1

Based on the information in the graphic shown, design a network addressing scheme that will supply the minimum number of subnets, and allow enough extra subnets and hosts for 100% growth in both areas. Circle each subnet on the graphic and answer the questions below.



Address class _____

B

Custom subnet mask _____

255.255.224.0

Minimum number of subnets needed _____

4

Extra subnets required for 100% growth
(Round up to the next whole number) _____

+ 4

Total number of subnets needed _____

= 8

Number of host addresses
in the largest subnet group _____

60

Number of addresses needed for
100% growth in the largest subnet
(Round up to the next whole number) _____

+ 60

Total number of address
needed for the largest subnet _____

= 120

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Research _____

172.16.0.0 to 172.31.255

IP address range for Marketing _____

172.16.32.0 to 172.63.255

IP address range for Management _____

172.16.64.0 to 172.95.255

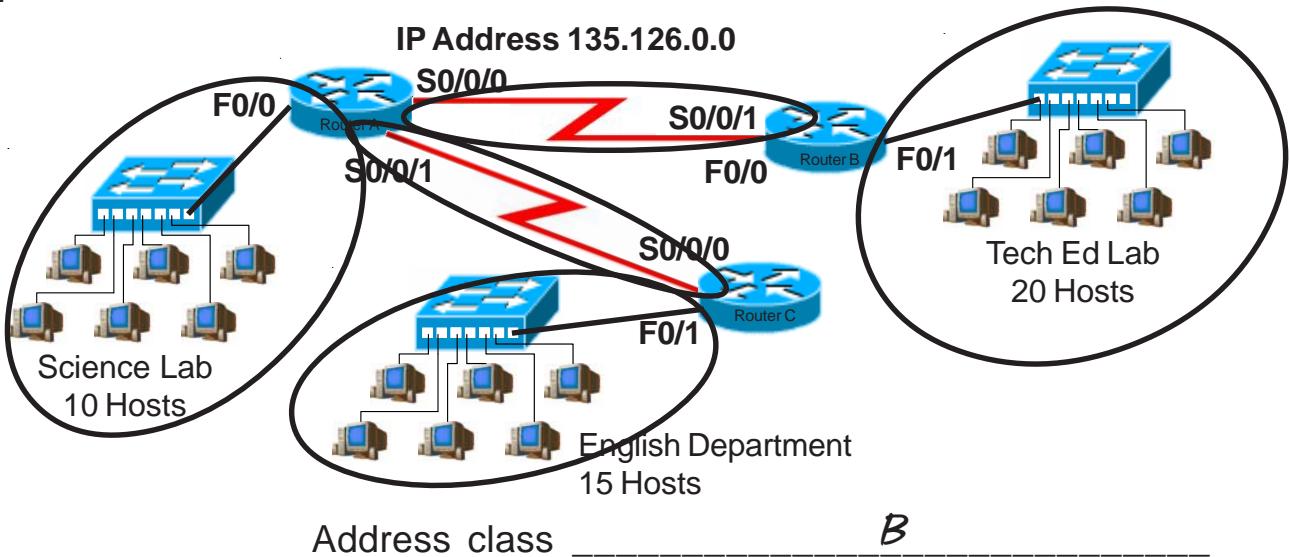
IP address range for Router A
to Router B serial connection _____

172.16.96.0 to 172.127.255

Show your work for Practical Subnetting 1 in the space below.

Practical Subnetting 2

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 30% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class B

Custom subnet mask 255.255.255.224

Minimum number of subnets needed 5

Extra subnets required for 30% growth + 2
(Round up to the next whole number)

Total number of subnets needed = 7

Number of host addresses in the largest subnet group 20

Number of addresses needed for 30% growth in the largest subnet + 6
(Round up to the next whole number)

Total number of address needed for the largest subnet = 26

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Tech Ed 135.126.0.0 to 135.126.0.31

IP address range for English 135.126.0.32 to 135.126.0.63

IP address range for Science 135.126.0.64 to 135.126.0.95

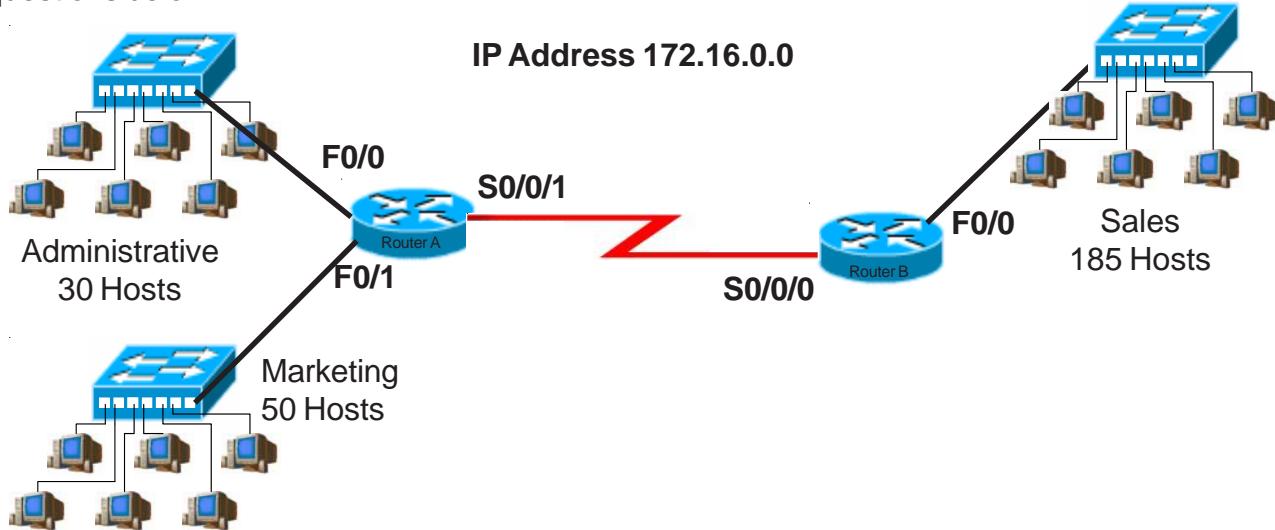
IP address range for Router A to Router B serial connection 135.126.0.96 to 135.126.0.127

IP address range for Router A to Router B serial connection 135.126.0.128 to 135.126.0.159

Show your work for Problem 2 in the space below.

Practical Subnetting 3

Based on the information in the graphic shown, design a classfull network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 25% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class B

Custom subnet mask 255.255.255.0

Minimum number of subnets needed 4

Extra subnets required for 25% growth + 1
(Round up to the next whole number)

Total number of subnets needed = 5

Number of host addresses
in the largest subnet group 185

Number of addresses needed for
25% growth in the largest subnet + 47
(Round up to the next whole number)

Total number of address
needed for the largest subnet = 232

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Sales 172.16.0.0 - 172.16.0.255

IP address range for Marketing 172.16.1.0 - 172.16.1.255

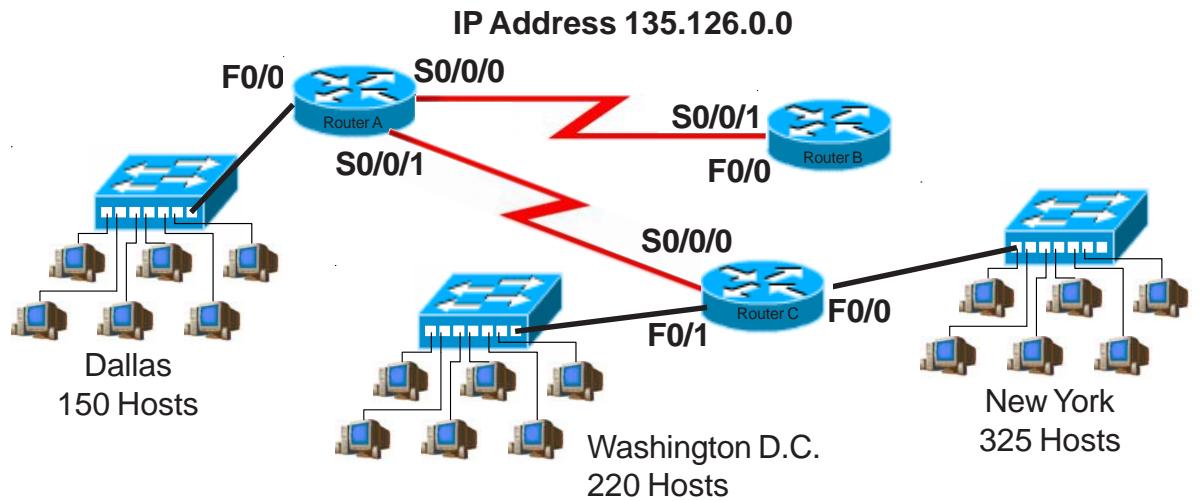
IP address range for Administrative 172.16.2.0 - 172.16.2.255

IP address range for Router A
to Router B serial connection 172.16.3.0 - 172.16.3.255

Show your work for Problem 3 in the space below.

Practical Subnetting 4

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 70% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class B

Custom subnet mask 255.255.240.0

Minimum number of subnets needed 5

Extra subnets required for 70% growth
(Round up to the next whole number) + 4

Total number of subnets needed = 9

Number of host addresses
in the largest subnet group 325

Number of addresses needed for
70% growth in the largest subnet
(Round up to the next whole number) + 228

Total number of address
needed for the largest subnet = 553

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for New York 135.126.0.0 - 135.126.15.255

IP address range for Washington D. C. 135.126.16.0 - 135.126.31.255

IP address range for Dallas 135.126.32.0 - 135.126.47.255

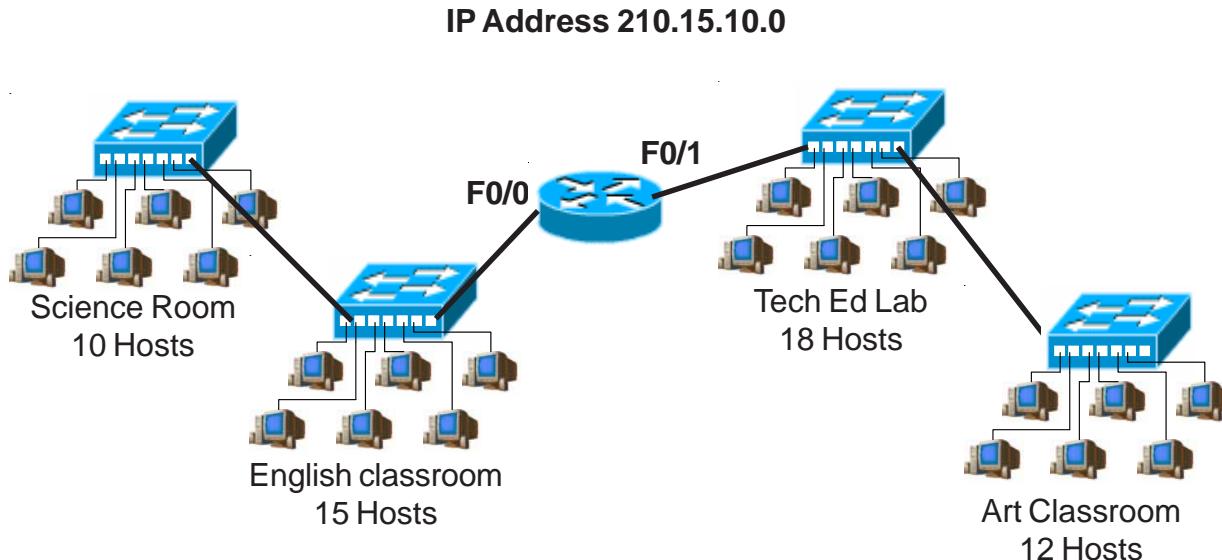
IP address range for Router A
to Router B serial connection 135.126.48.0 - 135.126.63.255

IP address range for Router A
to Router C serial connection 135.126.64.0 - 135.126.79.255

Show your work for Problem 4 in the space below.

Practical Subnetting 5

Based on the information in the graphic shown, design a network addressing scheme that will supply the minimum number of hosts per subnet, and allow enough extra subnets and hosts for 100% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class	C
Custom subnet mask	255.255.255.192
Minimum number of subnets needed	2
Extra subnets required for 100% growth <small>(Round up to the next whole number)</small>	+ 2
Total number of subnets needed	= 4
Number of host addresses in the largest subnet group	30
Number of addresses needed for 100% growth in the largest subnet <small>(Round up to the next whole number)</small>	+ 30
Total number of address needed for the largest subnet	= 60

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

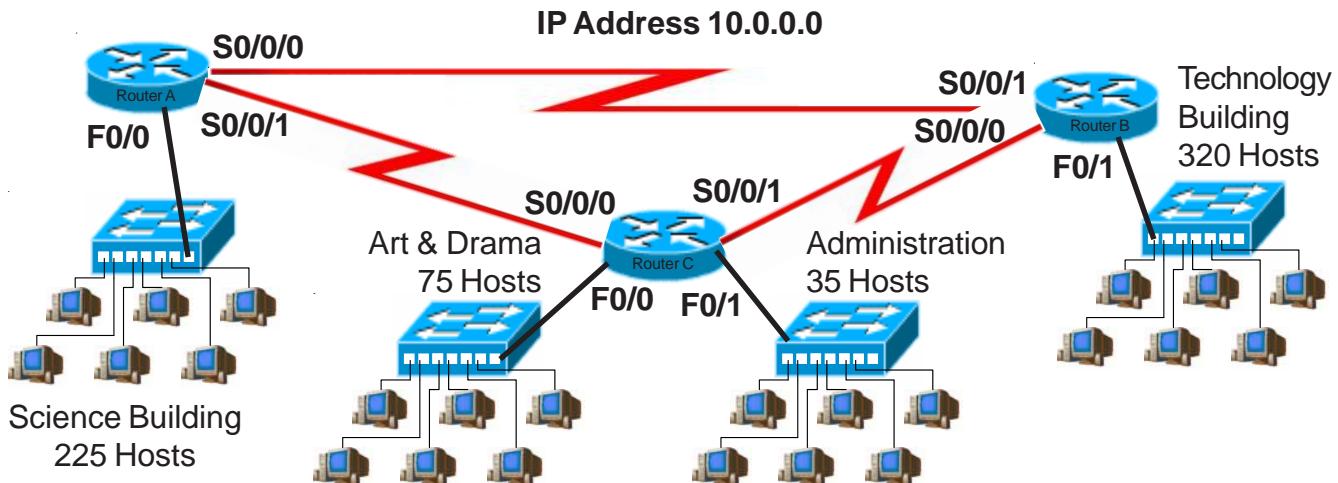
IP address range for Router F0/0 Port 210.15.10.0 - 210.15.10.63

IP address range for Router F0/1 Port 210.15.10.64 - 210.15.10.127

Show your work for Problem 5 in the space below.

Practical Subnetting 6

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 20% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class A

Custom subnet mask 255.240.0.0

Minimum number of subnets needed 7

Extra subnets required for 20% growth + 2
(Round up to the next whole number)

Total number of subnets needed = 9

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Technology 10.0.0.0 - 10.15.255.255

IP address range for Science 10.16.0.0 - 10.31.255.255

IP address range for Arts & Drama 10.32.0.0 - 10.47.255.255

IP Address range Administration 10.48.0.0 - 10.63.255.255

IP address range for Router A to Router B serial connection 10.64.0.0 - 10.79.255.255

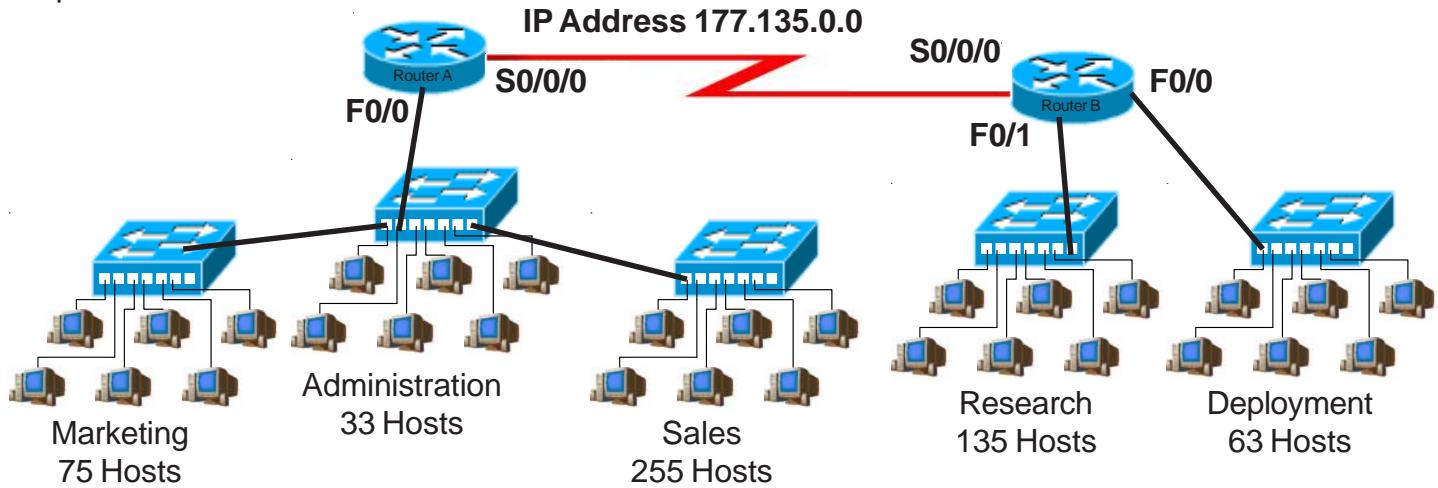
IP address range for Router A to Router C serial connection 10.80.0.0 - 10.95.255.255

IP address range for Router B to Router C serial connection 10.96.0.0 - 10.111.255.255

Show your work for Problem 6 in the space below.

Practical Subnetting 7

Based on the information in the graphic shown, design a network addressing scheme that will supply the minimum number of hosts per subnet, and allow enough extra subnets and hosts for 125% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class B

Custom subnet mask 255.255.252.0

Minimum number of subnets needed 4

Extra subnets required for 125% growth + 5
(Round up to the next whole number)

Total number of subnets needed = 9

Number of host addresses in the largest subnet group 363

Number of addresses needed for 125% growth in the largest subnet + 454
(Round up to the next whole number)

Total number of address needed for the largest subnet = 817

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Router A Port F0/0 177.135.0.0 - 177.135.3.255

IP address range for Research 177.135.4.0 - 177.135.7.255

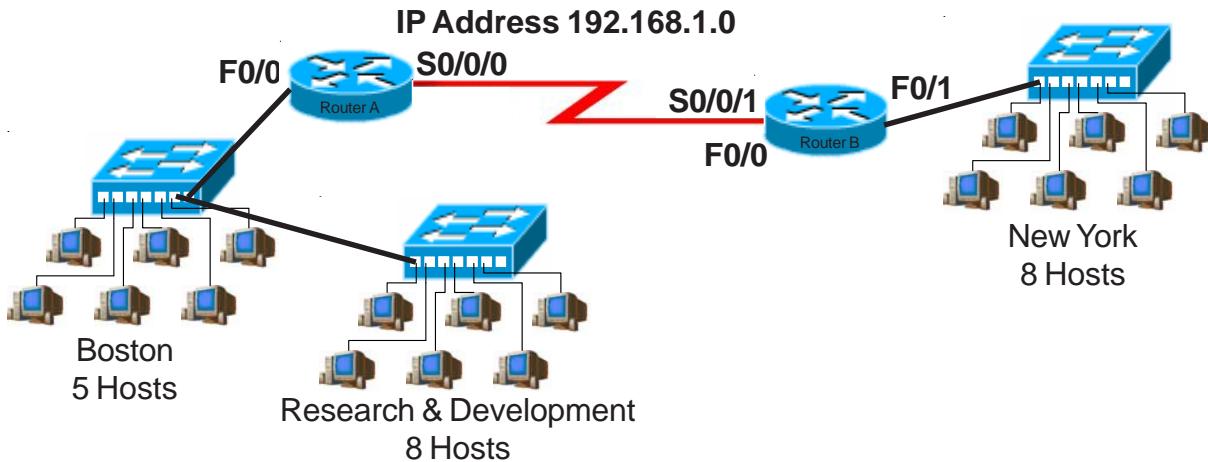
IP address range for Deployment 177.135.8.0 - 177.135.11.255

IP address range for Router A to Router B serial connection 177.135.12.0 - 177.135.15.255

Show your work for Problem 7 in the space below.

Practical Subnetting 8

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number subnets**, and allow enough extra subnets and hosts for 85% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class C

Custom subnet mask 255.255.255.224

Minimum number of subnets needed 3

Extra subnets required for 85% growth
(Round up to the next whole number) + 3

Total number of subnets needed = 6

Number of host addresses
in the largest subnet group 13

Number of addresses needed for
85% growth in the largest subnet
(Round up to the next whole number) + 12

Total number of address
needed for the largest subnet = 25

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Router A F0/0 192.168.1.0 - 192.168.1.31

IP address range for New York 192.168.1.32 - 192.168.1.63

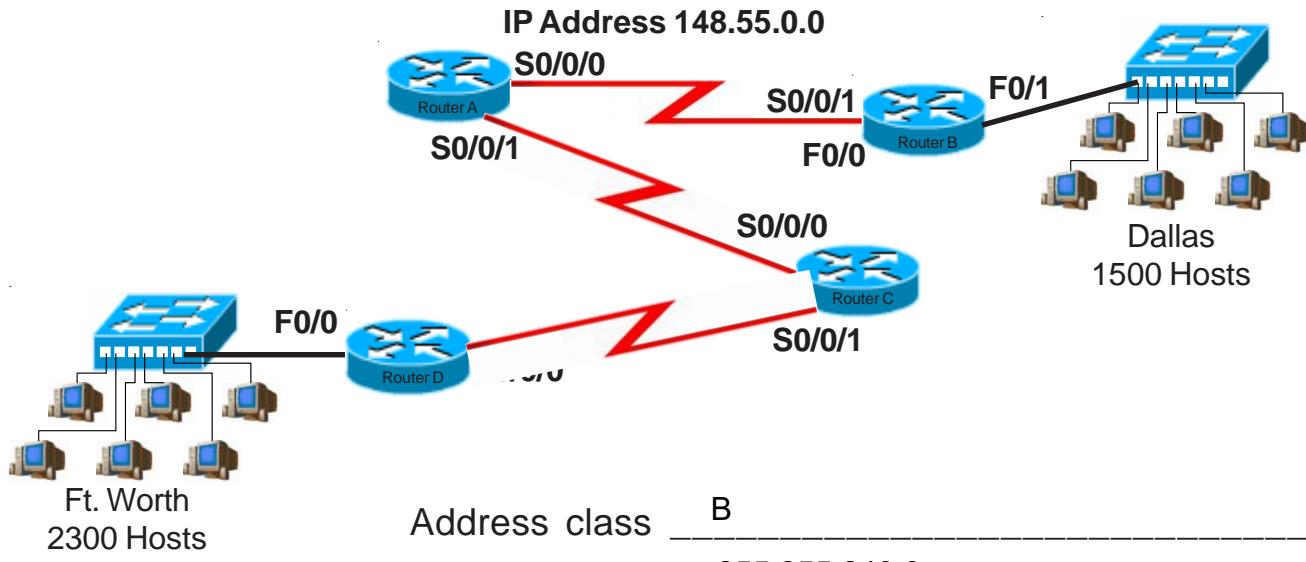
IP address range for Router A
to Router B serial connection 192.168.1.64 - 192.168.1.95

Show your work for Problem 8 in the space below.

148.55.16.0 - 148.55.31.25

Practical Subnetting 9

Based on the information in the graphic shown, design a network addressing scheme that will supply the minimum number of hosts per subnet, and allow enough extra subnets and hosts for 15% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class _____

Custom subnet mask _____

Minimum number of subnets needed _____

Extra subnets required for 15% growth
(Round up to the next whole number)

Total number of subnets needed = _____

Number of host addresses
in the largest subnet group _____

Number of addresses needed for
15% growth in the largest subnet
(Round up to the next whole number)

Total number of address
needed for the largest subnet = _____

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Ft. Worth _____

148.55.0.0 - 148.55.15.255

IP address range for Dallas _____

148.55.16.0 - 148.55.31.255

IP address range for Router A
to Router B serial connection

148.55.32.0 - 148.55.47.255

IP address range for Router A
to Router C serial connection

148.55.48.0 - 148.55.63.255

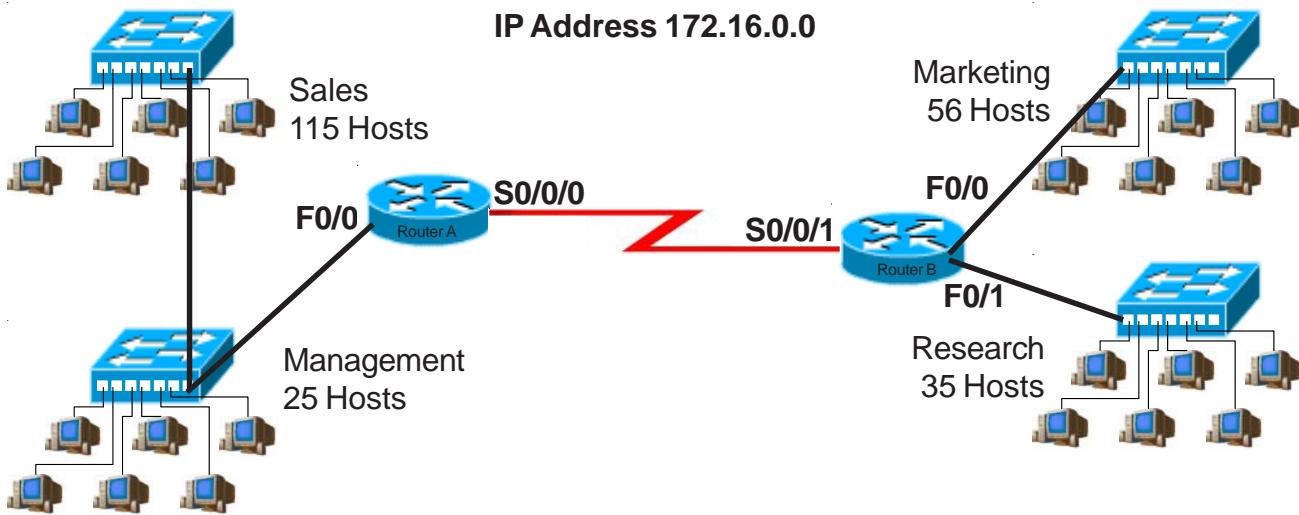
IP address range for Router C
to Router D serial connection

148.55.64.0 - 148.55.79.255

Show your work for Problem 9 in the space below.

Practical Subnetting 10

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 110% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class B

Custom subnet mask 255.255.240.0

Minimum number of subnets needed 4

Extra subnets required for 110% growth + 5
(Round up to the next whole number)

Total number of subnets needed = 9

Number of host addresses
in the largest subnet group 140

Number of addresses needed for
110% growth in the largest subnet + 154
(Round up to the next whole number)

Total number of address
needed for the largest subnet = 294

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Sales/Management 172.16.0.0 - 172.16.15.255

IP address range for Marketing 172.16.16.0 - 172.16.31.255

IP address range for Research 172.16.32.0 - 172.16.47.255

IP address range for Router A
to Router B serial connection 172.16.48.0 - 172.16.63.255

Show your work for Problem 10 in the space below.

Valid and Non-Valid IP Addresses

Using the material in this workbook identify which of the addresses below are correct and usable. If they are not usable addresses explain why.

IP Address: 0.230.190.192

Subnet Mask: 255.0.0.0

Reference Page Inside Front Cover

The network ID cannot be 0.

IP Address: 192.10.10.1

Subnet Mask: 255.255.255.0

Reference Pages 28-29

OK

IP Address: 245.150.190.10

Subnet Mask: 255.255.255.0

Reference Page Inside Front Cover

245 is reserved for experimental use

IP Address: 135.70.191.255

Subnet Mask: 255.255.254.0

Reference Pages 48-49

This is the broadcast address for this range

IP Address: 127.100.100.10

Subnet Mask: 255.0.0.0

Reference Pages Inside Front Cover

Invalid. 127 is reserved for loopback testing

IP Address: 93.0.128.1

Subnet Mask: 255.255.224.0

Reference Pages 56-57

OK

IP Address: 200.10.10.128

Subnet Mask: 255.255.255.224

Reference Pages 54-55

This is the subnet address for the 3rd usable range of 200.10.10.0

IP Address: 165.100.255.189

Subnet Mask: 255.255.255.192

Reference Pages 30-31

OK.

IP Address: 190.35.0.10

Subnet Mask: 255.255.255.192

Reference Pages 34-35

This address is taken from the first range for this subnet which is invalid.

IP Address: 218.35.50.195

Subnet Mask: 255.255.0.0

Reference Page Inside Front Cover

This is a class B subnet mask

IP Address: 200.10.10.175 /22

Reference Pages 54-55 and/or Inside Front Cover

A class C address must use a minimum of 24 bits /24

IP Address: 135.70.255.255

Subnet Mask: 255.255.224.0

Reference Pages 48-49

This is a broadcast address.

IP Address Breakdown

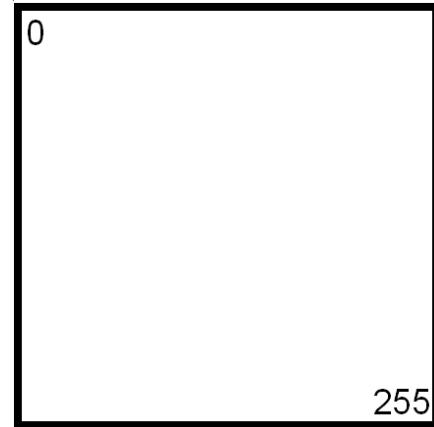
/24	/25	/26	/27	/28	/29	/30
8+8+8 255.255.255.0 256 Hosts	8+8+8+1 255.255.255.128 128 Hosts	8+8+8+2 255.255.255.192 64 Hosts	8+8+8+3 255.255.255.224 32 Hosts	8+8+8+4 255.255.255.240 16 Hosts	8+8+8+5 255.255.255.248 8 Hosts	8+8+8+6 255.255.255.252 4 Hosts
0-63				0-15	0-7	0-3
0-127				16-31	8-15	4-7
0-255				32-47	16-23	8-11
128-255				48-63	24-31	12-15
					32-39	16-19
					40-47	20-23
					48-55	24-27
					56-63	28-31
						32-35
						36-39
						40-43
						44-47
						48-51
						52-55
						56-59
						60-63
						64-67
						68-71
						72-75
						76-79
						80-83
						84-87
						88-91
						92-95
						96-99
						100-103
						104-107
						108-111
						112-115
						116-119
						120-123
						124-127
						128-131
						132-135
						136-139
						140-143
						144-147
						148-151
						152-155
						156-159
						160-163
						164-167
						168-171
						172-175
						176-179
						180-183
						184-187
						188-191
						192-195
						196-199
						200-203
						204-207
						208-211
						212-215
						216-219
						220-223
						224-227
						228-231
						232-235
						236-239
						240-243
						244-247
						248-251
						252-255

Visualizing Subnets Using The Box Method

The box method is the simplest way to visualize the breakdown of subnets and addresses into smaller sizes.

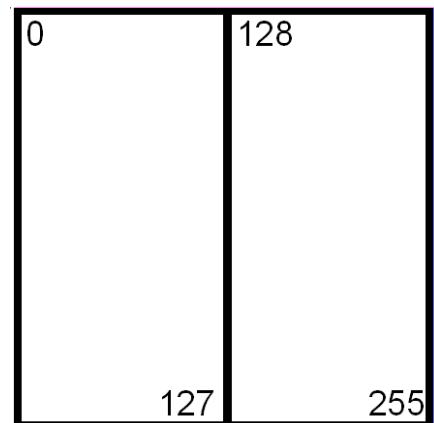
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



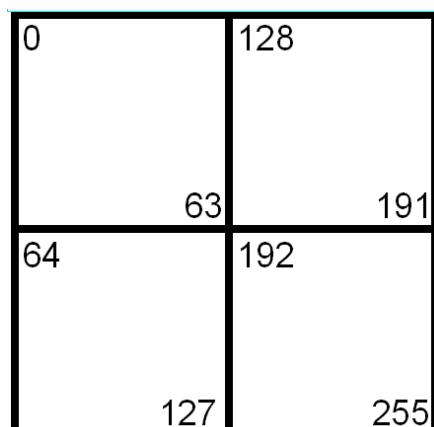
Split the box in half and you get two subnets with 128 addresses,

/25
255.255.255.128
128 Hosts
2 Subnets



Divide the box into quarters and you get four subnets with 64 addresses,

/26
255.255.255.192
64 Hosts
4 Subnets



Split each individual square and you get eight subnets with 32 addresses,

/27
255.255.255.224
32 Hosts
8 Subnets

0	32	128	160
31	63	159	191
64	96	192	224
95	127	223	255

Split the boxes in half again and you get sixteen subnets with sixteen addresses,

/28
255.255.255.240
16 Hosts
16 Subnets

0	32	128	160
15	47	143	175
16	48	144	176
31	63	159	191
64	96	192	224
79	111	207	239
80	112	208	240
95	127	223	255

The next split gives you thirty two subnets with eight addresses,

/29
255.255.255.248
8 Hosts
32 Subnets

0	8	32	40	128	136	160	168
7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184
23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232
71	79	103	111	199	207	321	339
80	88	112	120	208	216	240	248
87	95	119	127	215	223	247	255

The last split gives sixty four subnets with four addresses each,

/30
255.255.255.252
4 Hosts
64 Subnets

0	8	32	40	128	136	160	168
3	11	35	43	131	139	163	171
4	12	36	44	132	140	164	172
7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184
19	27	51	59	147	155	179	187
20	28	52	60	148	156	180	188
23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232
67	75	99	107	195	203	227	235
68	76	100	108	196	204	228	236
71	79	103	111	199	207	321	339
80	88	112	120	208	216	240	248
83	91	115	123	211	219	243	251
84	92	116	124	212	220	244	252
87	95	119	127	215	223	247	255

Class A Addressing Guide

CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/8	0	255.0.0.0	1	16,777,216	16,777,214
/9	1	255.128.0.0	2	8,388,608	8,388,606
/10	2	255.192.0.0	4	4,194,304	4,194,302
/11	3	255.224.0.0	8	2,097,152	2,097,150
/12	4	255.240.0.0	16	1,048,576	1,048,574
/13	5	255.248.0.0	32	524,288	524,286
/14	6	255.252.0.0	64	262,144	262,142
/15	7	255.254.0.0	128	131,072	131,070
/16	8	255.255.0.0	256	65,536	65,534
/17	9	255.255.128.0	512	32,768	32,766
/18	10	255.255.192.0	1,024	16,384	16,382
/19	11	255.255.224.0	2,048	8,192	8,190
/20	12	255.255.240.0	4,096	4,096	4,094
/21	13	255.255.248.0	8,192	2,048	2,046
/22	14	255.255.252.0	16,384	1,024	1,022
/23	15	255.255.254.0	32,768	512	510
/24	16	255.255.255.0	65,536	256	254
/25	17	255.255.255.128	131,072	128	126
/26	18	255.255.255.192	262,144	64	62
/27	19	255.255.255.224	524,288	32	30
/28	20	255.255.255.240	1,048,576	16	14
/29	21	255.255.255.248	2,097,152	8	6
/30	22	255.255.255.252	4,194,304	4	2

Class B Addressing Guide

CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/16	0	255.255.0.0	1	65,536	65,534
/17	1	255.255.128.0	2	32,768	32,766
/18	2	255.255.192.0	4	16,384	16,382
/19	3	255.255.224.0	8	8,192	8,190
/20	4	255.255.240.0	16	4,096	4,094
/21	5	255.255.248.0	32	2,048	2,046
/22	6	255.255.252.0	64	1,024	1,022
/23	7	255.255.254.0	128	512	510
/24	8	255.255.255.0	256	256	254
/25	9	255.255.255.128	512	128	126
/26	10	255.255.255.192	1,024	64	62
/27	11	255.255.255.224	2,048	32	30
/28	12	255.255.255.240	4,096	16	14
/29	13	255.255.255.248	8,192	8	6
/30	14	255.255.255.252	16,384	4	2

Class C Addressing Guide

CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/24	0	255.255.255.0	1	256	254
/25	1	255.255.255.128	2	128	126
/26	2	255.255.255.192	4	64	62
/27	3	255.255.255.224	8	32	30
/28	4	255.255.255.240	16	16	14
/29	5	255.255.255.248	32	8	6
/30	6	255.255.255.252	64	4	2

