

IPv4 Addressing and Subnetting Workbook

Version 2.1

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Student Name:

IPv4 Address Classes

Class A	1 – 127	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)		

Speciality Address Ranges

Loopback -	Only the single 127.0.0.1 address is used, addresses 127.0.0.0 to 127.255.255.255 are reserved. Any address within this block will loop back to the local host.
Link-Local Addresses -	IPv4 addresses in the address block 169.254.0.0 to 169.254.255.255 (169.254.0.0/16) are designated as link-local addresses.
TEST-NET Addresses -	The address block 192.0.2.0 to 192.0.2.255 (192.0.2.0/24) is set aside for teaching and learning purposes.
Experimental Addresses -	The addresses in the block 240.0.0.0 to 255.255.255.254 are listed as reserved for future use (RFC 3330).

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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and to everyone who has sent in suggestions to improve the series.

Inside Cover

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>	<i>128</i>	<i>64</i>
0	1	1	1	0	1	1	1	<u>119</u>	<i>16</i>	<i>32</i>
1	1	1	1	1	1	1	1		<i>2</i>	<i>16</i>
1	1	0	0	0	1	0	1		<i>146</i>	<i>4</i>
1	1	1	1	0	1	1	0			<i>2</i>
1	1	1	1	0	1	1	0			<i>1</i>
0	0	0	1	0	0	1	1			<u>119</u>
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	
1	1	1	0	1	1	1	0		238	238	34
										-128	-32
0	0	1	0	0	0	1	0		34	110	2
										-64	-2
									123	46	0
										-32	
									50	14	
										-8	
									255	6	
										-4	
									200	2	
										-2	
									10	0	
									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> <i>A</i> </u>
150.10.15.0	<u> <i>B</i> </u>
192.14.2.0	<u> </u>
148.17.9.1	<u> </u>
193.42.1.1	<u> </u>
126.8.156.0	<u> </u>
220.200.23.1	<u> </u>
230.230.45.58	<u> </u>
177.100.18.4	<u> </u>
119.18.45.0	<u> </u>
249.240.80.78	<u> </u>
199.155.77.56	<u> </u>
117.89.56.45	<u> </u>
215.45.45.0	<u> </u>
199.200.15.0	<u> </u>
95.0.21.90	<u> </u>
33.0.0.0	<u> </u>
158.98.80.0	<u> </u>
219.21.56.0	<u> </u>

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 *188 . 10 . 0 . 0*
255.255.0.0 _____

10.10.48.80 *10 . 10 . 48 . 0*
255.255.255.0 _____

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 *0 . 0 . 18 . 2*
255.255.0.0 _____

10.10.48.80 *0 . 0 . 0 . 80*
255.255.255.0 _____

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	<i>255 . 255 . 0 . 0</i> _____
119.18.45.0	<i>255 . 0 . 0 . 0</i> _____
191.249.234.191	_____
223.23.223.109	_____
10.10.250.1	_____
126.123.23.1	_____
223.69.230.250	_____
192.12.35.105	_____
77.251.200.51	_____
189.210.50.1	_____
88.45.65.35	_____
128.212.250.254	_____
193.100.77.83	_____
125.125.250.1	_____
1.1.10.50	_____
220.90.130.45	_____
134.125.34.9	_____
95.250.91.99	_____

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:

1 AND 1 = 1
1 AND 0 = 0
0 AND 1 = 0
0 AND 0 = 0

Sample:

What you see...

IP Address: 192 . 100 . 10 . 33

What you can figure out in your head...

Address Class:	C
Network Portion:	<u>192 . 100 . 10</u> . 33
Host Portion:	192 . 100 . 10 . <u>33</u>

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 . 1 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)

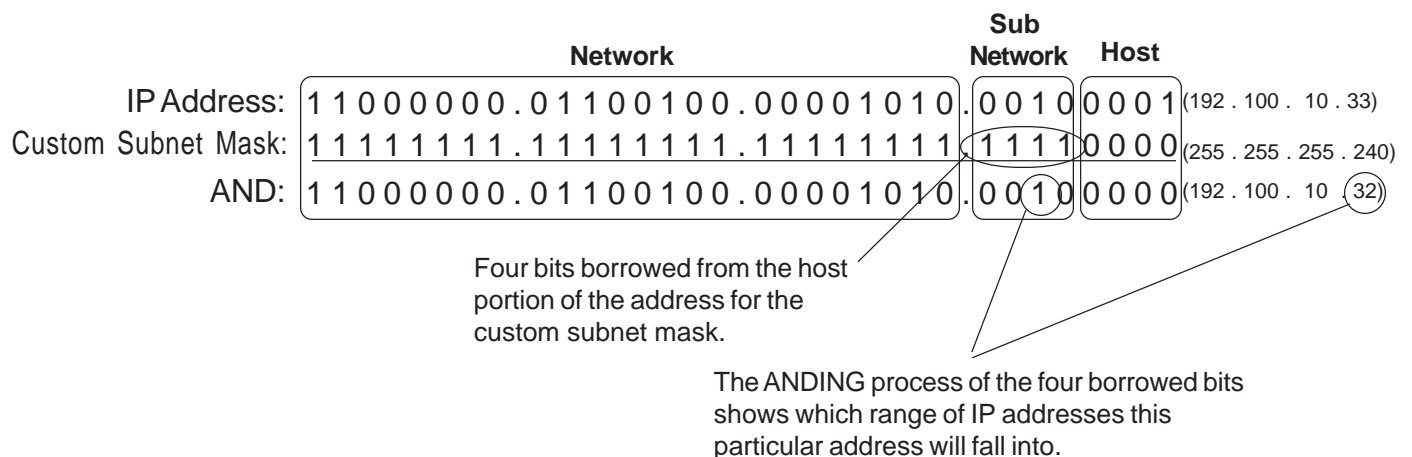
ANDING with the default subnet mask allows your computer to figure out the network portion of the address.

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

The formula that can provide this basic information:

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

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

This formula calculates 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 formula.

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

The number of subnets created by borrowing 2 bits is 2^2 or $2 \times 2 = 4$ subnets.

The number of hosts created by leaving 6 bits is $2^6 - 2$ or $2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64 - 2 = 62$ usable hosts per subnet.

Custom Subnet Problems

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.

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

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

	128
	64
	32
	+16
	<hr/>
	240

16	Observe the total number of hosts.
-2	
<hr/>	
14	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.

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
Number of Subnets -	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536
Binary values -	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
	165	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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

128	128
64	+64
32	192
16	
8	
4	
2	
+1	
255	

Observe the total number of hosts.

Subtract 2 for the number of usable hosts.

64
-2
62

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 1,024

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.

	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2
Number of Hosts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of Subnets	-	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768
Binary values	-	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2
		148	75	0	0	0	0	0	0	0	0	0	0	0	0	0

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

128	128
64	+64
32	192
16	
8	
4	
2	
+1	
255	

64	Observe the total number of hosts.
-2	
62	Subtract 2 for the number of usable hosts.

1024	
-2	
1,022	Subtract 2 for the total number of subnets to get the usable number of subnets.

Custom Subnet Masks

Problem 4

Number of needed subnets **6**

Number of needed usable hosts **30**

Network Address **195.85.8.0**

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 _____

Show your work for Problem 5 in the space below.

		Number of Subnets					Number of Hosts						
		256	128	64	32	16	8	4	2	-			
	-	2	4	8	16	32	64	128	256				
		128	64	32	16	8	4	2	1	-	Binary values		
195	.	85	.	8	.	0	0	0	0	0			

Custom Subnet Masks

Problem 5

Number of needed subnets 6

Number of needed usable hosts **30**

Network Address **210.100.56.0**

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 _____

Show your work for Problem 4 in the space below.

[illegible]

Custom Subnet Masks

Problem 6

Number of needed subnets **126**

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

Network Address **118.0.0.0**

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 _____

Show your work for Problem 6 in the space below.

Number of Hosts	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536	131072	262144	524288	1048576	2097152	4194304	8388608	16777216	33554432	67108864	134217728	268435456	536870912	1073741824	2147483648	4294967296	8589934592	17179869184	34359738368	68719476736	137438953472	274877906944	549755813888	1099511627776	2199023255552	4398046511104	8796093022208	17592186044416	35184372088832	70368744177664	140737488355328	281474976710656	562949953421312	1125899906842624	2251799813685248	4503599627370496	9007199254740992	18014398509481984	36028797018963968	72057594037927936	144115188075855872	288230376151711744	576460752303423488	1152921504606846976	2305843009213693952	4611686018427387904	9223372036854775808	18446744073709551616	36893488147419103232	73786976294838206464	147573952589676412928	295147905179352825856	590295810358705651712	1180591620717411303424	2361183241434822606848	4722366482869645213696	9444732965739290427392	18889465931478580854784	37778931862957161709568	75557863725914323419136	151115727451828646838272	302231454903657293676544	604462909807314587353088	1208925819614629174706176	2417851639229258349412352	4835703278458516698824704	9671406556917033397649408	19342813113834066795298816	38685626227668133590597632	77371252455336267181195264	154742504910672534362390528	309485009821345068724781056	618970019642690137449562112	1237940039285380274899124224	2475880078570760549798248448	4951760157141521099596496896	9903520314283042199192993792	19807040628566084398385987584	39614081257132168796771975168	79228162514264337593543950336	158456325028528675187087900672	316912650057057350374175801344	633825300114114700748351602688	1267650600228229401496703205376	2535301200456458802993406410752	5070602400912917605986812821504	10141204801825835211973625643008	20282409603651670423947251286016	40564819207303340847894502572032	81129638414606681695789005144064	162259276829213363391578010288128	324518553658426726783156020576256	649037107316853453566312041152512	1298074214633706907132624082305024	2596148429267413814265248164610048	5192296858534827628530496329220096	10384593717069655257060992658440192	20769187434139310514121985316880384	41538374868278621028243970633760768	83076749736557242056487941267521536	166153499473114484112975882535043072	332306998946228968225951765070086144	664613997892457936451903530140172288	1329227995784915872903807060280344576	2658455991569831745807614120560689152	5316911983139663491615228241121378304	10633823966279326983230456482242756608	21267647932558653966460912964485513216	42535295865117307932921825928971026432	85070591730234615865843651857942052864	17014118346046923173168730371588410528	34028236692093846346337460743176821056	68056473384187692692674921486353642112	136112946768375385385349842972707284224	272225893536750770770699685945414568448	544451787073501541541399371890829136896	1088903574147003083082798743781658273792	2177807148294006166165597487563316547584	4355614296588012332331194975126633095168	8711228593176024664662389950253266190336	17422457186352049329324779900506532380672	34844914372704098658649559801013064761344	6968982874540819731729911960202612952288	13937965749081639463459823920405225904576	27875931498163278926919647840810451809152	55751862996326557853839295681620903618304	111503725992653115707678591363241807236608	223007451985306231415357182726483614473216	4460149039
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Custom Subnet Masks

Problem 7

Number of needed subnets **2000**

Number of needed usable hosts **15**

Network Address **178.100.0.0**

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 _____

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
Number of Subnets	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536
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 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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

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 ~					Number of Hosts				
256	128	64	32	16	32	64	128	256	
2	4	8	16		8	4	2	1	Binary values
128	64	32	16						
192.10.10.0	0	0	0	0	0	0	0	0	
(1)	0	0	0	0	192.10.10.0	to	192.10.10.15		
(2)	0	0	0	1	192.10.10.16	to	192.10.10.31		
(3)	0	0	1	0	192.10.10.32	to	192.10.10.47		
(4)	0	0	1	1	192.10.10.48	to	192.10.10.63		
(5)	0	1	0	0	192.10.10.64	to	192.10.10.79		
(6)	0	1	0	1	192.10.10.80	to	192.10.10.95		
(7)	0	1	1	0	192.10.10.96	to	192.10.10.111		
(8)	0	1	1	1	192.10.10.112	to	192.10.10.127		
(9)	1	0	0	0	192.10.10.128	to	192.10.10.143		
(10)	1	0	0	1	192.10.10.144	to	192.10.10.159		
(11)	1	0	1	0	192.10.10.160	to	192.10.10.175		
(12)	1	0	1	1	192.10.10.176	to	192.10.10.191		
(13)	1	1	0	0	192.10.10.192	to	192.10.10.207		
(14)	1	1	0	1	192.10.10.208	to	192.10.10.223		
(15)	1	1	1	0	192.10.10.224	to	192.10.10.239		
(16)	1	1	1	1	192.10.10.240	to	192.10.10.255		

$$\begin{array}{r}
 128 \\
 64 \\
 32 \\
 +16 \\
 \hline
 \text{Custom subnet mask } 240
 \end{array}$$

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

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

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.

Number of Hosts	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536
Number of Subnets	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536
Binary values	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	1
	165	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	(1)	0	165.100.0.0	to	165.100.0.63
	(2)	1	165.100.0.64	to	165.100.0.127
Usable	64	128	165.100.0.128	to	165.100.0.191
hosts	62	32	165.100.0.192	to	165.100.0.255
	(5)	1	165.100.1.0	to	165.100.1.63
	(6)	1	165.100.1.64	to	165.100.1.127
	(7)	1	165.100.1.128	to	165.100.1.191
Custom	128	8	165.100.1.192	to	165.100.1.255
subnet mask	+64	4			
	192	2			
	+1	1			
	255	5	165.100.2.0	to	165.100.2.63
		1	165.100.2.64	to	165.100.2.127
		1	165.100.2.128	to	165.100.2.191
		1	165.100.2.192	to	165.100.2.255
	(13)	1	165.100.3.0	to	165.100.3.63
	(14)	1	165.100.3.64	to	165.100.3.127
	(15)	1	165.100.3.128	to	165.100.3.191
	(16)	1	165.100.3.192	to	165.100.3.255

Down to

(1023)	1	1	1	1	1	1	1	1	1	0	165.100.255.128	to	165.100.255.191
(1024)	1	1	1	1	1	1	1	1	1	1	165.100.255.192	to	165.100.255.255

The binary value of the last bit borrowed is the range. In this problem the range is 64.

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 3

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

Number of needed subnets **2**

Network Address **195.223.50.0**

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.

		256	128	64	32	16	8	4	2	-	Number of Hosts
Number of Subnets	-	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 _____

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 15th
subnet range? _____

What is the subnet number
for the 13th subnet? _____

What is the subnet
broadcast address for
the 10th subnet? _____

What are the assignable
addresses for the 6th
subnet? _____

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 _____

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 5th subnet? _____

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

What are the assignable
addresses for the 10th
subnet? _____

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 _____

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 9th
subnet range? _____

What is the subnet number
for the 4th subnet? _____

What is the subnet
broadcast address for
the 12th subnet? _____

What are the assignable
addresses for the 10th
subnet? _____

Show your work for Problem 6 in the space below.

Subnetting

Problem 7

Network Address **10.0.0.0 /16**

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 11th
subnet range? _____

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

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

What are the assignable
addresses for the 9th
subnet? _____

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 _____

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 4th
subnet range? _____

What is the subnet number
for the 5th subnet? _____

What is the subnet
broadcast address for
the 6th subnet? _____

What are the assignable
addresses for the 3rd
subnet? _____

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 _____

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 10th subnet? _____

What is the subnet broadcast
address for
the 4th subnet? _____

What are the assignable
addresses for the 6th
subnet? _____

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 _____

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 5th
subnet range? _____

What is the subnet number
for the 4th subnet? _____

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

What are the assignable
addresses for the 12th
subnet? _____

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 _____

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 6th
subnet range? _____

What is the subnet number
for the 7th subnet? _____

What is the subnet
broadcast address for
the 3rd subnet? _____

What are the assignable
addresses for the 5th
subnet? _____

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 _____

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 4th subnet? _____

What are the assignable
addresses for the 3rd
subnet? _____

Show your work for Problem 12 in the space below.

Subnetting

Problem 13

Network Address **165.200.0.0 /26**

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 10th
subnet range? _____

What is the subnet number
for the 11th subnet? _____

What is the subnet
broadcast address for
the 1023rd subnet? _____

What are the assignable
addresses for the 1022nd
subnet? _____

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 _____

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 7th
subnet range? _____

What is the subnet number
for the 5th subnet? _____

What is the subnet
broadcast address for
the 4th subnet? _____

What are the assignable
addresses for the 6th
subnet? _____

Show your work for Problem 14 in the space below.

Subnetting

Problem 15

Network Address **93.0.0.0 \19**

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 15th
subnet range? _____

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

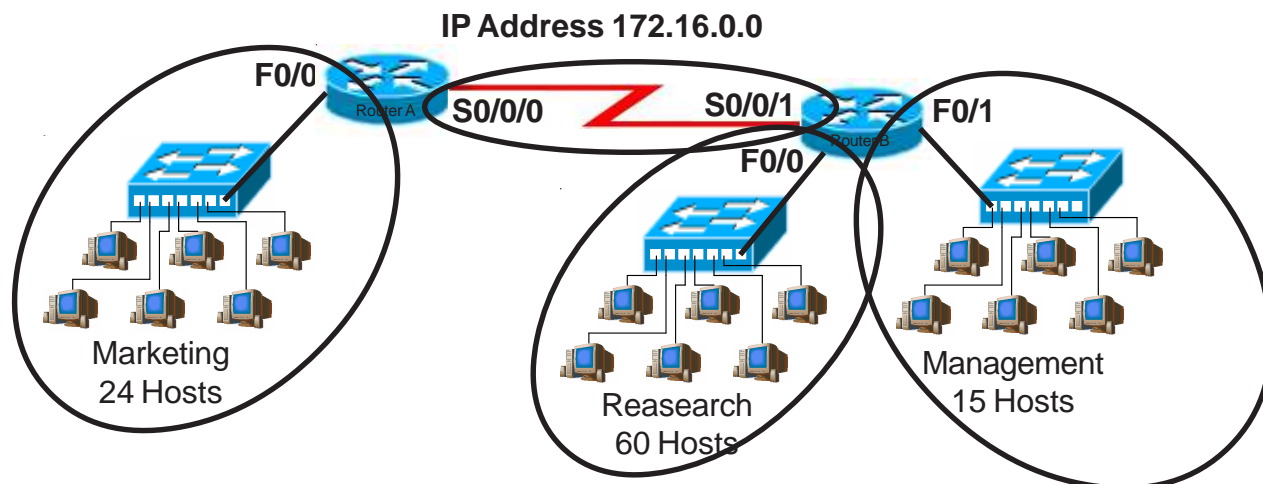
What is the subnet
broadcast address for
the 7th subnet? _____

What are the assignable
addresses for the 12th
subnet? _____

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	<u>B</u>
Custom subnet mask	<u>255.255.224.0</u>
Minimum number of subnets needed	<u>4</u>
Extra subnets required for 100% growth (Round up to the next whole number)	<u>+ 4</u>
Total number of subnets needed	<u>= 8</u>
Number of host addresses in the largest subnet group	<u>60</u>
Number of addresses needed for 100% growth in the largest subnet (Round up to the next whole number)	<u>+ 60</u>
Total number of address needed for the largest subnet	<u>= 120</u>

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

IP address range for Research	<u>172.16.0.0 to 172.31.255</u>
IP address range for Marketing	<u>172.16.32.0 to 172.63.255</u>
IP address range for Management	<u>172.16.64.0 to 172.95.255</u>
IP address range for Router A to Router B serial connection	<u>172.16.96.0 to 172.127.255</u>

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

Number of Hosts	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536	131072
Number of Subnets	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536	131072
Binary values	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64
	172	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

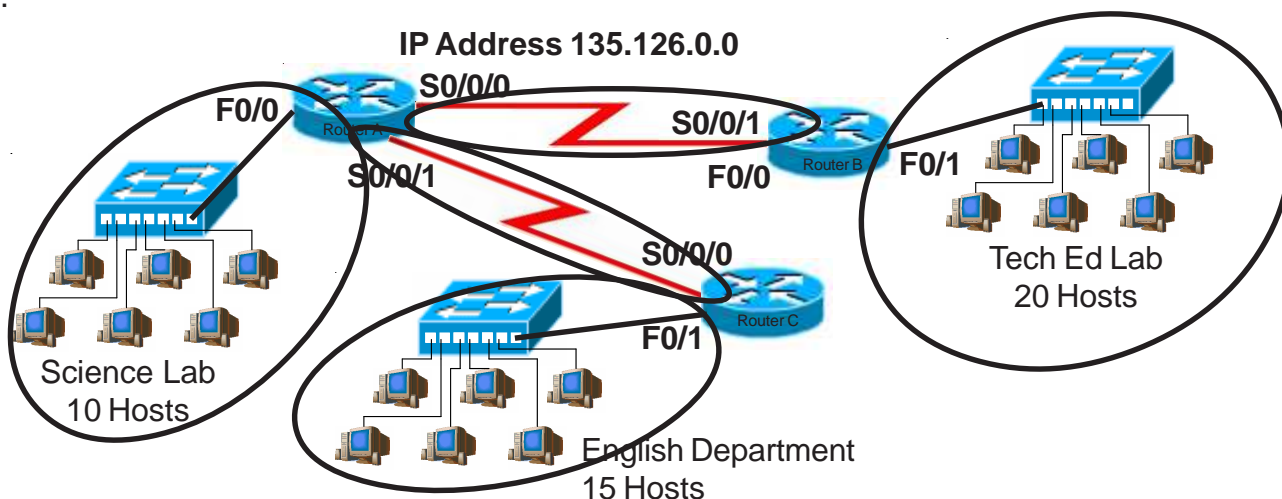
(1)			0	172.16.0.0	to	172.16.31.255
(2)			1	172.16.32.0	to	172.16.63.255
(3)		1	0	172.16.64.0	to	172.16.95.255
(4)		1	1	172.16.96.0	to	172.16.127.255
(5)	1	0	0	172.16.128.0	to	172.16.159.255
(6)	1	0	1	172.16.160.0	to	172.16.191.255
(7)	1	1	0	172.16.192.0	to	172.16.223.255
(8)	1	1	1	172.16.224.0	to	172.16.255.255

$$\begin{array}{r} 4 \\ \times 1.0 \\ \hline 4 \end{array}$$

$$\begin{array}{r} 60 \\ \times 1.0 \\ \hline 60 \end{array}$$

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.

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
Number of Subnets	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536
Binary values	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
	135	126	0	0	0	0	0	0	0	0	0	0	0	0	0	0

$$\begin{array}{r} 5 \\ \times 3 \\ \hline 15 \end{array}$$

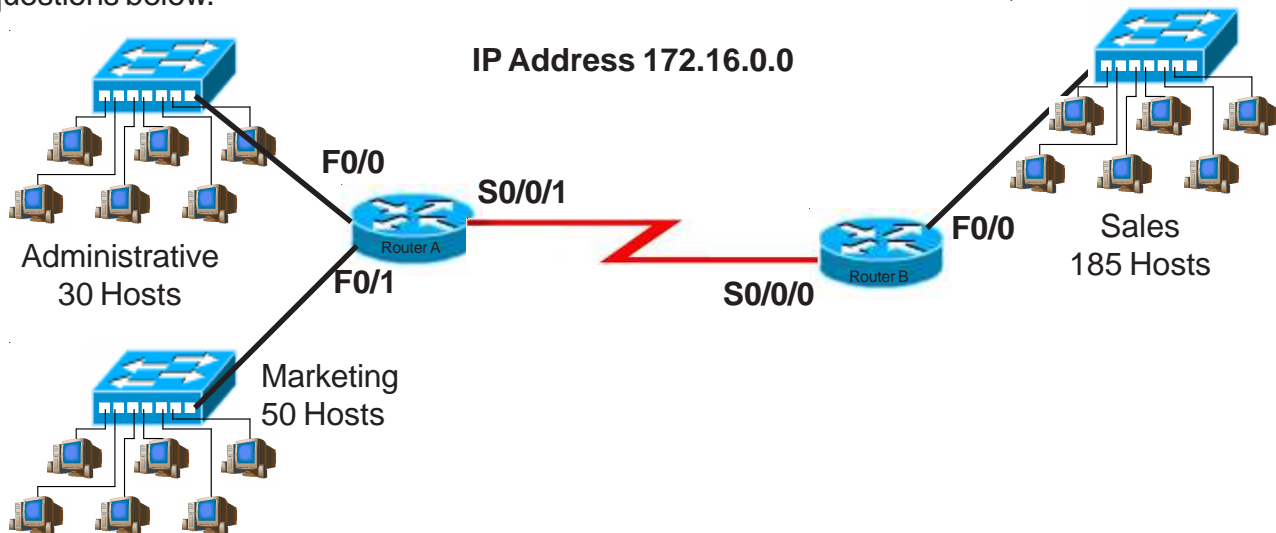
(Round up to 2)

$$\begin{array}{r} 20 \\ \times 3 \\ \hline 6 \end{array}$$

(1)				0	135.126.0.0	to	135.126.0.31
(2)				1	135.126.0.32	to	135.126.0.63
(3)			1	0	135.126.0.64	to	135.126.0.95
(4)			1	1	135.126.0.96	to	135.126.0.127
(5)		1	0	0	135.126.0.128	to	135.126.0.159
(6)		1	0	1	135.126.0.160	to	135.126.0.191
(7)		1	1	0	135.126.0.192	to	135.126.0.223
(8)		1	1	1	135.126.0.224	to	135.126.0.255
(9)	1	0	0	0	135.126.1.0	to	135.126.1.31
(10)	1	0	0	1	135.126.1.32	to	135.126.1.63
(11)	1	0	1	0	135.126.1.64	to	135.126.1.95
(12)	1	0	1	1	135.126.1.96	to	135.126.1.127
(13)	1	1	0	0	135.126.1.128	to	135.126.1.159
(14)	1	1	0	1	135.126.1.160	to	135.126.1.191
(15)	1	1	1	0	135.126.1.192	to	135.126.1.223
(16)	1	1	1	1	135.126.1.224	to	135.126.1.255

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 _____

Custom subnet mask _____

Minimum number of subnets needed _____

Extra subnets required for 25% 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
25% 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 Sales _____

IP address range for Marketing _____

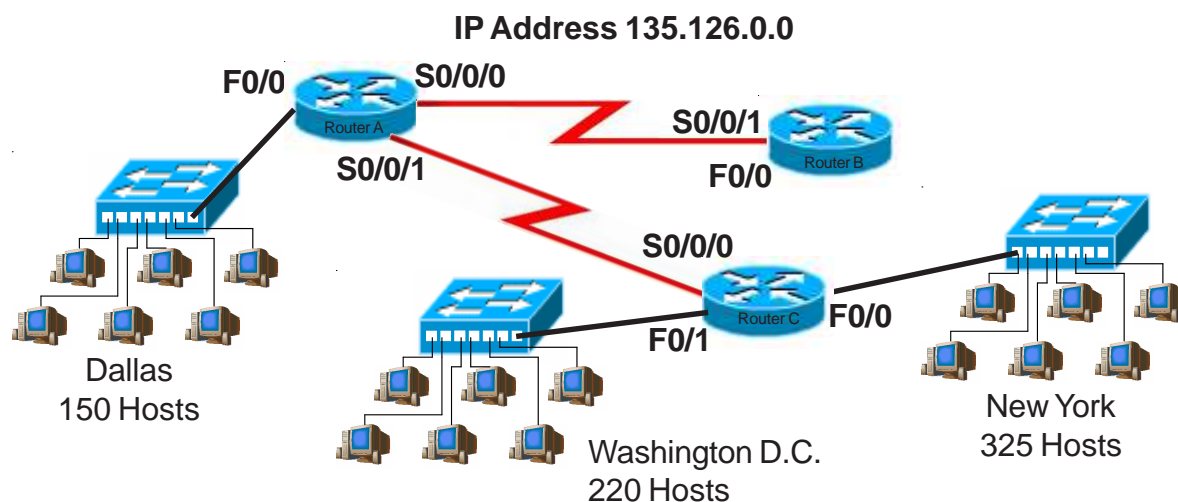
IP address range for Administrative _____

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

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. 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 70% 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
70% 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 New York _____

IP address range for Washington D. C. _____

IP address range for Dallas _____

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

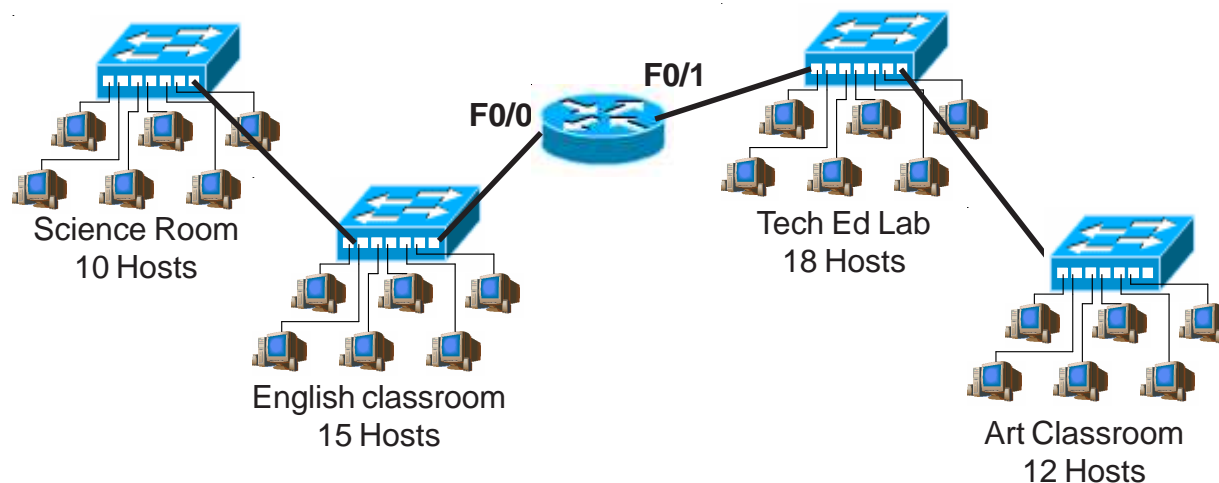
IP address range for Router A
to Router C serial connection _____

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.

IP Address 210.15.10.0



Address class _____

Custom subnet mask _____

Minimum number of subnets needed _____

Extra subnets required for 100% 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
100% 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.

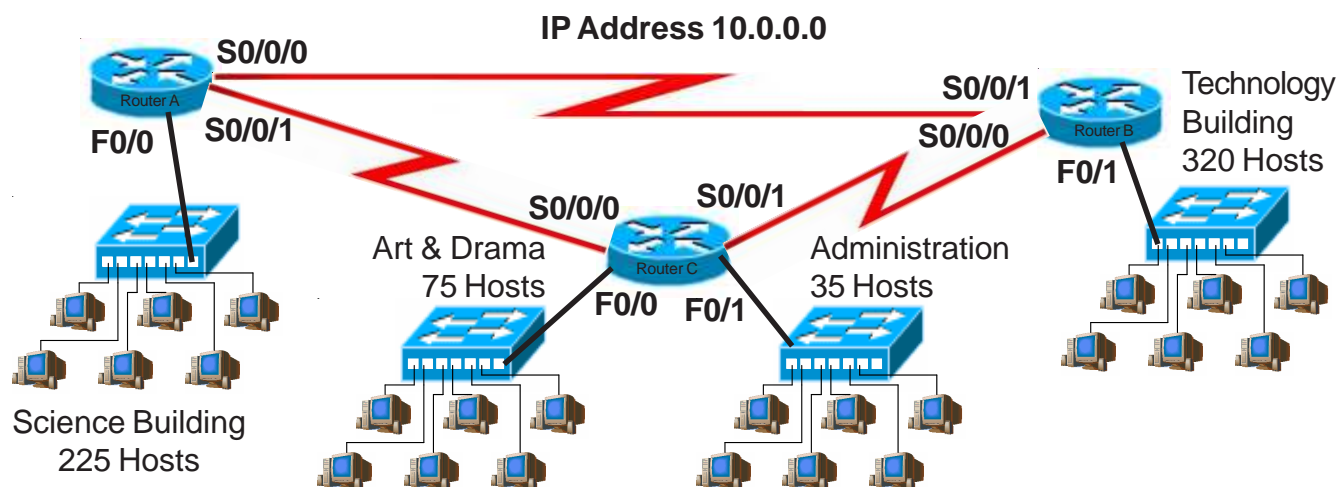
IP address range for Router F0/0 Port _____

IP address range for Router F0/1 Port _____

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 _____

Custom subnet mask _____

Minimum number of subnets needed _____

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

Total number of subnets needed **=** _____

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

IP address range for Technology _____

IP address range for Science _____

IP address range for Arts & Drama _____

IP Address range Administration _____

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

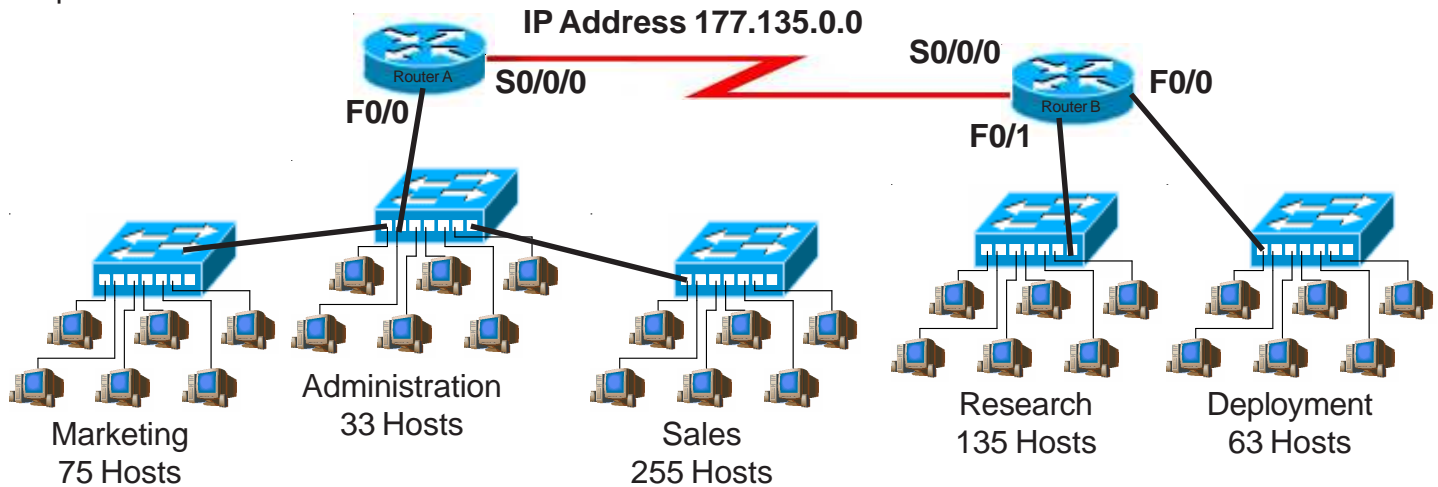
IP address range for Router A
to Router C serial connection _____

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

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 _____

Custom subnet mask _____

Minimum number of subnets needed _____

Extra subnets required for 125% 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
125% 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 Router A Port F0/0 _____

IP address range for Research _____

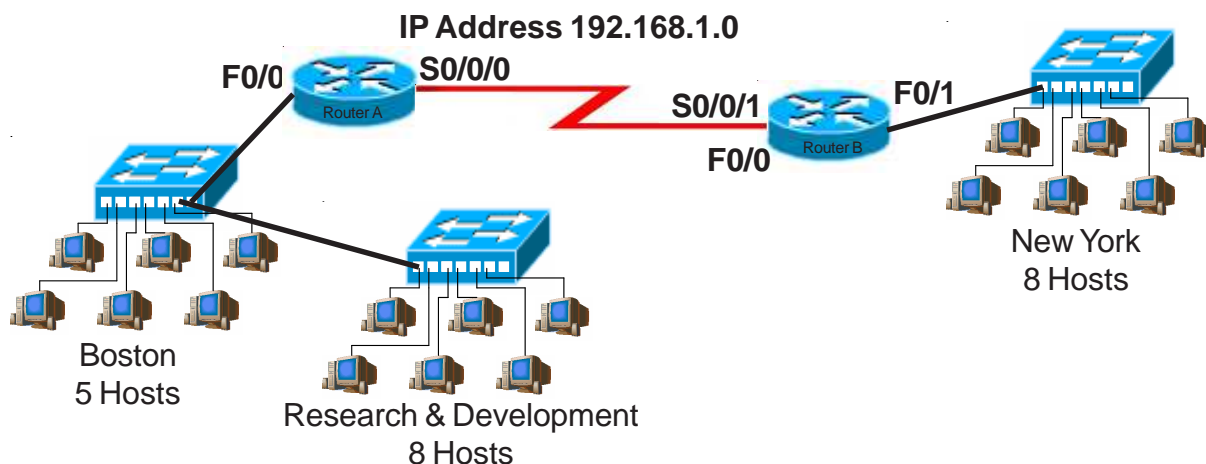
IP address range for Deployment _____

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

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 _____

Custom subnet mask _____

Minimum number of subnets needed _____

Extra subnets required for 85% 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
85% 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 Router A F0/0 _____

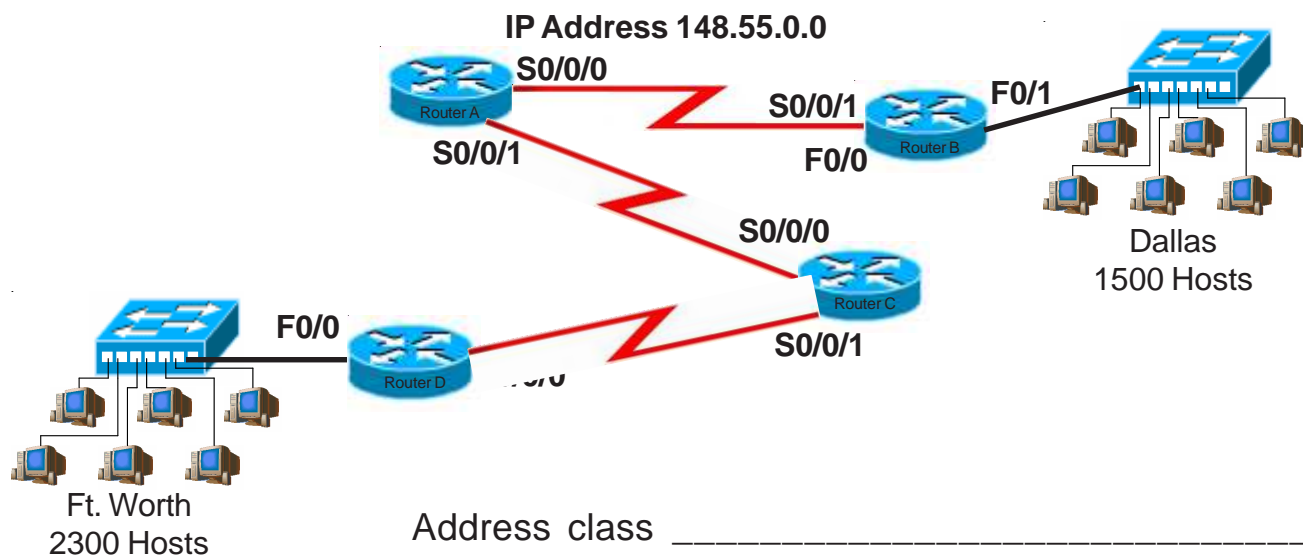
IP address range for New York _____

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

Show your work for Problem 8 in the space below.

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 _____

IP address range for Dallas _____

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

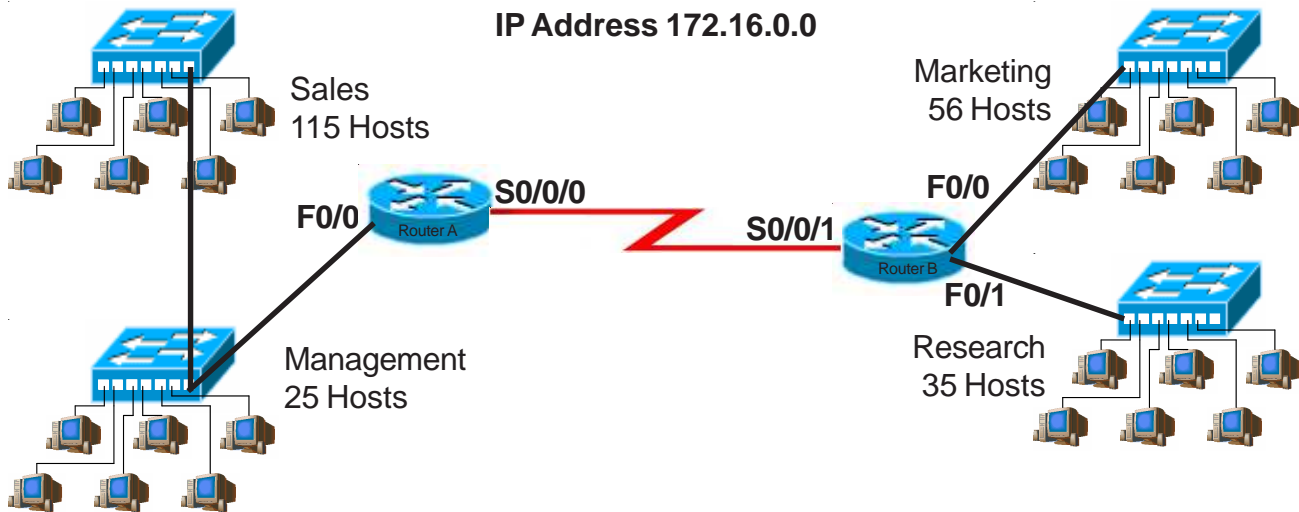
IP address range for Router A
to Router C serial connection _____

IP address range for Router C
to Router D serial connection _____

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 _____

Custom subnet mask _____

Minimum number of subnets needed _____

Extra subnets required for 110% 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
110% 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 Sales/Management _____

IP address range for Marketing _____

IP address range for Research _____

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

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

IP Address: 135.70.191.255

Subnet Mask: 255.255.254.0

Reference Pages 48-49

IP Address: 127.100.100.10

Subnet Mask: 255.0.0.0

Reference Pages Inside Front Cover

IP Address: 93.0.128.1

Subnet Mask: 255.255.224.0

Reference Pages 56-57

IP Address: 200.10.10.128

Subnet Mask: 255.255.255.224

Reference Pages 54-55

IP Address: 165.100.255.189

Subnet Mask: 255.255.255.192

Reference Pages 30-31

IP Address: 190.35.0.10

Subnet Mask: 255.255.255.192

Reference Pages 34-35

IP Address: 218.35.50.195

Subnet Mask: 255.255.0.0

Reference Page Inside Front Cover

IP Address: 200.10.10.175 /22

Reference Pages 54-55 and/or Inside Front Cover

IP Address: 135.70.255.255

Subnet Mask: 255.255.224.0

Reference Pages 48-49

Reference Charts and Support Materials

Class A Addresses
VLSM Chart 8-15 Bits (2nd octet)

β	r_1	r_2	r_3	r_4	r_5	r_6	r_7	r_8	r_9	r_{10}	r_{11}	r_{12}	r_{13}	r_{14}	r_{15}	r_{16}	r_{17}	r_{18}	r_{19}	r_{20}	r_{21}	r_{22}	r_{23}	r_{24}	r_{25}	r_{26}	r_{27}	r_{28}	r_{29}	r_{30}	r_{31}	r_{32}	r_{33}	r_{34}	r_{35}	r_{36}	r_{37}	r_{38}	r_{39}	r_{40}	r_{41}	r_{42}	r_{43}	r_{44}	r_{45}	r_{46}	r_{47}	r_{48}	r_{49}	r_{50}	r_{51}	r_{52}	r_{53}	r_{54}	r_{55}	r_{56}	r_{57}	r_{58}	r_{59}	r_{60}	r_{61}	r_{62}	r_{63}	r_{64}	r_{65}	r_{66}	r_{67}	r_{68}	r_{69}	r_{70}	r_{71}	r_{72}	r_{73}	r_{74}	r_{75}	r_{76}	r_{77}	r_{78}	r_{79}	r_{80}	r_{81}	r_{82}	r_{83}	r_{84}	r_{85}	r_{86}	r_{87}	r_{88}	r_{89}	r_{90}	r_{91}	r_{92}	r_{93}	r_{94}	r_{95}	r_{96}	r_{97}	r_{98}	r_{99}	r_{100}																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
0	201.0	202.0	203.0	204.0	205.0	206.0	207.0	208.0	209.0	210.0	211.0	212.0	213.0	214.0	215.0	216.0	217.0	218.0	219.0	220.0	221.0	222.0	223.0	224.0	225.0	226.0	227.0	228.0	229.0	230.0	231.0	232.0	233.0	234.0	235.0	236.0	237.0	238.0	239.0	240.0	241.0	242.0	243.0	244.0	245.0	246.0	247.0	248.0	249.0	250.0	251.0	252.0	253.0	254.0	255.0	256.0	257.0	258.0	259.0	260.0	261.0	262.0	263.0	264.0	265.0	266.0	267.0	268.0	269.0	270.0	271.0	272.0	273.0	274.0	275.0	276.0	277.0	278.0	279.0	280.0	281.0	282.0	283.0	284.0	285.0	286.0	287.0	288.0	289.0	290.0	291.0	292.0	293.0	294.0	295.0	296.0	297.0	298.0	299.0	300.0	301.0	302.0	303.0	304.0	305.0	306.0	307.0	308.0	309.0	310.0	311.0	312.0	313.0	314.0	315.0	316.0	317.0	318.0	319.0	320.0	321.0	322.0	323.0	324.0	325.0	326.0	327.0	328.0	329.0	330.0	331.0	332.0	333.0	334.0	335.0	336.0	337.0	338.0	339.0	340.0	341.0	342.0	343.0	344.0	345.0	346.0	347.0	348.0	349.0	350.0	351.0	352.0	353.0	354.0	355.0	356.0	357.0	358.0	359.0	360.0	361.0	362.0	363.0	364.0	365.0	366.0	367.0	368.0	369.0	370.0	371.0	372.0	373.0	374.0	375.0	376.0	377.0	378.0	379.0	380.0	381.0	382.0	383.0	384.0	385.0	386.0	387.0	388.0	389.0	390.0	391.0	392.0	393.0	394.0	395.0	396.0	397.0	398.0	399.0	400.0	401.0	402.0	403.0	404.0	405.0	406.0	407.0	408.0	409.0	410.0	411.0	412.0	413.0	414.0	415.0	416.0	417.0	418.0	419.0	420.0	421.0	422.0	423.0	424.0	425.0	426.0	427.0	428.0	429.0	430.0	431.0	432.0	433.0	434.0	435.0	436.0	437.0	438.0	439.0	440.0	441.0	442.0	443.0	444.0	445.0	446.0	447.0	448.0	449.0	450.0	451.0	452.0	453.0	454.0	455.0	456.0	457.0	458.0	459.0	460.0	461.0	462.0	463.0	464.0	465.0	466.0	467.0	468.0	469.0	470.0	471.0	472.0	473.0	474.0	475.0	476.0	477.0	478.0	479.0	480.0	481.0	482.0	483.0	484.0	485.0	486.0	487.0	488.0	489.0	490.0	491.0	492.0	493.0	494.0	495.0	496.0	497.0	498.0	499.0	500.0	501.0	502.0	503.0	504.0	505.0	506.0	507.0	508.0	509.0	510.0	511.0	512.0	513.0	514.0	515.0	516.0	517.0	518.0	519.0	520.0	521.0	522.0	523.0	524.0	525.0	526.0	527.0	528.0	529.0	530.0	531.0	532.0	533.0	534.0	535.0	536.0	537.0	538.0	539.0	540.0	541.0	542.0	543.0	544.0	545.0	546.0	547.0	548.0	549.0	550.0	551.0	552.0	553.0	554.0	555.0	556.0	557.0	558.0	559.0	560.0	561.0	562.0	563.0	564.0	565.0	566.0	567.0	568.0	569.0	570.0	571.0	572.0	573.0	574.0	575.0	576.0	577.0	578.0	579.0	580.0	581.0	582.0	583.0	584.0	585.0	586.0	587.0	588.0	589.0	590.0	591.0	592.0	593.0	594.0	595.0	596.0	597.0	598.0	599.0	600.0	601.0	602.0	603.0	604.0	605.0	606.0	607.0	608.0	609.0	610.0	611.0	612.0	613.0	614.0	615.0	616.0	617.0	618.0	619.0	620.0	621.0	622.0	623.0	624.0	625.0	626.0	627.0	628.0	629.0	630.0	631.0	632.0	633.0	634.0	635.0	636.0	637.0	638.0	639.0	640.0	641.0	642.0	643.0	644.0	645.0	646.0	647.0	648.0	649.0	650.0	651.0	652.0	653.0	654.0	655.0	656.0	657.0	658.0	659.0	660.0	661.0	662.0	663.0	664.0	665.0	666.0	667.0	668.0	669.0	670.0	671.0	672.0	673.0	674.0	675.0	676.0	677.0	678.0	679.0	680.0	681.0	682.0	683.0	684.0	685.0	686.0	687.0	688.0	689.0	690.0	691.0	692.0	693.0	694.0	695.0	696.0	697.0	698.0	699.0	700.0	701.0	702.0	703.0	704.0	705.0	706.0	707.0	708.0	709.0	710.0	711.0	712.0	713.0	714.0	715.0	716.0	717.0	718.0	719.0	720.0	721.0	722.0	723.0	724.0	725.0	726.0	727.0	728.0	729.0	730.0	731.0	732.0	733.0	734.0	735.0	736.0	737.0	738.0	739.0	740.0	741.0	742.0	743.0	744.0	745.0	746.0	747.0	748.0	749.0	750.0	751.0	752.0	753.0	754.0	755.0	756.0	757.0	758.0	759.0	760.0	761.0	762.0	763.0	764.0	765.0	766.0	767.0	768.0	769.0	770.0	771.0	772.0	773.0	774.0	775.0	776.0	777.0	778.0	779.0	780.0	781.0	782.0	783.0	784.0	785.0	786.0	787.0	788.0	789.0	790.0	791.0	792.0	793.0	794.0	795.0	796.0	797.0	798.0	799.0	800.0	801.0	802.0	803.0	804.0	805.0	806.0	807.0	808.0	809.0	810.0	811.0	812.0	813.0	814.0	815.0	816.0	817.0	818.0	819.0	820.0	821.0	822.0	823.0	824.0	825.0	826.0	827.0	828.0	829.0	830.0	831.0	832.0	833.0	834.0	835.0	836.0	837.0	838.0	839.0	840.0	841.0	842.0	843.0	844.0	845.0	846.0	847.0	848.0	849.0	850.0	851.0	852.0	853.0	854.0	855.0	856.0	857.0	858.0	859.0	860.0	861.0	862.0	863.0	864.0	865.0	866.0	867.0	868.0	869.0	870.0	871.0	872.0	873.0	874.0	875.0	876.0	877.0	878.0	879.0	880.0	881.0	882.0	883.0	884.0	885.0	886.0	887.0	888.0	889.0	890.0	891.0	892.0	893.0	894.0	895.0	896.0	897.0	898.0	899.0	900.0	901.0	902.0	903.0	904.0	905.0	906.0	907.0	908.0	909.0	910.0	911.0	912.0	913.0	914.0	915.0	916.0	917.0	918.0	919.0	920.0	921.0	922.0	923.0	924.0	925.0	926.0	927.0	928.0	929.0	930.0	931.0	932.0	933.0	934.0	935.0	936.0	937.0	938.0	939.0	940.0	941.0	942.0	943.0	944.0	945.0	946.0	947.0	948.0	949.0	950.0	951.0	952.0	953.0	954.0	955.0	956.0	957.0	958.0	959.0	960.0	961.0	962.0	963.0	964.0	965.0	966.0	967.0	968.0	969.0	970.0	971.0	972.0	973.0	974.0	975.0	976.0	977.0	978.0	979.0	980.0	981.0	982.0	983.0	984.0	985.0	986.0	987.0	988.0	989.0	990.0	991.0	992.0	993.0	994.0	995.0	996.0	997.0	998.0	999.0	1000.0
0.01													9.93	8.7	7.9	7.2	6.6	6.1	5.7	5.3	5.0	4.7	4.4	4.2	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																																																																																																																																																																																																																																																																																																																																																																																																																

Class B Addresses
VLSM Chart 16-23 Bits (3rd octet)

16 161-200 16,100 hours	17 161-200 17,700 hours	18 161-200 18,300 hours	19 161-200 19,000 hours	20 161-200 20,000 hours	21 161-200 21,000 hours	22 161-200 22,000 hours	23 161-200 23,000 hours
				0-15	0-15	0-15	0-15
					16-30	16-30	16-30
					31-45	31-45	31-45
					46-60	46-60	46-60
					61-75	61-75	61-75
					76-90	76-90	76-90
					91-105	91-105	91-105
					106-120	106-120	106-120
					121-135	121-135	121-135
					136-150	136-150	136-150
					151-165	151-165	151-165
					166-180	166-180	166-180
					181-195	181-195	181-195
					196-210	196-210	196-210
					211-225	211-225	211-225
					226-240	226-240	226-240
					241-255	241-255	241-255
					256-270	256-270	256-270
					271-285	271-285	271-285
					286-300	286-300	286-300
					301-315	301-315	301-315
					316-330	316-330	316-330
					331-345	331-345	331-345
					346-360	346-360	346-360
					361-375	361-375	361-375
					376-390	376-390	376-390
					391-405	391-405	391-405
					406-420	406-420	406-420
					421-435	421-435	421-435
					436-450	436-450	436-450
					451-465	451-465	451-465
					466-480	466-480	466-480
					481-495	481-495	481-495
					496-510	496-510	496-510
					511-525	511-525	511-525
					526-540	526-540	526-540
					541-555	541-555	541-555
					556-570	556-570	556-570
					571-585	571-585	571-585
					586-600	586-600	586-600
					601-615	601-615	601-615
					616-630	616-630	616-630
					631-645	631-645	631-645
					646-660	646-660	646-660
					661-675	661-675	661-675
					676-690	676-690	676-690
					691-705	691-705	691-705
					706-720	706-720	706-720
					721-735	721-735	721-735
					736-750	736-750	736-750
					751-765	751-765	751-765
					766-780	766-780	766-780
					781-795	781-795	781-795
					796-810	796-810	796-810
					811-825	811-825	811-825
					826-840	826-840	826-840
					841-855	841-855	841-855
					856-870	856-870	856-870
					871-885	871-885	871-885
					886-900	886-900	886-900
					901-915	901-915	901-915
					916-930	916-930	916-930
					931-945	931-945	931-945
					946-960	946-960	946-960
					961-975	961-975	961-975
					976-990	976-990	976-990
					991-1005	991-1005	991-1005
					1006-1020	1006-1020	1006-1020
					1021-1035	1021-1035	1021-1035
					1036-1050	1036-1050	1036-1050
					1051-1065	1051-1065	1051-1065
					1066-1080	1066-1080	1066-1080
					1081-1095	1081-1095	1081-1095
					1096-1110	1096-1110	1096-1110
					1111-1125	1111-1125	1111-1125
					1126-1140	1126-1140	1126-1140
					1141-1155	1141-1155	1141-1155
					1156-1170	1156-1170	1156-1170
					1171-1185	1171-1185	1171-1185
					1186-1200	1186-1200	1186-1200
					1201-1215	1201-1215	1201-1215
					1216-1230	1216-1230	1216-1230
					1231-1245	1231-1245	1231-1245
					1246-1260	1246-1260	1246-1260
					1261-1275	1261-1275	1261-1275
					1276-1290	1276-1290	1276-1290
					1291-1305	1291-1305	1291-1305
					1306-1320	1306-1320	1306-1320
					1321-1335	1321-1335	1321-1335
					1336-1350	1336-1350	1336-1350
					1351-1365	1351-1365	1351-1365
					1366-1380	1366-1380	1366-1380
					1381-1395	1381-1395	1381-1395
					1396-1410	1396-1410	1396-1410
					1411-1425	1411-1425	1411-1425
					1426-1440	1426-1440	1426-1440
					1441-1455	1441-1455	1441-1455
					1456-1470	1456-1470	1456-1470
					1471-1485	1471-1485	1471-1485
					1486-1500	1486-1500	1486-1500
					1501-1515	1501-1515	1501-1515
					1516-1530	1516-1530	1516-1530
					1531-1545	1531-1545	1531-1545
					1546-1560	1546-1560	1546-1560
					1561-1575	1561-1575	1561-1575
					1576-1590	1576-1590	1576-1590
					1591-1605	1591-1605	1591-1605
					1606-1620	1606-1620	1606-1620
					1621-1635	1621-1635	1621-1635
					1636-1650	1636-1650	1636-1650
					1651-1665	1651-1665	1651-1665
					1666-1680	1666-1680	1666-1680
					1681-1695	1681-1695	1681-1695
					1696-1710	1696-1710	1696-1710
					1711-1725	1711-1725	1711-1725
					1726-1740	1726-1740	1726-1740
					1741-1755	1741-1755	1741-1755
					1756-1770	1756-1770	1756-1770
					1771-1785	1771-1785	1771-1785
					1786-1800	1786-1800	1786-1800
					1801-1815	1801-1815	1801-1815
					1816-1830	1816-1830	1816-1830
					1831-1845	1831-1845	1831-1845
					1846-1860	1846-1860	1846-1860
					1861-1875	1861-1875	1861-1875
					1876-1890	1876-1890	1876-1890
					1891-1905	1891-1905	1891-1905
					1906-1920	1906-1920	1906-1920
					1921-1935	1921-1935	1921-1935
					1936-1950	1936-1950	1936-1950
					1951-1965	1951-1965	1951-1965
					1966-1980	1966-1980	1966-1980
					1981-1995	1981-1995	1981-1995
					1996-2010	1996-2010	1996-2010
					2011-2025	2011-2025	2011-2025
					2026-2040	2026-2040	2026-2040
					2041-2055	2041-2055	2041-2055
					2056-2070	2056-2070	2056-2070
					2071-2085	2071-2085	2071-2085
					2086-2100	2086-2100	2086-2100
					2101-2115	2101-2115	2101-2115
					2116-2130	2116-2130	2116-2130
					2131-2145	2131-2145	2131-2145
					2146-2160	2146-2160	2146-2160
					2161-2175	2161-2175	2161-2175
					2176-2190	2176-2190	2176-2190
					2191-2205	2191-2205	2191-2205
					2206-2220	2206-2220	2206-2220
					2221-2235	2221-2235	2221-2235
					2236-2250	2236-2250	2236-2250
					2251-2265	2251-2265	2251-2265
					2266-2280	2266-2280	2266-2280
					2281-2295	2281-2295	2281-2295
					2296-2310	2296-2310	2296-2310
					2311-2325	2311-2325	2311-2325
					2326-2340	2326-2340	2326-2340
					2341-2355	2341-2355	2341-2355
					2356-2370	2356-2370	2356-2370
					2371-2385	2371-2385	2371-2385
					2386-2400	2386-2400	2386-2400
					2401-2415	2401-2415	2401-2415
					2416-2430	2416-2430	2416-2430
					2431-2445	2431-2445	2431-2445
					2446-2460	2446-2460	2446-2460
					2461-2475	2461-2475	2461-2475
					2476-2490	2476-2490	2476-2490
					2491-2505	2491-2505	2491-2505
					2506-2520	2506-2520	2506-2520
					2521-2535	2521-2535	2521-2535
					2536-2550	2536-2550	2536-2550
					2551-2565	2551-2565	2551-2565
					2566-2580	2566-2580	2566-2580
					2581-2595	2581-2595	2581-2595
					2596-2610	2596-2610	2596-2610
					2611-2625	2611-2625	2611-2625
					2626-2640	2626-2640	2626-2640
					2641-2655	2641-2655	2641-2655
					2656-2670	2656-2670	2656-2670
					2671-2685	2671-2685	2671-2685
					2686-2700	2686-2700	2686-2700
					2701-2715	2701-2715	2701-2715
					2716-2730	2716-2730	2716-2730
					2731-2745	2731-2745	2731-2745
					2746-2760	2746-2760	2746-2760
					2761-2775	2761-2775	2761-2775
					2776-2790	2776-2790	2776-2790
					2791-2805	2791-2805	2791-2805
					2806-2820	2806-2820	2806-2820
					2821-2835	2821-2835	2821-2835
					2836-2850	2836-2850	2836-2850
					2851-2865</		

Class C Addresses
VLSM Chart 24-30 Bits (4th octet)

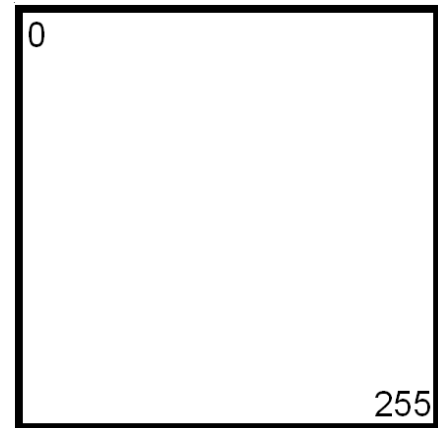
D4	D5	D6	D7	D8	D9	D10
205,206,207,208	209,210,211,212	213,214,215,216	217,218,219,220	221,222,223,224	225,226,227,228	229,230,231,232
			0-15	0-7	0-7	0-7
				8-16	8-16	8-16
		0-31	16-23	16-23	16-23	16-23
			24-31	24-31	24-31	24-31
			32-39	32-39	32-39	32-39
		32-63	40-47	40-47	40-47	40-47
			48-55	48-55	48-55	48-55
			56-63	56-63	56-63	56-63
			64-71	64-71	64-71	64-71
		64-95	72-79	72-79	72-79	72-79
			80-87	80-87	80-87	80-87
			88-95	88-95	88-95	88-95
			96-103	96-103	96-103	96-103
			104-111	104-111	104-111	104-111
			112-119	112-119	112-119	112-119
			120-127	120-127	120-127	120-127
			128-135	128-135	128-135	128-135
			136-143	136-143	136-143	136-143
			144-151	144-151	144-151	144-151
			152-159	152-159	152-159	152-159
			160-167	160-167	160-167	160-167
			168-175	168-175	168-175	168-175
			176-183	176-183	176-183	176-183
			184-191	184-191	184-191	184-191
			192-199	192-199	192-199	192-199
			200-207	200-207	200-207	200-207
			208-215	208-215	208-215	208-215
			216-223	216-223	216-223	216-223
			224-231	224-231	224-231	224-231
			232-239	232-239	232-239	232-239
			240-247	240-247	240-247	240-247
			248-255	248-255	248-255	248-255

Visualizing Subnets Using The Box Method

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

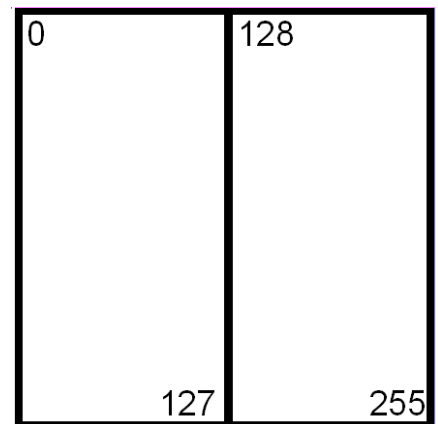
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



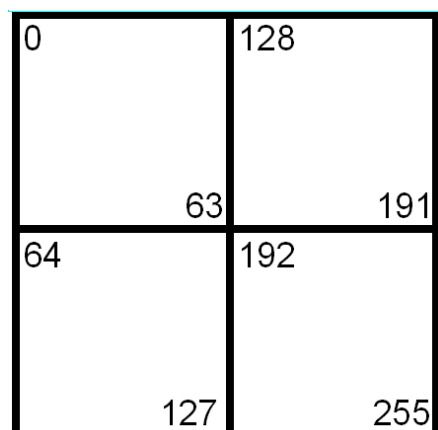
Split the box in half and you get two subnets with 128 addresses,

/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
64	96	192	224
	95	127	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
16	48	144	176
	31	63	159
64	96	192	224
	79	111	207
80	112	208	240
	95	127	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	175
16	24	48	56	144	152	176	184
	23	31	55	63	151	159	183
64	72	96	104	192	200	224	232
	71	79	103	111	199	207	239
80	88	112	120	208	216	240	248
	87	95	119	127	215	223	255

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

/30
255.255.255.252
4 Hosts
64 Subnets

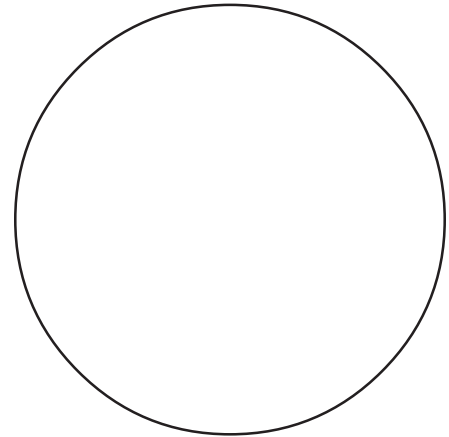
0	8	32	40	128	136	160	168
	3	11	35	43	131	139	171
4	12	36	44	132	140	164	172
	7	15	39	47	135	143	175
16	24	48	56	144	152	176	184
	19	27	51	59	147	155	179
20	28	52	60	148	156	180	188
	23	31	55	63	151	159	183
64	72	96	104	192	200	224	232
	67	75	99	107	195	203	235
68	76	100	108	196	204	228	236
	71	79	103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

Visualizing Subnets Using The Circle Method

The circle method is another method used to visualize the breakdown of subnets and addresses into smaller sizes. By shading or coloring in the different sections of the circle you can easily break up your subnets without overlapping your addresses. You adjust each subnet to the correct size needed.

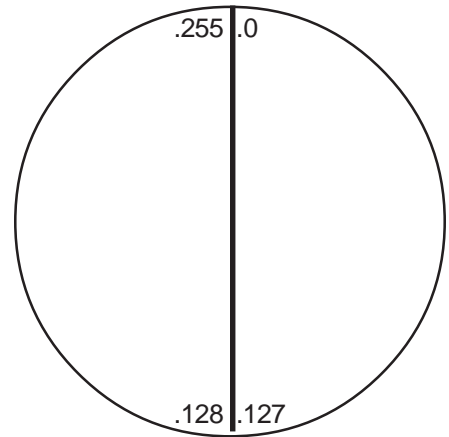
Start with a circle. The whole circle is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



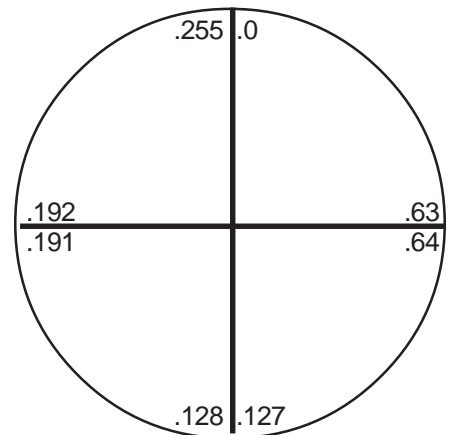
Split the circle in half and you get two subnets with 128 addresses.

/25
255.255.255.128
128 Hosts
2 Subnets



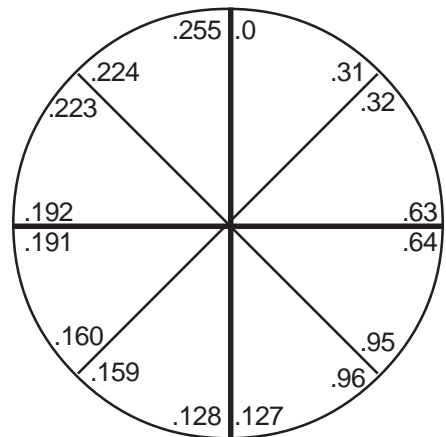
Divide the circle into quarters and you get four subnets with 64 addresses.

/26
255.255.255.192
64 Hosts
4 Subnets



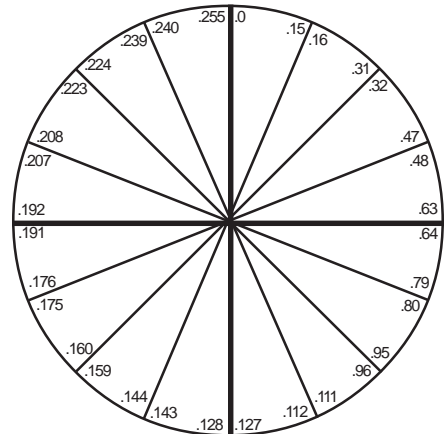
Split each quarter and you get eight subnets with 32 addresses.

/27
255.255.255.224
32 Hosts
8 Subnets



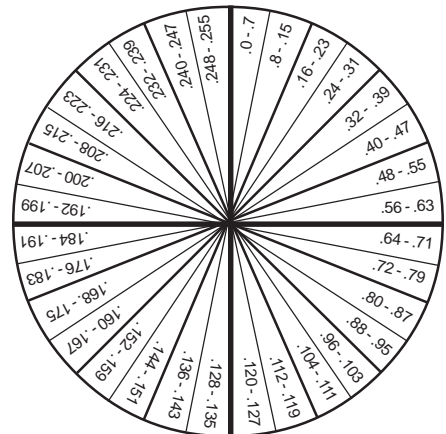
Split the boxes in half again and you get sixteen subnets with sixteen addresses.

/28
255.255.255.240
16 Hosts
16 Subnets



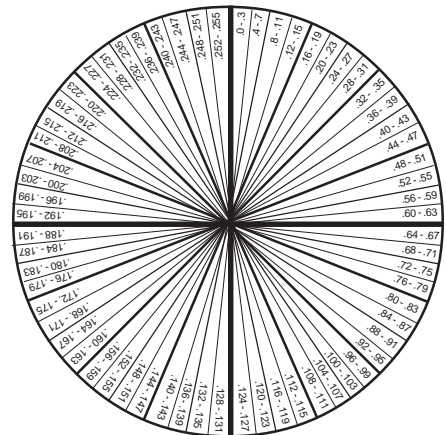
The next split gives you thirty two subnets with eight addresses.

/29
255.255.255.248
8 Hosts
32 Subnets



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

/30
255.255.255.252
4 Hosts
64 Subnets



Class A Addresses

VLSM Chart 8-15 Bits (2nd octet)

/8	/9	/10	/11	/12	/13	/14	/15				
255.0.0.0 16,777,216 Hosts	255.128.0.0 8,388,608 Hosts	255.192.0.0 4,194,304 Hosts	255.224.0.0 2,097,152 Hosts	255.240.0.0 1,048,576 Hosts	255.248.0.0 524,288 Hosts	255.252.0.0 262,144 Hosts	255.254.0.0 131,072 Hosts				
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1				
					8-15	4-7	2-3				
				16-31	16-23	8-11	4-5				
					24-31	12-15	6-7				
					32-63	40-47	16-19	8-9			
						48-63	48-55	20-23	10-11		
			56-63	24-27			12-13				
			64-71	28-31			14-15				
			64-127	64-95	80-87		32-35	16-17			
					88-95	36-39	18-19				
					96-111	40-43	20-21				
						96-99	44-45	22-23			
				96-127	112-119	48-47	24-25				
					120-127	124-127	52-55	26-27			
						128-135	56-59	28-29			
					128-191	128-159	136-143	60-63	30-31		
		144-159					140-143	32-33			
							148-151	34-35			
		152-159	36-37								
		160-191	160-167	38-39		36-37					
			168-175	164-167		40-41	38-39				
				176-183		168-171	42-43				
			176-191	184-191		172-175	44-45				
				188-191		176-179	46-47				
				128-255		128-219	192-199	180-183	48-49		
		200-207					184-187	50-51			
		208-223	188-191				52-53				
			216-223				54-55				
		192-255	224-231				56-57				
			232-239				228-231	58-59			
							240-247	60-61			
			240-255		244-247		62-63				
					248-255	248-251	64-65				
						252-255	66-67				
			72-75								
		76-79	70-71								
		80-83	72-73								
		84-87	74-75								
		88-91	76-77								
		92-95	78-79								
		96-99	80-81								
		100-103	82-83								
		104-107	84-85								
		108-111	86-87								
	112-115	88-89									
	116-119	90-91									
	120-123	92-93									
	124-127	94-95									
	128-131	96-97									
	132-135	98-99									
	136-139	100-101									
	140-143	102-103									
	144-147	104-105									
	148-149	106-107									
	152-153	108-109									
	156-157	110-111									
	160-159	112-113									
	164-163	114-115									
	168-167	116-117									
	172-169	118-119									
	176-177	120-121									
	180-183	122-123									
	184-185	124-125									
	188-189	126-127									
	192-193	128-129									
	196-197	130-131									
	198-199	132-133									
	200-201	134-135									
	202-203	136-137									
	204-205	138-139									
	206-207	140-141									
	208-209	142-143									
	210-211	144-145									
	212-213	146-147									
	214-215	148-149									
	216-217	150-151									
	218-219	152-153									
	220-221	154-155									
	222-223	156-157									
	224-225	158-159									
	226-227	160-161									
	228-229	162-163									
	230-231	164-165									
	232-233	166-167									
	234-235	168-169									
	236-237	170-171									
	238-239	172-173									
	240-241	174-175									
	242-243	176-177									
	244-245	178-179									
	246-247	180-181									
	248-249	182-183									
	250-251	184-185									
	252-253	186-187									
	254-255	188-189									
		190-191									
		192-193									
		194-195									
		196-197									
		198-199									
		200-201									
		202-203									
		204-205									
		206-207									
		208-209									
		210-211									
		212-213									
		214-215									
		216-217									
		218-219									
		220-221									
		222-223									
		224-225									
		226-227									
		228-229									
		230-231									
		232-233									
		234-235									
		236-237									
		238-239									
		240-241									
		242-243									
		244-245									
		246-247									
		248-249									
		250-251									
		252-253									
		254-255									

Class B Addresses

VLSM Chart 16-23 Bits (3rd octet)

/16 255.255.0.0 65,536 Hosts	/17 255.255.128.0 32,768 Hosts	/18 255.255.192.0 16,384 Hosts	/19 255.255.224.0 8,192 Hosts	/20 255.255.240.0 4,096 Hosts	/21 255.255.248.0 2,048 Hosts	/22 255.255.252.0 1,024 Hosts	/23 255.255.254.0 512 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1
					4-7	4-5	2-3
					8-15	8-11	6-7
						12-15	8-9
			16-31	16-23		16-19	10-11
						20-23	4-5
				24-31		24-27	6-7
						28-31	8-9
			32-63	32-39		32-35	12-13
						36-39	14-15
				40-47		40-43	16-17
						44-47	18-19
				48-63		48-51	20-21
						52-55	22-23
						56-59	24-25
					56-63	60-63	26-27
	64-127	64-127	64-95	64-79	64-71	64-67	28-29
						68-71	30-31
				80-95	72-79	72-75	32-33
					80-87	80-83	34-35
			96-127	88-95		84-87	36-37
						88-91	38-39
				96-103		92-95	40-41
						96-99	42-43
			96-111	100-103		100-103	44-45
						104-107	46-47
				104-111		108-111	48-49
						112-115	50-51
			112-127	112-119		116-119	52-53
						120-123	54-55
				120-127		124-127	56-57
						128-131	58-59
	128-255	128-191	128-159	128-143		128-135	60-61
						132-135	62-63
				136-143		136-139	64-65
						140-143	66-67
			144-159	144-151		144-147	68-69
						148-151	70-71
				152-159		152-155	72-73
						156-159	74-75
			160-191	160-167		160-163	76-77
						164-167	78-79
				168-175		168-171	80-81
						172-175	82-83
			176-191	176-183		176-179	84-85
						180-183	86-87
				184-191		184-187	88-89
						188-191	90-91
	192-255	192-223	192-207	192-199		192-195	92-93
						196-199	94-95
				200-207		200-203	96-97
						204-207	98-99
			208-223	208-215		208-211	100-101
						212-215	102-103
				216-223		216-219	104-105
						220-223	106-107
		224-255	224-239	224-231		224-227	108-109
						228-231	110-111
				232-239		232-235	112-113
						236-239	114-115
			240-255	240-247		240-243	116-117
						244-247	118-119
				248-255		248-251	120-121
						252-255	122-123

Class C Addresses

VLSM Chart 24-30 Bits (4th octet)

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

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