

00011001

**IP Addressing
and
Subnetting**
Workbook
Version 1.1

00011001

11111110

10010101

00011011

10000110

11010011

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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Special Thanks to Melvin Baker and Jim Dorsch
for taking the time to check this workbook for errors.

Binary To Decimal Conversion

128	64	32	16	8	4	2	1	Answers	Scratch Area
1	0	0	1	0	0	1	0	146	128 16 32
0	1	1	1	0	1	1	1	119	2 146 4
1	1	1	1	1	1	1	1		2 1
1	1	0	0	0	1	0	1		119
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	
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>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

Default Subnet Masks

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

177.100.18.4 255 . 255 . 0 . 0

119.18.45.0 255 . 0 . 0 . 0

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: **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 . 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 . 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)

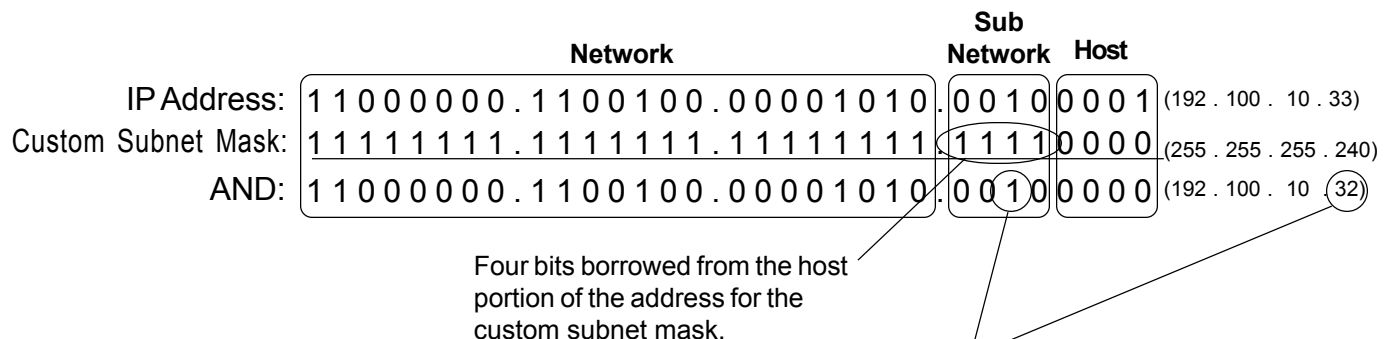
ANDING with the default subnet mask allows your computer to figure out the network portion of the address.

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 (Invalid Range)
 192.100.10.16 to 192.100.10.31 (1st Usable Range)
 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 (Invalid Range)



The ANDING process of the four borrowed bits shows which range of IP addresses this particular address will fall into.

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

Custom Subnet Masks

Problem 1

Number of needed usable 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

Number of usable subnets 14

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	-	<i>Number of Hosts</i>
<i>Number of Subnets</i>	-	2	4	8	16	32	64	128	256		
	128	64	32	16	8	4	2	1	-	<i>Binary values</i>	
192 . 10 . 10 . 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
64
32
+16
240

16	Observe the total number of hosts.
-2	
14	Subtract 2 for the number of usable hosts.

16	
-2	Subtract 2 for the total number of subnets to get the usable number of subnets.
14	

Custom Subnet Masks

Problem 2

Number of needed usable 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**

Number of usable subnets **1,022**

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	0	0	0	0	0	0	0	0	0	0	0	0

128
 64
 32
 16
 8
 4
 2
 +1

 255

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

1024
 -2

 1,022

Subtract 2 for the total number of subnets to get the usable number of subnets.

64
 -2

 62

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

Custom Subnet Masks

Problem 3

/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.

Network Address **148.75.0.0 /26**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Number of usable subnets 1,022

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	65536
Binary values	-	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
		148	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0

$$\begin{array}{r} 128 \\ 64 \\ 32 \\ 16 \\ 8 \\ 4 \\ 2 \\ +1 \\ \hline 255 \end{array}$$

$$\begin{array}{r} 1024 \\ -2 \\ \hline 1,022 \end{array}$$

$$\begin{array}{r} 64 \\ -2 \\ \hline 62 \end{array}$$

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

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

Subtract 2 for the total number of subnets to get the usable number of subnets.

Custom Subnet Masks

Problem 4

Number of needed usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

Show your work for Problem 4 in the space below.

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

Custom Subnet Masks

Problem 5

Number of needed usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

Show your work for Problem 5 in the space below.

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

Custom Subnet Masks

Problem 7

Number of needed usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

Show your work for Problem 7 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	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

Custom Subnet Masks

Problem 8

Number of needed usable subnets **1**

Number of needed usable hosts **45**

Network Address **200.175.14.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable 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 usable 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 _____

Number of usable 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 _____

Number of usable 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 usable subnets **250**

Network Address **101.0.0.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable 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 usable subnets **5**

Network Address **218.35.50.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable 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 _____

Number of usable 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 usable subnets **10**

Network Address **172.59.0.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable 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 _____

Number of usable 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 _____

Number of usable 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 usable 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

Number of usable subnets 14

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

What is the 3rd usable subnet range? 192.10.10.48 to 192.10.10.63

What is the subnet number for the 7th usable subnet? 192 . 10 . 10 . 112

What is the subnet broadcast address for the 12th usable subnet? 192 . 10 . 10 . 207

What are the assignable addresses for the 8th usable subnet? 192.10.10.129 to 192.10.10.142

Show your work for Problem 1 in the space below.

<p style="text-align: right; margin: 0;">Number of Subnets - 2 4 8 16</p> <p style="text-align: right; margin: 0;">128 64 32 16</p> <p style="font-size: 1.2em; margin: 0;">192.10.10.0 0 0 0 0</p>	<p style="text-align: right; margin: 0;">16 8 4 2 - Number of Hosts</p> <p style="text-align: right; margin: 0;">32 64 128 256</p> <p style="text-align: right; margin: 0;">8 4 2 1 - Binary values</p> <p style="font-size: 1.2em; margin: 0;">0 0 0 0</p>																																																
<p style="margin: 0;">(Invalid range) 0</p> <p style="margin: 0;">1</p> <p style="margin: 0;">1 0</p> <p style="margin: 0;">1 1</p> <p style="margin: 0;">1 0 0</p> <p style="margin: 0;">1 0 1</p> <p style="margin: 0;">1 1 0</p> <p style="margin: 0;">1 1 1</p> <p style="margin: 0;">1 0 0 0</p> <p style="margin: 0;">1 0 0 1</p> <p style="margin: 0;">1 0 1 0</p> <p style="margin: 0;">1 0 1 1</p> <p style="margin: 0;">1 1 0 0</p> <p style="margin: 0;">1 1 0 1</p> <p style="margin: 0;">1 1 1 0</p> <p style="margin: 0;">(Invalid range) 1 1 1 1</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.0</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.15</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.16</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.31</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.32</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.47</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.48</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.63</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.64</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.79</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.80</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.95</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.96</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.111</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.112</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.127</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.128</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.143</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.144</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.159</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.160</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.175</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.176</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.191</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.192</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.207</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.208</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.223</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.224</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.239</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">192.10.10.240</td> <td style="padding: 5px;">to</td> <td style="padding: 5px;">192.10.10.255</td> </tr> </table>	192.10.10.0	to	192.10.10.15	192.10.10.16	to	192.10.10.31	192.10.10.32	to	192.10.10.47	192.10.10.48	to	192.10.10.63	192.10.10.64	to	192.10.10.79	192.10.10.80	to	192.10.10.95	192.10.10.96	to	192.10.10.111	192.10.10.112	to	192.10.10.127	192.10.10.128	to	192.10.10.143	192.10.10.144	to	192.10.10.159	192.10.10.160	to	192.10.10.175	192.10.10.176	to	192.10.10.191	192.10.10.192	to	192.10.10.207	192.10.10.208	to	192.10.10.223	192.10.10.224	to	192.10.10.239	192.10.10.240	to	192.10.10.255
192.10.10.0	to	192.10.10.15																																															
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192.10.10.224	to	192.10.10.239																																															
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 and last range of addresses are not usable.

The first usable range of addresses is: 192.10.10.16 to 192.10.10.31.

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 usable 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*

Number of usable subnets *1,022*

Total number of host addresses *64*

Number of usable addresses *62*

Number of bits borrowed *10*

What is the 14th usable subnet range? *165.100.3.128 to 165.100.3.191*

What is the subnet number for the 5th usable subnet? *165 . 100 . 1 . 64*

What is the subnet broadcast address for the 5th usable subnet? *165 . 100 . 1 . 127*

What are the assignable addresses for the 8th usable subnet? *165.100.2.1 to 165.100.0.62*

Show your work for Problem 2 in the space below.

Number of Hosts -	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536
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	1	1	1	1	1	1	1	1
165.100.0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Usable subnets	1024	128	64	32	16	8	4	2	1	1	1	1	1	1	1	1
Custom subnet mask	192	255	255	255	255	255	255	255	255	255	255	255	255	255	255	255
Usable subnets	1,022	128	64	32	16	8	4	2	1	1	1	1	1	1	1	1
Usable hosts	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
Binary values -	128	64	32	16	8	4	2	1	1	1	1	1	1	1	1	1
165.100.0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165.100.0.63	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
165.100.0.127	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165.100.0.191	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
165.100.0.255	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Down to

165.100.255.128 to 165.100.255.191
 165.100.255.192 to 165.100.255.255

(Invalid range)

The binary value of the last bit borrowed is the range. In this problem the range is 64.
 The first and last range of addresses are not usable.
 The first usable range of addresses is: 165.100.0.64 to 165.100.0.127

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

Number of needed usable subnets **1**

Network Address **195.223.50.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 2nd usable subnet range? _____

What is the subnet number for the 1st usable subnet? _____

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

What are the assignable addresses for the 2nd usable subnet? _____

Show your work for Problem 3 in the space below.

	256	128	64	32	16	8	4	2	-	<i>Number of Hosts</i>
<i>Number of Subnets</i>	-	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	-	<i>Binary values</i>
195. 223 . 50 . 0 0	0	0	0	0	0	0	0	0	0	

Subnetting

Problem 4

Number of needed usable subnets **750**

Network Address **190.35.0.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 14th usable
subnet range? _____

What is the subnet number
for the 12th usable
subnet? _____

What is the subnet
broadcast address for
the 9th usable subnet? _____

What are the assignable
addresses for the 5th
usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 1st usable
subnet range? _____

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

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

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

Show your work for Problem 5 in the space below.

Subnetting

Problem 6

Number of needed usable subnets **10**

Network Address **192.70.10.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 8th usable subnet range? _____

What is the subnet number for the 3rd usable subnet? _____

What is the subnet broadcast address for the 11th usable subnet? _____

What are the assignable addresses for the 9th usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 10th usable subnet range? _____

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

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

What are the assignable addresses for the 8th usable subnet? _____

Show your work for Problem 7 in the space below.

Subnetting

Problem 8

Number of needed usable subnets **4**

Network Address **172.50.0.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 3rd usable
subnet range? _____

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

What is the subnet
broadcast address for
the 5th usable subnet? _____

What are the assignable
addresses for the 2nd
usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 1st usable subnet range? _____

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

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

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

Show your work for Problem 9 in the space below.

Subnetting

Problem 10

Number of needed usable subnets **45**

Network Address **220.100.100.0**

Address class _____

Default subnet mask _____

Custom subnet mask _____

Total number of subnets _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 4th usable subnet range? _____

What is the subnet number for the 3rd usable subnet? _____

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

What are the assignable addresses for the 11th usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 5th usable
subnet range? _____

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

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

What are the assignable
addresses for the 4th
usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 1st usable subnet range? _____

What is the subnet number for the 1st usable subnet? _____

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

What are the assignable addresses for the 2nd usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 9th usable subnet range? _____

What is the subnet number for the 10th usable subnet? _____

What is the subnet broadcast address for the 1022nd usable subnet? _____

What are the assignable addresses for the 1021st usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 6th usable
subnet range? _____

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

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

What are the assignable
addresses for the 5th
usable 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 _____

Number of usable subnets _____

Total number of host addresses _____

Number of usable addresses _____

Number of bits borrowed _____

What is the 14th usable subnet range? _____

What is the subnet number for the 8th usable subnet? _____

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

What are the assignable addresses for the 11th usable subnet? _____

Show your work for Problem 15 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

The network ID cannot be 0.

IP Address: 192.10.10.1
Subnet Mask: 255.255.255.0

OK

IP Address: 245.150.190.10
Subnet Mask: 255.255.255.0

IP Address: 135.70.191.255
Subnet Mask: 255.255.254.0

IP Address: 127.100.100.10
Subnet Mask: 255.0.0.0

IP Address: 93.0.128.1
Subnet Mask: 255.255.224.0

IP Address: 200.10.10.128
Subnet Mask: 255.255.255.224

IP Address: 165.100.255.189
Subnet Mask: 255.255.255.192

IP Address: 190.35.0.10
Subnet Mask: 255.255.255.192

IP Address: 218.35.50.195
Subnet Mask: 255.255.0.0

IP Address: 200.10.10.175 /22

IP Address: 135.70.255.255
Subnet Mask: 255.255.224.0

Class A Addressing Guide

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

Class B Addressing Guide

# of Bits Borrowed	Subnet Mask	Total # of Subnets	Usable # of Subnets	Total # of Hosts	Usable # of Hosts
2	255.255.192.0	4	2	16,384	16,382
3	255.255.224.0	8	6	8,192	8,190
4	255.255.240.0	16	14	4,096	4,094
5	255.255.248.0	32	30	2,048	2,046
6	255.255.252.0	64	62	1,024	1,022
7	255.255.254.0	128	126	512	510
8	255.255.255.0	256	254	256	254
9	255.255.255.128	512	510	128	126
10	255.255.255.192	1,024	1,022	64	62
11	255.255.255.224	2,048	2,046	32	30
12	255.255.255.240	4,096	4,094	16	14
13	255.255.255.248	8,192	8,190	8	6
14	255.255.255.252	16,384	16,382	4	2

Class C Addressing Guide

# of Bits Borrowed	Subnet Mask	Total # of Subnets	Usable # of Subnets	Total # of Hosts	Usable # of Hosts
2	255.255.255.192	4	2	64	62
3	255.255.255.224	8	6	32	30
4	255.255.255.240	16	14	16	14
5	255.255.255.248	32	30	8	6
6	255.255.255.252	64	62	4	2

