IP Addressing and Subnetting

Workbook

Version 1.1

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

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	*146*	*128 64*
0	1	1	1	0	1	1	1	*119*	*16 32*
1	1	1	1	1	1	1	1		*2 16*
1	1	0	0	0	1	0	1		*146 4*
1	1	1	1	0	1	1	0		*2*
0	0	0	1	0	0	1	1		*1*
1	0	0	0	0	0	0	1		*119*
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		

Binary	Answer
00011011	
10101010	
01101111	
11111000	
00100000	
01010101	
00111110	
00000011	
11101101	
11000000	

1

Decimal To Binary Conversion
Use all 8 bits for each problem

128	64	32	16	8	4	2	1	= 255
1	1	1	0	1	1	1	0	238
0	0	1	0	0	0	1	0	34
								123
								50
								255
								200
								10
								138
								1
								13
								250
								107
								224
								114
								192
								172
								100
								119
								57
								98
								179
								2

Scratch Area

```
 238        34
-128       -32
 110         2
 -64        -2
  46         0
 -32
  14
  -8
   6
  -4
   2
  -2
   0
```

Address Class Identification

Address	Class
10.250.1.1	_A_
150.10.15.0	_B_
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 you 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.
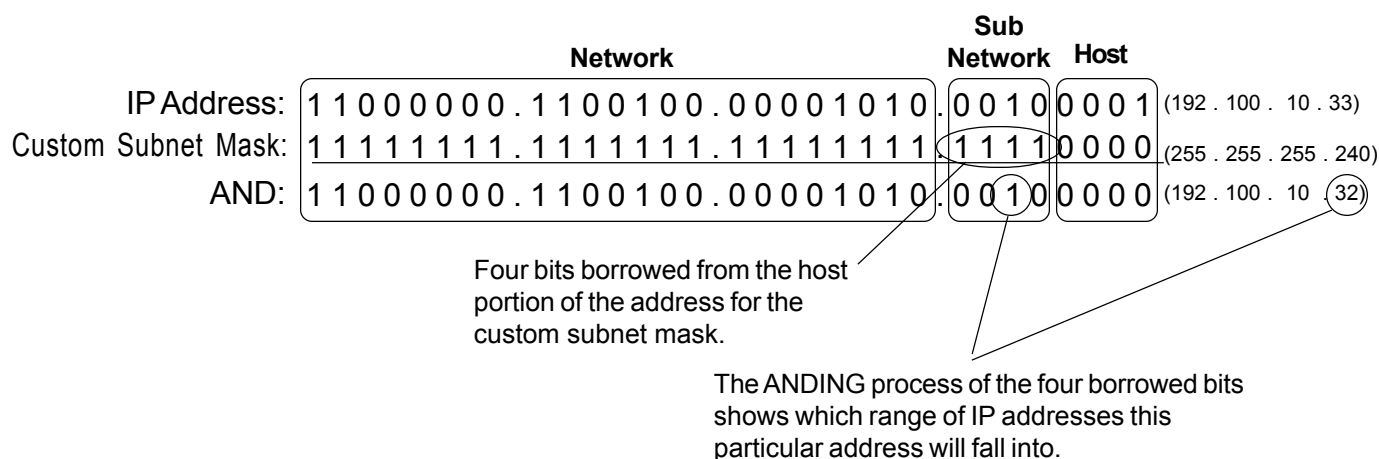
ANDING With
Custom subnet masks

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)

	Network	Sub 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)
Custom 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 .	1 1 1 1	0 0 0 0	(255 . 255 . 255 . 240)
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 1 0	0 0 0 0	(192 . 100 . 10 . 32)

Four bits borrowed from the host portion of the address for the custom subnet mask.

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	~ *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

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

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

Observe the total number of hosts.

Subtract 2 for the number of usable hosts.

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

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

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

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	4,096	8,192	16,384	32,768	65,536
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

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

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

```
 64
−2
───
 62
```
Observe the total number of hosts.
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.

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Custom Subnet Masks

Problem 3

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.

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	4,096	8,192	16,384	32,768	65,536
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*	*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
  -2     hosts.
  62     Subtract 2 for the number of
         usable hosts.
```

```
1024     Subtract 2 for the total number of
  -2     subnets to get the usable number of
1,022    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 <u>C</u>

Default subnet mask <u>255.255.255.0</u>

Custom subnet mask <u>255.255.255.224</u>

Total number of subnets <u>8</u>

Number of usable subnets <u>6</u>

Total number of host addresses <u>32</u>

Number of usable addresses <u>30</u>

Number of bits borrowed <u>3</u>

Show your work for Problem 4 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	

210 . 100 . 56 . 0 0 0 | 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.

	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 . 85 . 8 . O O O O O O | O O

Custom Subnet Masks

Problem 6

Number of needed usable 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 _____

Number of usable 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	–	4,194,304	2,097,152	1,048,576	524,288	262,144	131,072	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	1,024	2,048	4,096	8,192	16,384	32,768	65,536	.	131,072	262,144	524,288	1,048,576	2,097,152	4,194,304
Binary values	–	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1

118. 0 0 0 0 0 0 0 | 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

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.

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	4,096	8,192	16,384	32,768	65,536
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

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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.

				Number of Hosts					
	256	128	64	32	16	8	4	2	~ 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

(Invalid range)	0			192.10.10.0	to	192.10.10.15
	1			192.10.10.16	to	192.10.10.31
	1	0		192.10.10.32	to	192.10.10.47
	1	1		192.10.10.48	to	192.10.10.63
	1	0	0	192.10.10.64	to	192.10.10.79
	1	0	1	192.10.10.80	to	192.10.10.95
	1	1	0	192.10.10.96	to	192.10.10.111
	1	1	1	192.10.10.112	to	192.10.10.127
1	0	0	0	192.10.10.128	to	192.10.10.143
1	0	0	1	192.10.10.144	to	192.10.10.159
1	0	1	0	192.10.10.160	to	192.10.10.175
1	0	1	1	192.10.10.176	to	192.10.10.191
1	1	0	0	192.10.10.192	to	192.10.10.207
1	1	0	1	192.10.10.208	to	192.10.10.223
1	1	1	0	192.10.10.224	to	192.10.10.239
(Invalid range) 1	1	1	1	192.10.10.240	to	192.10.10.255

Custom subnet mask
$$128$$
$$64$$
$$32$$
$$+16$$
$$\overline{240}$$

Usable subnets
$$16$$
$$-2$$
$$\overline{14}$$

Usable hosts
$$16$$
$$-2$$
$$\overline{14}$$

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.

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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 ~ 65,536 32,768 16,384 8,192 4,096 2,048 1,024 512 256 128

Number of Subnets ~ 2 4 8 16 32 64 128 256

Binary values ~ 128 64 32 16 8 4 2 1 . 256 128

165.100.0.0.0 0 0 0 0 0 0 0 . 0 0 0

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

165 . 100 . 0 . 0 . 0 0 0 0 0 0 0 0 . 0 0 0

1024
~2
Usable subnets 1,022

64
~2
Usable hosts 62

128
Custom +64
subnet mask 192
+1
255

0 to 1	(Invalid range)				165.100.0.0	to	165.100.0.63
0 to 1	1	1			165.100.0.64	to	165.100.0.127
0 to 1	1	. 1			165.100.0.128	to	165.100.0.191
0 to 1	1	. 1			165.100.0.192	to	165.100.0.255
0 to 1, 0 to 1	1 1	. . 1 1	0 . . 0	1 1 1 1	165.100.1.0	to	165.100.1.63
					165.100.1.64	to	165.100.1.127
					165.100.1.128	to	165.100.1.191
					165.100.1.192	to	165.100.1.255
0 to 1, 0 to 1	0 0 1 1	0 . 0 . 1 1	1 1 0 . . 0	1 1 1 1	165.100.2.0	to	165.100.2.63
					165.100.2.64	to	165.100.2.127
					165.100.2.128	to	165.100.2.191
					165.100.2.192	to	165.100.2.255
0 to 1, 0 to 1	0 0 1 1	. . . . 1 1	1 1 1 1	165.100.3.0	to	165.100.3.63
					165.100.3.64	to	165.100.3.127
					165.100.3.128	to	165.100.3.191
					165.100.3.192	to	165.100.3.255

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.

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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.

			Number of Subnets –	256	128	64	32	16	8	4	2	– Number of Hosts
						2	4	8	16	32	64	128	256
				128	64	32	16	8	4	2	1	– Binary values
195.	223.	50.	0	0	0	0	0	0	0	0

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