Solutions to Practice Problems

Practice Problem 13.1
Express each of the following IP addresses in dotted-decimal notation.
(a) 00001011 00000010 00000000 00100111
(b) 10000000 10000000 11111111 00000000
Solution: (a) 11.2.0.39  (b) 128.128.255.0

Practice Problem 13.2
Which of the following can serve as masks?
(a) 255.2.0.0
(b) 255.255.0.0
(c) 255.255.0.23
(d) 255.255.64.0
Solution: (a) No  (b) Yes  (c) No  (d) No

Practice Problem 13.3
Show that the address 255.240.0.0 is a mask by writing out the address as 32 bits.
Solution: 1 1 1 1 1 1 1 1.1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
yep…it meets the criteria.

Practice Problem 13.4
Write the following masks in slash notation.
(a) 255.0.0.0.
(b) 255.255.255.0
(c) 255.240.0.0
Solution: (a): /8  (b) /24  (c) /12

Practice Problem 13.5
Write the following masks in dotted decimal notation.
(a) /16
(b) /9
Solution: (a) 255.255.0.0  (b) 255.128.0.0
Practice Problem 13.6
Suppose an organization has been given a mask /24. One of its machines has IP address 200.137.34.56. What is the network ID?

Solution: The mask is

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

You should readily see that in this example if you bitwise AND the mask with the 32-bit IP address, the first three octets will be unchanged and the fourth octet will be zeroed-out.

The network address is 200.137.34.0

Practice Problem 13.7
Suppose an organization has been given a mask /13. One of its machines has IP address 200.137.34.56. What is the network ID?

Solution: The mask is

1 1 1 1 1 1 1 1 . 1 1 1 1 1 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

You should readily see that in this example if you bitwise AND the mask with the 32-bit IP address, the first octet will be unchanged and the third fourth octets will be zeroed-out. Examining just the second octet, we see:

Mask: 1 1 1 1 1 0 0 0
IP address: 1 0 0 0 1 0 0 1

- - - - - - - -
1 0 0 0 1 0 0 0 = 136

The network address is 200.136.0.0

Practice Problem 13.8
You know that one of your organization’s IP addresses is 205.16.37.39 / 28.

(a) Describe the mask qualitatively.

Solution: The mask is 28 ones followed by four zeros

(b) What is the mask in binary?

Solution:

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 1 0 0 0 0

(c) What is the mask in dotted decimal notation?

Solution: 255.255.255.240

(d) Now, the mask bits with a 1 correspond to the “network-ID” and the mask bits with a zero correspond to the bits that you can play with to assign IP addresses to your hosts. If that is the case, how many addresses have you been given?

Solution: 16 (we will have to revise this answer shortly!)
Practice Problem 13.9
You own a small organization that needs (and is given) 14 IP addresses for assignment to individual hosts. What is your mask in dotted decimal notation?

Solution: We need 16 IP addresses (the 14 that we use for hosts, plus a network ID plus a broadcast ID).

Thus, we need four bits for the host portion, since $2^4 = 16$. This leaves $32 - 4 = 28$ bits for the mask.

$$\text{1111 1111 1111 1111 1111 1111 1111 0000 = 255.255.255.240.}$$

Practice Problem 13.10
As in the example above, you know that one of your organization’s IP addresses is $205.16.37.39 / 28$. What is the network address assigned to your organization?

Solution: Bit-wise AND the mask with this address:

<table>
<thead>
<tr>
<th>Last byte: MASK</th>
<th>1 1 1 1 0 0 0 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>0 0 1 0 0 1 1 1</td>
</tr>
<tr>
<td>Result</td>
<td>0 0 1 0 0 0 0 0</td>
</tr>
</tbody>
</table>

So, the network address you have been given is $205.16.37.32$.

Practice Problem 13.11
What is the network address of a network that has a host assigned the IP address: $182.44.82.16 / 26$?

Solution: Consider the mask: it has 26 ones and 6 zeros. Thus, the first 3 octets of the network address are $182.44.82$.

The last octet is where the mask comes in. If we bitwise AND the last octet of the mask with the last octet of this host’s IP address, we have:

| 1 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 |
|---------------------|---------------------|
| Last octet of mask  | Last octet of IP address |
| 0 0 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 |

The network address for this network is $182.44.82.0$.

Practice Problem 13.12
What is the network address of a network that has a host assigned the IP address: $182.44.82.80 / 26$?

Solution: If we bitwise AND the last octet of the mask with the last octet of this host’s IP address, we have:

| 1 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 |
|---------------------|---------------------|
| Last octet of mask  | Last octet of IP address |
| 0 1 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 |

The network address for this network is $182.44.82.64$. 
**Practice Problem 13.13**

Using the technique above, determine the network address of a network that has a host assigned the IP address: 182.44.82.16 / 26

Solution: Set the 32−26 = 6 rightmost bits of 182.44.82.16 to zero. Only the last octet:

0 0 0 1 0 0 0 0

will be affected. Setting the rightmost 6 bits to zero, we have the network address: 182.44.82.0

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**Practice Problem 13.14**

Using the technique above, determine the network address of a network that has a host assigned the IP address: 182.44.82.80 / 26

Solution: Set the 32−26 = 6 rightmost bits of 182.44.82.80 to zero. Only the last octet:

0 1 0 1 0 0 0 0

will be affected. Setting the rightmost 6 bits to zero, we have the network address: 182.44.82.64

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**Practice Problem 13.15**

Suppose one of you machines has the IP address 180.34.64.65 / 30.

(a) How many addresses do you have available for assignment to hosts?

(b) What is your network address?

Solution:

(a) You have two bits to play with. 2^2 = 4. But, you need to set aside the network address (i.e., it won’t be given to an individual host) and the broadcast address, so you have 2 addresses for hosts.

(b) 180.34.64.64

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**Practice Problem 13.16**

Suppose you know that one of your organization’s IP addresses is 205.16.37.39/28. What is the last address (the broadcast address) in the block assigned to your organization?

Solution: Only the last byte is in play here.

39 = 0 0 1 0 0 1 1 1

Setting the 32 − 28 = 4 rightmost bits to 1, we have 0 0 1 0 1 1 1 1 = 47.

So, the last address we have is 205.16.37.47
Practice Problem 13.17

(a) Can more than one organization assign the number 172.18.3.1 to one of its machines?

(b) If no, why not? If yes, does this violate the cardinal rule: No two machines on the Internet can have the same IP address at the same time?

(c) What happens if I try to launch a packet with the destination address 172.18.3.1 onto the Internet?

Solution:  
(a) Yes.

(b) No. These addresses are not used by the Internet. These addresses are only used on private networks. These addresses must be unique within a private network, but do not need to be unique globally.

(c) No router will forward it. All IP routers know that these addresses are for private networks only.