# Addressing Tutorial Sample Solutions

**Question 1**

Suppose the network 193.1.1.0/24 has been divided into 8 subnets using fixed length subnetting.

a) What is the network address of the network?
b) What is the network address of the subnet with subnet ID 6?
c) What is the network address of the subnet with subnet ID 0?
d) What is the broadcast address of the subnet with subnet ID 6?

**Sample Solution**

To divide a network into 8 subnets, we require 3 bits for the subnet ID, because $2^3 = 8$.

a) 193.1.1.0/24. This is the address as given in the question, with all the host ID bits set to 0.
b) 193.1.1.**110**00000/27 (binary) or 193.1.1.192/27 (decimal). Subnet ID 6 is 110 in binary.
c) 193.1.1.0/27. This is the network address (first 24 bits), followed by the subnet ID with all bits set to 0 (for subnet ID 0) and all host ID bits set to 0.
d) 193.1.1.**110**11111/27 (binary) or 193.1.1.223/27 (decimal). Subnet ID 6 is 110 in binary, and all host ID bits are set to 1 in a broadcast address.

**Question 2**

A company was given the network block 137.73.0.0/16. The block needs to be divided into 6 subnets with the following capacities:

a) Two large subnets with capacity for 8,000 hosts each
b) Three smaller subnets with capacity for 4,000 hosts each
c) A very large subnet with capacity for 20,000 addresses

Provide a division of the network block to meet the above requirements and give addresses for each one of the subnets. If there is a spare block of addresses left, please indicate so.

**Sample Solution**

This network block contains 16 bits for addresses of local hosts.

We start by allocating a block of addresses for the largest subnet, (c). We need at least 15 bits in order to provide space for 20,000 addresses ($2^{14} - 2 = 16,382$, which is not sufficient to cover 20,000 addresses). This leaves 1 bit left for the subnet ID. We could choose either 0 or 1 for subnet (c), so here we will choose 1. So, the network address for (c) is:

137.73.**1**0000000.00000000/17 (binary) or 137.73.128.0/17 (decimal)

The remaining block is:

137.73.**0**0000000.00000000/17 (binary) or 137.73.0.0/17 (decimal)

We will divide this up for the other subnets. Next we allocate the second largest two subnets, (a). We need 13 bits for each subnet ($2^{13} - 2 = 8192 - 2 = 8190$ addresses). This leaves 3 bits for the subnet ID. The first of the three bits must be 0, as shown above. We will choose subnet IDs 011 and 010 for the (a) subnets. So, the network address for (a) is:

137.73.**011**00000.00000000/19 (binary) or 137.73.96.0/19 (decimal)
137.73.**010**00000.00000000/19 (binary) or 137.73.64.0/19 (decimal)

The remaining blocks are:

137.73.**000**00000.00000000/19 (binary) or 137.73.0.0/19 (decimal)
137.73.**001**00000.00000000/19 (binary) or 137.73.32.0/19 (decimal)

Finally, we allocate the three smallest subnets, (b). We need 12 bits for each subnet ($2^{12} - 2 = 4096 - 2 = 4094$ addresses). This leaves 4 bits for the subnet ID. The first three bits must be 000 or 001 as shown above. We will choose subnet IDs 0011, 0010 and 0001 for the (c) subnets. So, the network address for (c) is:

137.73.**0011**00000.00000000/20 (binary) or 137.73.48.0/20 (decimal)
137.73.**0010**00000.00000000/20 (binary) or 137.73.32.0/20 (decimal)

137.73.**0001**00000.00000000/20 (binary) or 137.73.16.0/20 (decimal)

There is one remaining block:

137.73.**0000**00000.00000000/20 (binary) or 137.73.0.0/20 (decimal)

In summary, we have allocated the following subnets:

a) 137.73.96.0/19 and 137.73.64.0/19
b) 137.73.48.0/20, 137.73.32.0/20, and 137.73.16.0/20
c) 137.73.128.0/17

and there is one spare block of addresses:

137.73.0.0/20