**Part A [1]**

**Provided network: 190.11.40.0/23 – Minimum of 50 hosts per subnet (all 0s and 1s ARE usable)**

Before Subnetting:

* Network Addresses (range)
  + 190.11.40.0 🡪 190.11.41.255
* Broadcast Address
  + 190.11.41.255
* Netmask
  + 255.255.11111110.0 (decimal in cyan, binary in yellow)
  + 255.255.254.0
* Maximum number of hosts
  + There are a **total of 9 host bits**
  + This means there can be a total of 512 hosts before subnetting (given the statement that we are **able** to use all 0s and 1s)

After Subnetting:

* Netmask
  + We will use a total of **3 bits to create the subnets**
  + We can create a total of 8 subnets (given the statement that we are **able** to use all 0s and 1s)
  + New netmask will be /26 (23 + 3)
  + 255.255.255.11000000 (decimal in cyan, binary in yellow)
  + 255.255.255.192
* Maximum number of hosts per subnet
  + **6 host bits** are needed to achieve a minimum of 50 hosts per subnet
  + This means that we have a maximum number of 64 hosts per subnet (given the statement that we are **able** all 0s and 1s)

**Part A [1]**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subnet Number** | **Subnet ID Binary Value** | **Network bits 3rd octet** | **3rd octet decimal value** | **Host bits binary range (4th octet)** | **4th octet binary range** | **4th octet decimal value** | **IP Range (From)** | **IP Range (To)** |
| 0 | 0 00 | 0010100 0 | 40 | 000000 - 111111 | 00 000000 - 00 111111 | 0-63 | 190.11.40.0 | 190.11.40.63 |
| 1 | 0 01 | 0010100 0 | 40 | 000000 - 111111 | 01 000000 - 01 111111 | 64-127 | 190.11.40.64 | 190.11.40.127 |
| 2 | 0 10 | 0010100 0 | 40 | 000000 - 111111 | 10 000000 - 10 111111 | 128-191 | 190.11.40.128 | 190.11.40.191 |
| 3 | 0 11 | 0010100 0 | 40 | 000000 - 111111 | 11 000000 - 11 111111 | 192-255 | 190.11.40.192 | 190.11.40.255 |
| 4 | 1 00 | 0010100 1 | 41 | 000000 - 111111 | 00 000000 - 00 111111 | 0-63 | 190.11.41.0 | 190.11.41.63 |
| 5 | 1 01 | 0010100 1 | 41 | 000000 - 111111 | 01 000000 - 01 111111 | 64-127 | 190.11.41.64 | 190.11.41.127 |
| 6 | 1 10 | 0010100 1 | 41 | 000000 - 111111 | 10 000000 - 10 111111 | 128-191 | 190.11.41.128 | 190.11.41.191 |
| 7 | 1 11 | 0010100 1 | 41 | 000000 - 111111 | 11 000000 - 11 111111 | 192-255 | 190.11.41.192 | 190.11.41.255 |

**Part A [2]**

**Provided network: 175.21.0.0/16 (Class B) – 11 usable subnets (all 0s and 1s NOT usable)**

Before Subnetting:

* **Network Addresses (range)**
  + 175.21.0.0 🡪 175.21.255.255
* **Broadcast Address**
  + 175.21.255.255
* **Netmask**
  + 255.255. 0.0 (decimal)
* **Maximum number of hosts**
  + There are a total of 16 host bits
  + This means there can be a total of 65536 hosts before subnetting
  + 65534 hosts are usable (given the statement that we are **unable** to use all 0s and 1s)

After Subnetting:

* **New netmask**
  + Since we need a minimum number of 11 usable subnets, 4 bits are required
  + We can create a total of 16 subnets, 14 of which are usable (given the statement that we are **unable** to use all 0s and 1s)
  + New netmask will be /20 (16 + 4)
  + 255.255.11110000.0 (decimal in cyan, binary in yellow)
  + 255.255.240.0
* **Maximum number of hosts per subnet**
  + After subnetting, there is a total of **12 host bits per subnet**
  + This means that we have a maximum number of 4096 hosts per subnet
  + 4094 hosts are usable (given the statement that we are **unable** to use all 0s and 1s)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subnet Number** | **Subnet ID Binary Value** | **Host bits binary range (3rd octet)** | **3rd octet binary range** | **3rd octet decimal value** | **IP Range (From)** | **IP Range (To)** | **Usable** |
| 0 | 0000 | 0000 - 1111 | 0000 0000 – 0000 1111 | 0-15 | 175.21.0.0 | 175.21.15.255 | No |
| 1 | 0001 | 0000 - 1111 | 0001 0000 – 0001 1111 | 16-31 | 175.21.16.0 | 175.21.31.255 | Yes |
| 2 | 0010 | 0000 - 1111 | 0010 0000 – 0010 1111 | 32-47 | 175.21.32.0 | 175.21.47.255 | Yes |
| 3 | 0011 | 0000 - 1111 | 0011 0000 – 0011 1111 | 48-63 | 175.21.48.0 | 175.21.63.255 | Yes |
| 4 | 0100 | 0000 - 1111 | 0100 0000 – 0100 1111 | 64-79 | 175.21.64.0 | 175.21.79.255 | Yes |
| 5 | 0101 | 0000 - 1111 | 0101 0000 – 0101 1111 | 80-95 | 175.21.80.0 | 175.21.95.255 | Yes |
| 6 | 0110 | 0000 - 1111 | 0110 0000 – 0110 1111 | 96-111 | 175.21.96.0 | 175.21.111.255 | Yes |
| 7 | 0111 | 0000 - 1111 | 0111 0000 – 0111 1111 | 112-127 | 175.21.112.0 | 175.21.127.255 | Yes |
| 8 | 1000 | 0000 - 1111 | 1000 0000 – 1000 1111 | 128-143 | 175.21.128.0 | 175.21.143.255 | Yes |
| 9 | 1001 | 0000 - 1111 | 1001 0000 – 1001 1111 | 144-159 | 175.21.144.0 | 175.21.159.255 | Yes |
| 10 | 1010 | 0000 - 1111 | 1010 0000 – 1010 1111 | 160-175 | 175.21.160.0 | 175.21.175.255 | Yes |
| 11 | 1011 | 0000 - 1111 | 1011 0000 – 1011 1111 | 176-191 | 175.21.176.0 | 175.21.191.255 | Yes |
| 12 | 1100 | 0000 - 1111 | 1100 0000 – 1100 1111 | 192-207 | 175.21.192.0 | 175.21.207.255 | Yes |
| 13 | 1101 | 0000 - 1111 | 1101 0000 – 1101 1111 | 208-223 | 175.21.208.0 | 175.21.223.255 | Yes |
| 14 | 1110 | 0000 - 1111 | 1110 0000 – 1110 1111 | 224-239 | 175.21.224.0 | 175.21.239.255 | Yes |
| 15 | 1111 | 0000 - 1111 | 1111 0000 – 1111 1111 | 240-255 | 175.21.240.0 | 175.21.255.255 | No |

**Part A [2]**