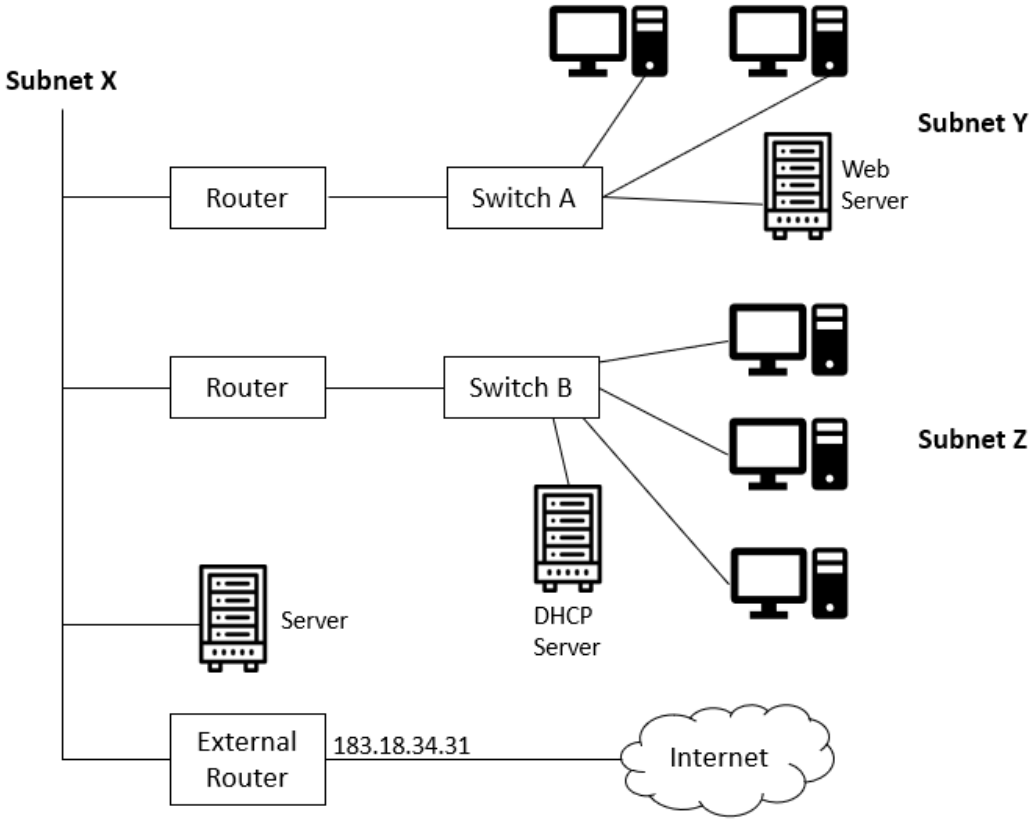
4.9.4.3 IP Addresses & Subnets

1) **Figure 1** shows the physical topology of a local area network (LAN) used by a company, and its connection to the internet. The LAN uses the IPv4 protocol.

Figure 1



Internally, the network has been divided into subnets: 27 bits have been allocated to the network/subnet identifier.

a) In binary, write out the subnet mask that has been programmed into the device on the network.

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

[1 mark]

b) **Subnet Z** consists of all the devices that are directly connected to Switch B.

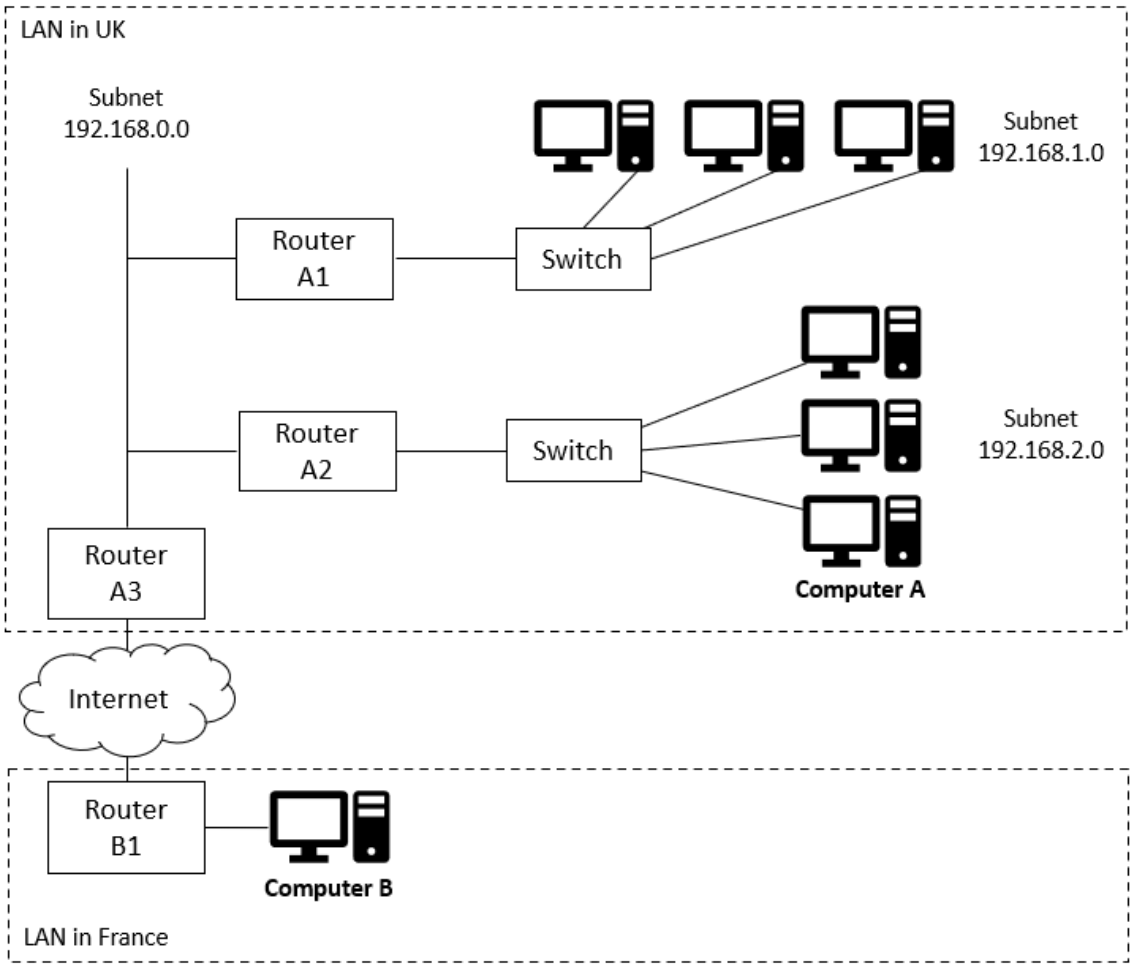
What is the maximum number of devices that could be connected to **Subnet Z** at the same time?

[1 mark]

- **30 // $2^5 - 2$**

2) **Figure 2** shows a computer (**Computer A**) which is located on a LAN.

Figure 2



Computer A has the IP address 192.168.2.3

Many other computers connected to the Internet have the same IP address.

Explain how two or more computers connected to the Internet can have the same IP address and still communicate with each other.

[2 marks]

- **The computers have private/non-routable IP addresses // 192.168.2.3 is a private/non-routable IP address**
- **NAT translates the private IP address to the public IP address of the router/gateway when communicating over the Internet**

3) A packet of data is to be transmitted across the internet from a Computer A in the UK to a Computer B in Belgium.

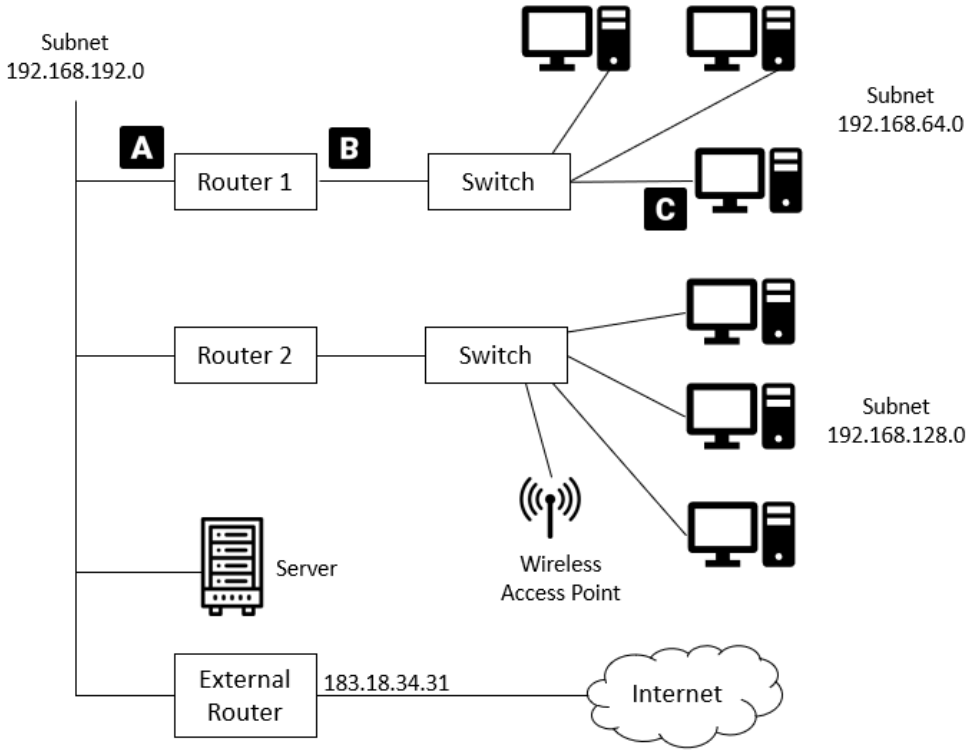
Explain how Computer A will use a subnet mask to determine whether it can send the packet directly to Computer B across the LAN or if the packet must be sent via the Internet.

[3 marks]

- **AND operation is performed between the subnet mask and the IP addresses of computer A and computer B**
- **The result of each is the network ID which are then compared**
- **If they are the same then the packet can be sent directly to Computer B // they are on the same subnet**
- **If they are different, the packet must be sent to the router/default gateway because the computers are on different subnets**

4) **Figure 3** shows a computer network. The devices connected to the network are identified using IPv4 addresses. When assigning IP addresses, 20 bits have been allocated to the Network IDs and 12 bits have been allocated to the Host IDs.

Figure 3



a) State suitable IP addresses for

- The Router 1 port labelled **A**
- The Router 1 port labelled **B**
- The computer labelled **C**

[3 marks]

- **A: 192.168.x.y**
  Where x is in range 192 to 207
  Where y is in range 0 to 255
  Note: reject 192.168.192.0 and 192.168.207.255
- **B: 192.168.x.y**
  Where x is in range 64 to 79
  Where y is in range 0 to 255
  Note: reject 192.168.64.0 and 192.168.79.255
- **C: 192.168.x.y**
  Where x is in range 64 to 79
  Where y is in range 0 to 255
  Note: reject 192.168.64.0, 192.168.79.255 and same as answer for B

b) Which of the following four subnet masks (**A**-**D**) is the one that has been assigned to the devices connected to the network in **Figure 3**.

A	255.255.0.0
B	255.255.15.0
C	255.255.240.0
D	255.255.255.0

[1 mark]

- **C**

c) The devices on the network in **Figure 3** use IPv4.

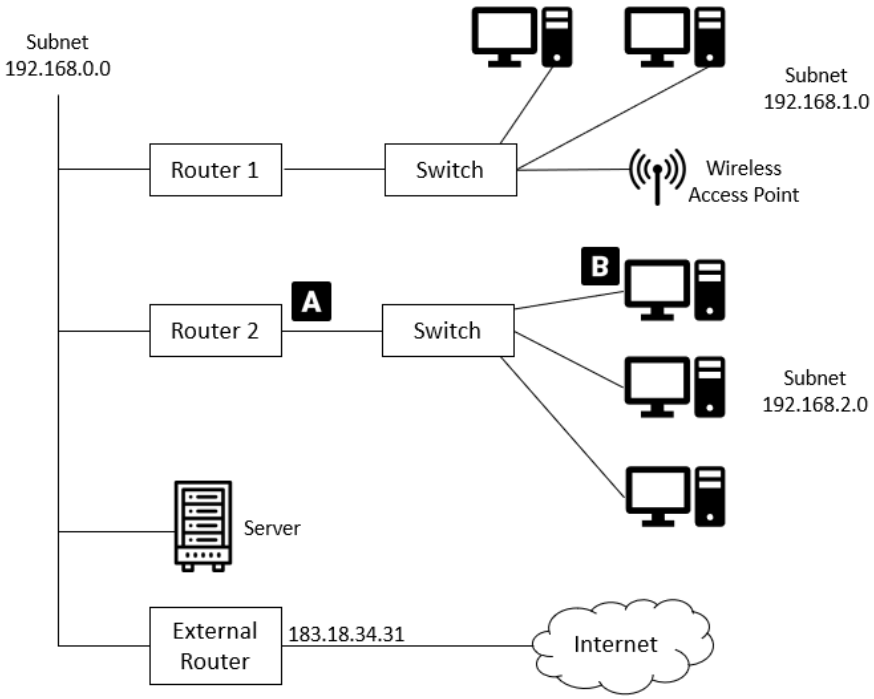
State **one** reason why IPv6 has been introduced to replace IPv4.

[1 mark]

- **There are not enough unique addresses in IPv4;**
- **It eliminates the needs for NAT;**
- **More efficient routing is possible;**
- **Automatic configuration possible without DHCP;**
- **Allows bigger packet sizes;**
- **Devices can roam and keep same IP address;**

5) **Figure 4** shows the physical topology of a local area network (LAN) and its connection to the Internet. The LAN uses the IPv4 protocol.

Figure 4



a) State suitable IP addresses for:

- The Router 2 port labelled **A**
- The computer network interface card labelled **B**

[2 marks]

- **192.168.2.y where y is not 0 or 255**
- **192.168.2.y where y is not 0 or 255 or same as the other IP address**