Q.1

* Information bit: 1001
* The generator polynomial g(x) = x3+x+1, which is represented in binary: 1011
* We add n – 1 bits to the data bit, so the codeword is 1001aaa
* Dividing modulo 2:

1 0 0 1 0 0 0 1011

1 0 1 1 1010

0 0 1 0 0 0

1 0 1 1

0 0 1 1 0

* R = 110, so the codeword is 1001110

Q.2

* TCP/IP over Ethernet allows data frames with a payload size up to 1460 bytes. Therefore, L = 100 bytes, 500 bytes, 1000 bytes are within this limit.
* The message overhead include:

+ TCP: 20 bytes of header

+ IP: 20 bytes of header

+ Ethernet: 18 bytes of header and trailer

* Therefore:

+ With L = 100 bytes, the percentage is: 100 / (100 + 20 + 20 + 18) = 63,29%

+ With L = 500 bytes, the percentage is: 500 / (500 + 20 + 20 + 18) = 89,61%

+ With L = 1000 bytes, the percentage is: 1000 / (1000 + 20 + 20 + 18) = 94,52%

Q.3

* Information bit: 10011101
* The generator polynomial x3 + 1, which is represented in binary: 1001
* We add n – 1 bits to the data bit, so the codeword is 10011101aaa
* Dividing modulo 2:

1 0 0 1 1 1 0 1 0 0 0 1001

1 0 0 1 10001100

0 0 0 0 1 1 0 1

1 0 0 1

0 1 0 0 0

1 0 0 1

0 0 0 1 0 0

* R = 100, so the codeword is 10011101100
* The actual bit string transmitted: 10011101100
* During transmission, the bit string is: 10111101100. CRC algorithm will detect this error.

1 0 1 1 1 1 0 1 1 0 0 1001

1 0 0 1 10101000

0 0 1 0 1 1

1 0 0 1

0 0 1 0 0 1

1 0 0 1

0 0 0 0 1 0 0

The remainder of the division is not equal to 0, so there will be error detected at the receivers end.

Q.4

IP address: 135.46.63.10

Take 22 bits of the IP address:

135.46.63.10 ⬄ 1000 0111.0010 1110.0011 1111.0000 1010

We have the network address:

1000 0111.0010 1110.0011 1100.0 ⬄ 135.46.60.0

The router will forward the packet to Interface 1.



IP address: 135.46.57.14

Take 22 bits of the IP address:

135.46.57.14 ⬄ 1000 0111.0010 1110.0011 1001.0000 1110

We have the network address:

1000 0111.0010 1110.0011 1000.0 ⬄ 135.46.56.0

The router will forward the packet to Interface 0.

Q.5

* Before compression, size = 1 megabyte = 1024 . 1024 . 8 bits = 8388608 bits



+ Rate: 32 kilobit/second = 32000 bit/s

* Time: 8388608 / 32000 = 262,144 (s)



+ Rate: 1 megabit/second = 106 bit/s

* Time: 8388608 / 106 = 8,388608 (s)

1. After compression, size = 8388608 / 6 = 1398101,333 bits = 1398101 bits

+ Rate: 32000 bit/s -> Time: 1398101 / 32000 = 43,69 (s)

+ Rate: 106 bit/s -> Time: 1398101 / 106 = 1,398101 (s)