**Q1.** Suppose an application layer entity wants to send an *L*-byte message to its peer process, using an existing TCP connection. The TCP segment consists of the message plus 20 bytes of header. The segment is encapsulated into an IP packet that has an additional 20 bytes of header. The IP packet in turn goes inside an Ethernet frame that has 18 bytes of header and trailer. What percentage of the transmitted bits in the physical layer correspond to message information, if *L* = 100 bytes, 500 bytes, 1000 bytes

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

The message overhead includes:   
• TCP: 20 bytes of header   
• IP: 20 bytes of header   
• Ethernet: total 18 bytes of header and trailer.

Therefore   
L = 100 bytes, 100/158 = 63% efficiency (1).   
L = 500 bytes, 500/558 = 90% efficiency (1).   
L = 1000 bytes, 1000/1058 = 95% efficiency (1).

**Q2.** Suppose the size of an uncompressed text file is 1 megabyte

1. **How long does it take to download the file over a 32 kilobit/second modem?**

T32k = 8 (1024) (1024) / 32000 = 262.144 seconds

1. **How long does it take to take to download the file over a 1 megabit/second modem?**

T1M = 8 (1024) (1024) bits / 1x106 bits/sec = 8.38 seconds

c. **Suppose data compression is applied to the text file. How much do the transmission times in parts (a) and (b) change?**

**If we assume a maximum compression ratio of 1:6, then we have the following times for the 32 kilobit and 1 megabit lines respectively:**

T32k = 8 (1024) (1024) / (32000 x 6) = 43.69 sec

T1M = 8 (1024) (1024) / (1x106 x 6) = 1.4 sec

**Q3. Consider the three-way handshake in TCP connection setup.**

1. **Suppose that an old SYN segment from station A arrives at station B, requesting a TCP connection. Explain how the three-way handshake procedure ensures that the connection is rejected.**

In a three-way handshake procedure, one must ensure the selection of the initial sequence number is always unique. If station B receives an old SYN segment from A, B will acknowledge the request based on the old sequence number. When A receives the acknowledgment segment from B, A will find out that B received a wrong sequence number. A will discard the acknowledgment packet and reset the connection.

1. **Now suppose that an old SYN segment from station A arrives at station B, followed a bit later by an old ACK segment from A to a SYN segment from B. Is this connection request also rejected?**

If an old SYN segment from A arrives at B, followed by an old ACK segment from A to a SYN segment from B, the connection will also be rejected. Initially, when B receives an old SYN segment, B will send a SYN segment with its own distinct sequence number set by itself. If B receives the old ACK from A, B will notify A that the connection is invalid since the old ACK sequence number does not match the sequence number previously defined by B. Therefore, the connection is rejected.

**Q.4 A router has the following CIDR entries in its routing table:**

Address/mask Next hop

135.46.56.0/22 Interface 0

135.46.60.0/22 Interface 1

192.53.40.0/23 Router 1

default Router 2

1. **What does the router do if a packet with an IP address 135.46.63.10 arrives?**

The first 22 bits of 135.46.63.10 is network address, is 135.46.60.0.The router forwards the packet to Interface 1

1. **What does the router do if a packet with an IP address 135.46.57.14 arrives?**

Given that the first 22 bits of the IP above address, we have 135.45.56.0 which corresponds to the network address of the first row. The packet will be forwarded to Interface 0