1. Raise two main advantages of packet switching, compared to message switching.

Ans: There are two important benefits from packet switching.
The first and most important benefit is that since packets are short, the communication links between the nodes are only allocated to transferring a single message for a short period of time while transmitting each packet.

2. Given a 20-bit frame and bit-error-rate *p* in communication. What is the probability that the frame has no error? What is the probability of 1-bit errors?

Ans: Probability of no bit errors: P1= (1−Pb)^F
Probability of 1 or more bit errors: P2= 1−(1−Pb)^F

3. Give two features that the data link layer and transport layer have in common, and further give two features in which they differ.

Ans: Features that they have in common:
- Both layers can provide recovery from transmission errors.
- Both layers can provide flow control.
- Both layers can support multiplexing.

Features in which they differ:
- The transport layer is end to end and involves the interaction of peer processes across the network.
- The data link layer involves the interaction of peer-to-peer processes that are connected directly.

4. Which OSI layer is responsible for (a) determining the best path to route packets; (b) providing end-to-end reliable communications; (c) providing node-to-node reliable communications?

Ans: (a)Determining the best path to route packets: The network layer is concerned with the selection of paths across the network.

(b)Providing end-to-end communications with reliable service: The transport layer is concerned with providing reliable service on an end-to-end basis across the network.

(c)Providing node-to-node communications with reliable service: The data link layer provides for the reliable transfer of information between adjacent nodes in a network.

5. How does the network layer in a connection-oriented packet-switching network differ from the network layer in a connectionless packet-switching network?

Ans: **Connection-oriented, reliable (virtual circuit)**

A connection is established between end-point network layers, quality of service params, cost, speed can be negotiated, then data can be reliably sent. All packets take the same path. The connections are known as virtual circuits.
The PSTN is the model here, with customers not wanting to deal with complexity and wanting to rely on the carrier for a reliable channel. Some types of data (synchronous) are much easier to do with a reliable service. ATMs are designed like this.
Each virtual circuit is uniquely identified by being given a number in each router. Each packet of data has the virtual circuit identified in it, so the routers know how to pass the packet along. The virtual circuits are released and the identifiers are freed when the circuit is torn down.
The programmers interface to a virtual circuit subnet is a bit more complex:

open_connection(),
send_packet(), receive_packet()
close_connection()

Connection-less, unreliable (datagram)

Each packet is independent of all others, includes complete addressing info, and may follow a path different from the other packets in the same message. The network layer doesn't guarantee delivery of each packet, and doesn't promise to deliver them in the same order. The packets in the network layer are known as datagrams.
The argument here (made by Internet people) is that networks will always be unreliable, no matter what you do in the network layer, so transport layers will always have to have error and flow control. Why repeat this in the network layer? Hosts are cheap (capable of doing more complex stuff in transport layer), some types of data need speed over reliability, the public

infrastructure should remain simple and basic.

Each router knows something about how to further the progress of each packet, and it makes its decision by looking at the destination address contained in the packet. Since reliable delivery is guaranteed in the transport layer, the routers don't have to do anything special when a connection is torn down (they don't know about the connections).

The programmers interface to a datagram subnet is quite simple:

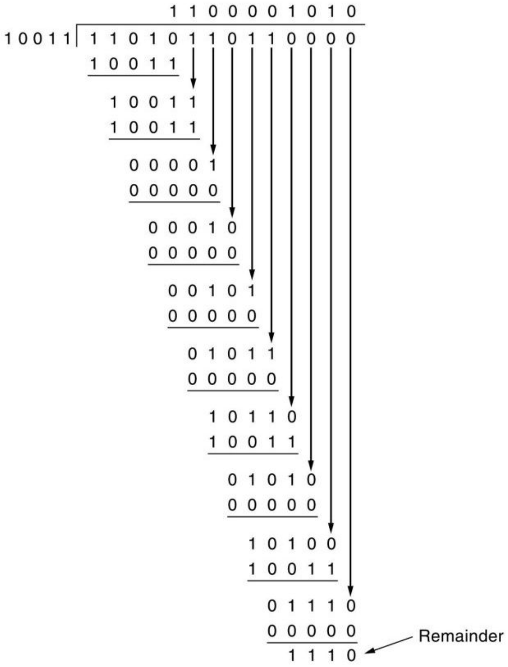
send_packet() and receive_packet()

6. A bit stream 1101011011 is transmitted using the standard CRC method. The polynomial generator is x^4+ x + 1. What is the actual bit string transmitted? Show the major steps to your answer.

Ans: The generator polynomial G(x) = x^4 + x + 1 is encoded as 10011.

- Clearly, the generator polynomial consists of 5 bits.
- So, a string of 4 zeroes is appended to the bit stream to be transmitted.
- The resulting bit stream is 1101011011**0000**.

Now, the binary division is performed as:



7. Suppose a IP header consists of four 16-bit words: (11111111 11111111, 11111111 00000000, 11110000 11110000, 11000000 11000000). Please find the Internet checksum for the code.

Ans: b0 = 11111111 11111111 = 216 – 1 = 65535
b1 = 11111111 00000000 = 65280
b2 = 11110000 11110000 = 61680
b3 = 11000000 11000000 = 49344
x = b0 + b1 + b2 + b3 modulo 65535 = 241839 modulo 65535 = 45234
b4 = −x modulo 65535 = 20301
So the Internet checksum = 01001111 01001101

8. Suppose that a group of computers is connected to an Ethernet LAN. If the computers communicate only with each other, does it make sense to use IP protocol in the computers? Should the computers run TCP directly over Ethernet? How is addressing handled?

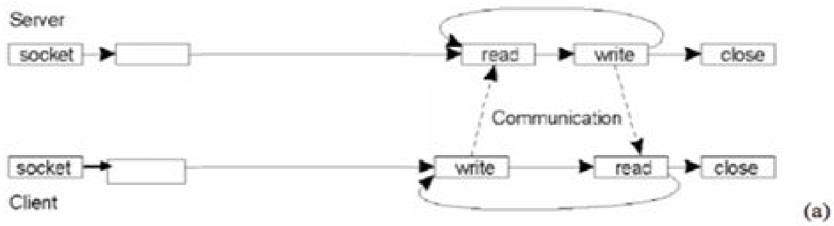
Ans: When a group of computers are connected to an Ethernet LAN, there's no need for IP.

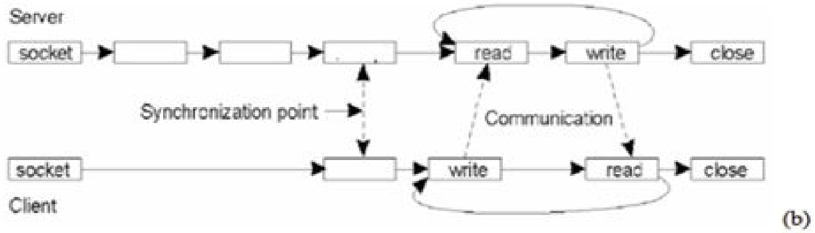
You can't run standards-based TCP without IP, as TCP utilizes IP addresses. You would have to use your own custom streaming protocol that's based on Ethernet or other link layers as a lower layer.
One thing IP does is abstract the link layer from upper levels of the stack - there was a time where it was possible you could have Ethernet or token ring, and there are things like PPP and HDLC, and also the loopback interface.

This is something you get to decide when you create your custom protocol above. An option if you don't want to support routing at all is just using the MAC address. Non-IP protocols like IPX/SPX and AppleTalk had their own address schemes and methods to obtain host addresses.

9. a. The figures below show the TCP/UDP communication pattern diagrams. Which diagram works for TCP? Why?

b. Fill the missing steps (blank boxes) in both diagrams for TCP/UDP correspondingly.





Ans: a: Connectionless communication pattern using sockets: UDP

b: Connection-oriented communication pattern using sockets: TCP