Questions on Chapter 2

Questions:

Q2-1. What is the first principle we discussed in this chapter for protocol layering that needs to be followed to make the communication bidirectional?

To make the communication bidirectional, each layer needs to be able to provide 2 opposite tasks, one in each direction

Q2-2. Which layers of the TCP/IP protocol suite are involved in a link-layer switch?

The link-layer switch is normally involved in the first 2 layers of the TCP/IP protocol suite:

a) The physical layer b) The data link layer

Q2-3. A router connects three links (networks). How many of each of the following layers can the router be involved with?

a. physical layer b. data-link layer c. network layer

The router is involved in:

a) Three physical layers b) Three data link layers

c) Only one network layer

Q2-4. In the TCP/IP protocol suite, what are the identical objects at the sender and the receiver sites when we think about the logical connection at the application layer?

The identical objects are the 2 messages: One sent and one received.

Q2-5. A host communicates with another host using the TCP/IP protocol suite. What is the unit of data sent or received at each of the following layers?

a. application layer b. network layer c. data-link layer

a) At the application layer, the unit of data is a message.

b) At the network layer, the unit of data is a datagram.

c) At the data link layer, the unit of data is a frame.

Q2-6. Which of the following data units is encapsulated in a frame?

a. a user datagram **b. a datagram** **c. a segment**

A frame is a link layer data unit it encapsulates a data unit coming from the network layer. In this case, the data unit is datagram.

Q2-7. Which of the following data units is decapsulated from a user datagram?

a. a datagram **b. a segment** **c. a message**

A user datagram is a transport-layer data unit It decapsulates a data unit going to the application layer. In case the data is a message

Q2-8. Which of the following data units has an application-layer message plus the header from layer 4?

a. a frame **b. a user datagram** **c. a bit**

The data unit should belong to layer 4. In this case it is a user datagram

Q2-9. List some application-layer protocols mentioned in this chapter.

We mentioned HTTP, FTP, SNMP, TELNET, SSH and DNS.

Q2-10. If a port number is 16 bits (2 bytes), what is the minimum header size at the transport layer of the TCP/IP protocol suite?

The transport-layer packet needs to include 2 port numbers: Source and destination port numbers. The transport layer header needs to be at least 32 bits (4 bytes) long, but header size in normally much longer because we need to include other pieces of information.

Q2-11. What are the types of addresses (identifiers) used in each of the following layers?

a. application layer **b. network layer** **c. data-link layer**

a. At the application layer we normally use a name to define the destination computer name and the name of the file we need to access, an example is something@somewhere.com

b. At the network layer, we use two logical addresses (Source and destination) to define the source and destination computers. These addresses are unique universally.

c. At the data link layer, we use two link layer addresses (source and destination) to define the source and destination connections to the link.

Q2-12. When we say that the transport layer multiplexes and demultiplexes application layer messages, do we mean that a transport-layer protocol can combine several messages from the application layer in one packet? Explain.

The answer is no. Multiplexing/demultiplexing at the transport layer doesn't mean combining several Upper layer packets (from the same or different applications) into one transport-layer packet. It only means that each of the transport-layer protocols (such as TCP or UDP) can carry a packet from any application-layer protocol that needs its service. However, a transport-layer packet can carry one and only one packet from an application layer protocol
For example: UDP can carry a message from FTP in one user datagram and a message from HTTP in another user datagram.

Q2-13. Explain why we didn't mention multiplexing/demultiplexing services for the application layer?

The application layer is the top layer in the suite. It doesn't provide services to any layer; which means multiplexing/demultiplexing doesn't exist for this layer.

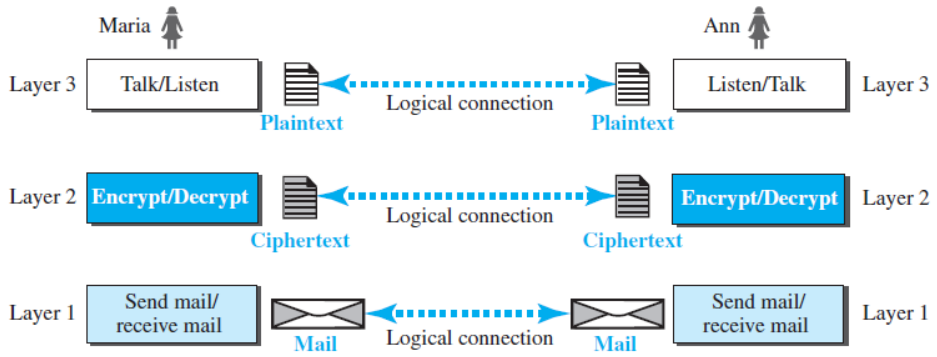
Q2-14. Assume we want to connect two isolated hosts together to let each host communicate with the other. Do we need a link-layer switch between the two? Explain.

We don't need a link layer switch because the communication in this case automatically one-to-many communication to a one to one

Q2-15. If there is a single path between the source host and the destination host, do we need a router between the two hosts?

We don't need a router in this case because a router is needed when there is more than one path between the two hosts; the router is responsible for choosing the best path at each moment.

Problems:



P2-1. Answer the following questions when the communication is from Maria to Ann:

***a*. What is the service provided by layer 1 to layer 2 at Maria's site?**

***b*. What is the service provided by layer 1 to layer 2 at Ann's site?**

Solution:

The services provided in part a and part b are the opposite of each other

a) Layer 1 takes the cipher text from layer 2, inserts (Encapsulates) it in an envelope and sends it.

b) Layer 1 receives the mail, removes (decapsulates) the cipher text from the envelope and delivers it to layer 2.

P2-2. when the communication is from Maria to Ann:

a. What is the service provided by layer 2 to layer 3 at Maria's site?

b. What is the service provided by layer 2 to layer 3 at Ann's site?

Solution:

The services provided in part A and Part B are opposite of each other.

a) Layer 2 takes the plaintext from layer 3, encrypts it, and delivers it to layer 1.
b) Layer 2 takes the cipher text from layer 1 decrypts it and delivers it to layer 3.

P2-3. Assume that the number of hosts connected to the Internet at year 2010 is five hundred million. If the number of hosts increases only 20 percent per year, what is the number of hosts in year 2020?

In 10 years, the number of hosts becomes about six times ($1.20^{10} \simeq 6.19$) in 2010. This means the number of hosts connected to the Internet is more than three billion.

P2-4. Assume a system uses five protocol layers. If the application program creates a message of 100 bytes and each layer (including the fifth and the first) adds a header of 10 bytes to the data unit, what is the efficiency (the ratio of application layer bytes to the number of bytes transmitted) of the system?

The system transmits 150 bytes for a 100-byte message. The efficiency is 100/150 or 66.66%.

P2-5. Assume we have created a packet-switched internet. Using the TCP/IP protocol suite, we need to transfer a huge file. What is the advantage and disadvantage of sending large packets?

The advantage of using large packet is less overhead. When using large packets, the number of packets to be sent for a huge file becomes small. Since we are adding three headers to each packet, we are sending fewer extra bytes than in the case in which the number of packets is large. The disadvantage manifests itself when a packet in lost or corrupted during the transmission; we need to resend a large amount of data.

P2-6. Match the following to one or more layers of the TCP/IP protocol suite:

a. route determination

b. connection to transmission media

c. providing services for the end user

Solution:

a) The network layer is responsible for route determination.
b) The physical layer is only layer that is connected to the transmission media.
c) The application layer provides services for the end users.

P2-7. Match the following to one or more layers of the TCP/IP protocol suite:

a. creating user datagrams

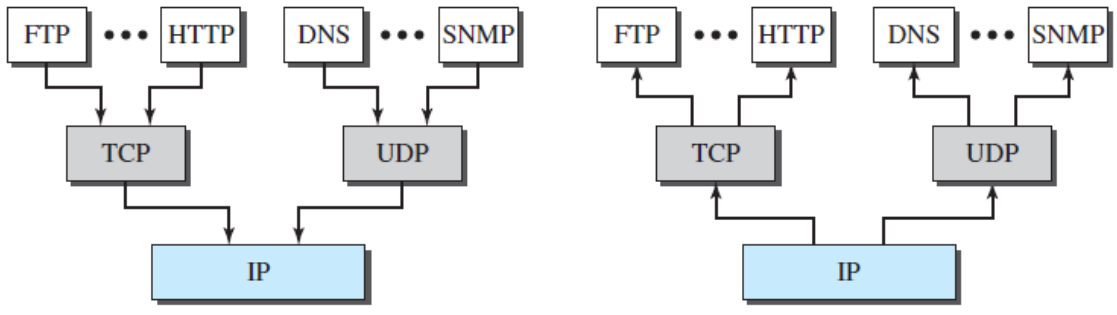
b. responsibility for handling frames between adjacent nodes

c. transforming bits to electromagnetic signals

Solution:

a) User datagrams are created at the transport layer.
b) The data-link layer is responsible for handling frames between adjacent nodes.
c) The physical layer is responsible for transforming bits to electromagnetic signals.

Figure 2.10 *Multiplexing and demultiplexing*



a. Multiplexing at source

b. Demultiplexing at destination

P2-8. In Figure 2.10, when the IP protocol decapsulates the transport-layer packet, how does it know to which upper-layer protocol (UDP or TCP) the packet should be delivered?

There should be an upper-layer identifier in the header of the IP protocol to define to which upper-layer protocol the encapsulated packet belongs. The identifier is called the protocol field.

P2-9. Assume a private internet uses three different protocols at the data-link layer (L1, L2, and L3). Redraw Figure 2.10 with this assumption. Can we say that, in the data-link layer, we have demultiplexing at the source node and multiplexing at the destination node?

The following figure shows the situation. If we think about multiplexing as many to one and demultiplexing as one to many we have demultiplexing at the source node and multiplexing at the destination node in the data-link layer. however, some purists call these two inverse multiplexing and inverse demultiplexing.

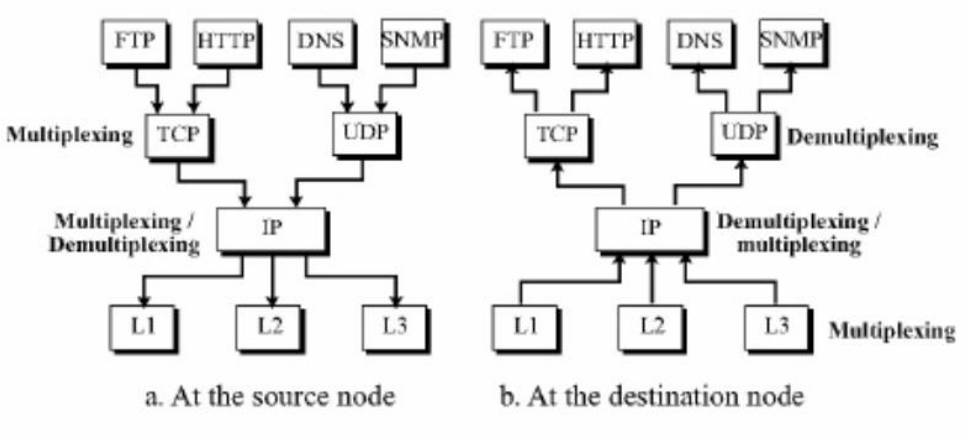
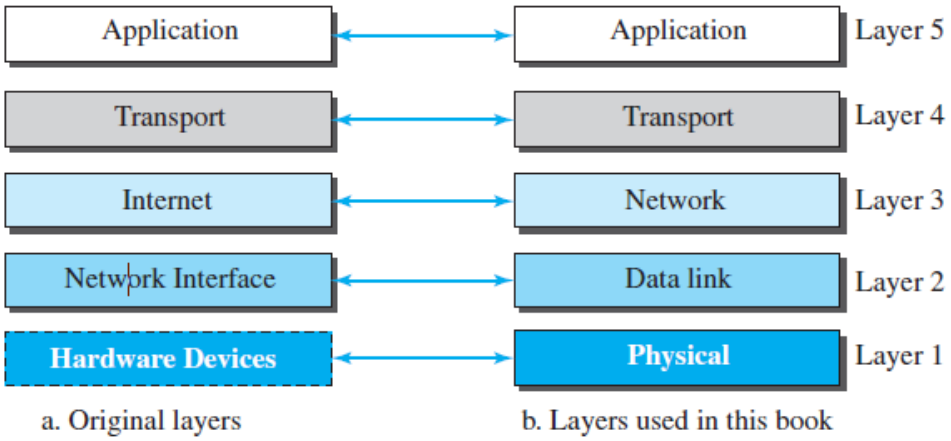
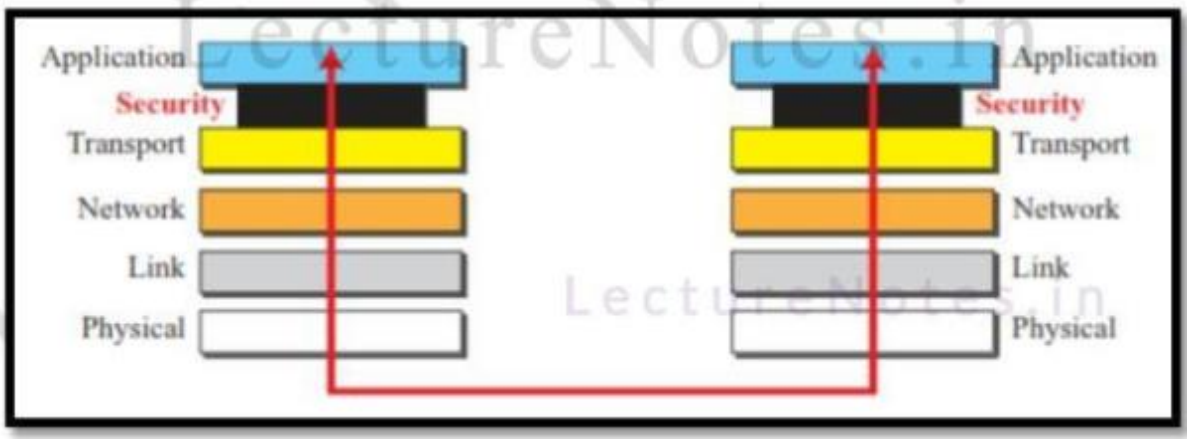


Figure 2.4 *Layers in the TCP/IP protocol suite*



P2-10. Assume that a private internet requires that the messages at the application layer be encrypted and decrypted for security purposes. If we need to add some information about the encryption/decryption process (such as the algorithms used in the process), does it mean that we are adding one layer to the TCP/IP protocol suite? Redraw the TCP/IP layers (Figure 2.4) if you think so.

Every time any packet at any layer is encapsulated inside another packet at the same layer, we can think of this as a new layer being added under that layer. The following figure shows the new suite.



P2-11. Protocol layering can be found in many aspects of our lives such as air travelling. Imagine you make a round-trip to spend some time on vacation at a resort. You need to go through some processes at your city airport before flying. You also need to go through some processes when you arrive at the resort airport. Show the protocol layering for the round trip using some layers such as baggage checking/claiming, boarding/unhoarding, takeoff/landing.

The following figure shows the layers. Note that we have not shown the security checking that you need to pass through because it doesn't have the counterpart when you arrive. It must be included in baggage/checking layer.

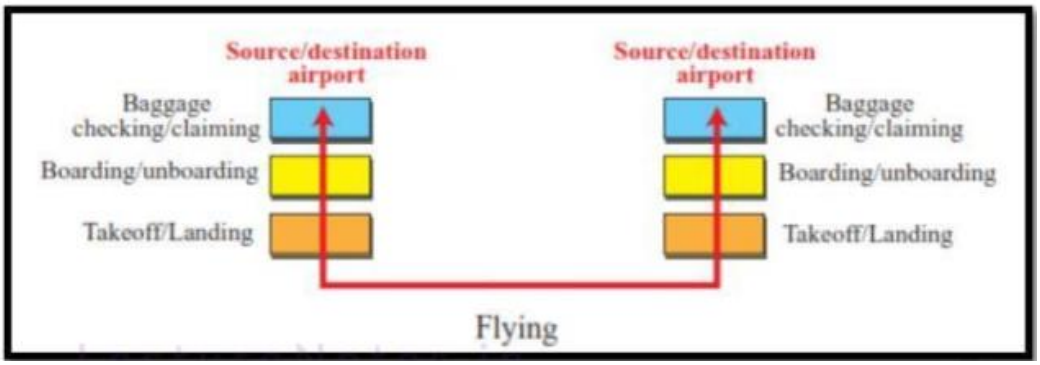
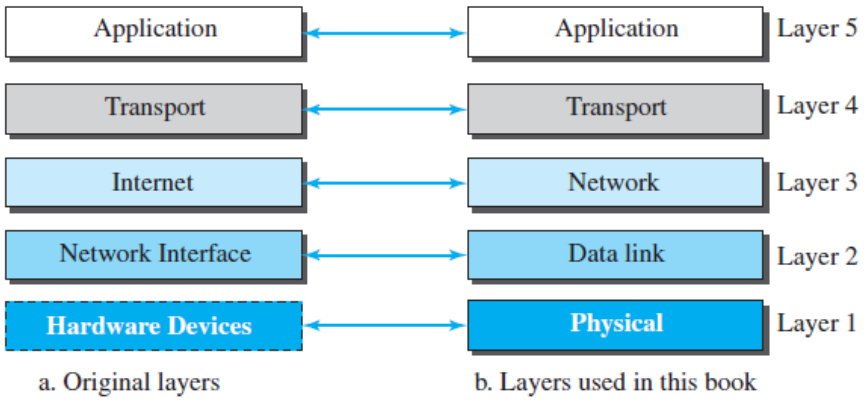
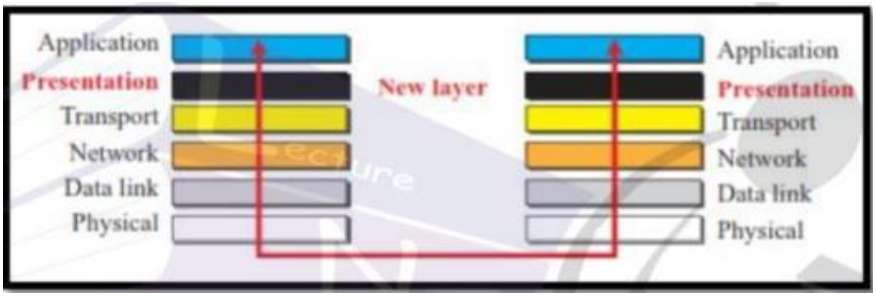


Figure 2.4 *Layers in the TCP/IP protocol suite*



P2-12. The presentation of data is becoming more and more important in today's Internet. Some people argue that the TCP/IP protocol suite needs to add a new layer to take care of the presentation of data. If this new layer is added in the future, where should its position be in the suite? Redraw Figure 2.4 to include this layer.

The following figure shows the position of the presentation layer. The new layer is at the same position as the presentation layer in the OSI model if we ignore the session layer.



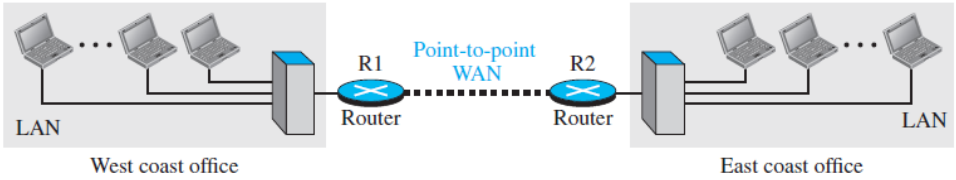
P2-13. In an internet, we change the LAN technology to a new one. Which layers in the TCP/IP protocol suite need to be changed?

The only two layers that need to be changed are the data-link layer and the physical layer. The new hardware and software need to be installed in all the host, routers, and link-layer switches. As long as the new data-link layers can encapsulate and decapsulate datagrams from the network layer, there is no need to change any protocol in the upper three layers. This is one of the characteristics of the protocol layering.

P2-14. Assume that an application-layer protocol is written to use the services of UDP. Can the application-layer protocol use the services of TCP without change?

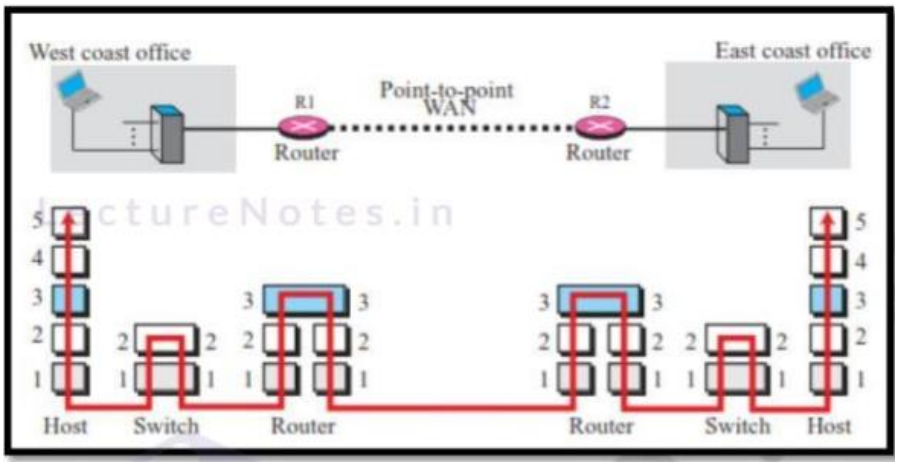
The reason for having several protocols in a layer is to provide different services to the upper-layer protocols. The services provided by UDP are different from the services provided by TCP. When we write an application program, we need to first define which transport-layer protocol is supposed to give services to this application program. Note that this doesn't violate the principle of layer independence. The independency of a layer means that we can change a protocol in a layer as long as the new one gives the same services as the old one. This doesn't mean that we can replace UDP by TCP, because they provide different services.

Figure 1.11 *An internetwork made of two LANs and one point-to-point WAN*



P2-15. Using the internet in Figure 1.11 (Chapter 1) in the text, show the layers of the TCP/IP protocol suite and the flow of data when two hosts, one on the west coast and the other on the east coast, exchange messages.

The following figure shows the layers and the flow of data. Note that each host is involved in five layers, each in two layers, and each router in three layers.



MCQ:

1) The TCP/IP protocol suite consists of _____ layers.

A) two
B) three
C) five
D) six

Solution: **C**

2) A router is involved in _____ layers of the TCP/IP protocol suite.

A) two
B) three
C) four
D) five

Solution: **B**

3) A link-layer switch is involved in _____ layers of the TCP/IP protocol suite.

A) two
B) three
C) four
D) five

Solution: **A**

4) In the TCP/IP protocol suite, which of the following is an application layer protocol?

A) The User Datagram Protocol (UDP)
B) The Internet Protocol (IP)
C) The File Transfer Protocol (FTP)
D) The Transmission Control Protocol (TCP)

Solution: **C**

5) In the TCP/IP protocol suite, which of the following is a transport-layer protocol?

A) The Internet Control Message Protocol (ICMP)
B) The Internet Protocol (IP)
C) The Address Resolution Protocol (ARP)
D) The Transmission Control Protocol (TCP)

Solution: **D**

6) In the TCP/IP protocol suite, which of the following is a network layer protocol?

A) The Stream Control Transmission Protocol (SCTP)
B) The Secure Shell (SSH)
C) The Internet Protocol (IP)
D) User Datagram Protocol (UDP)

Solution: **C**

7) The transport-layer packet in the TCP/IP protocol suite is called _____.

A) a message
B) a datagram
C) a segment or a user datagram
D) a frame

Solution: **C**

8) In the TCP/IP protocol suite, the _____ layer is responsible for moving frames from one hop (node) to the next.

A) physical
B) data-link
C) transport
D) network

Solution: **B**

9) In the TCP/IP protocol suite, the physical layer is concerned with the movement of _____ over the physical medium.

A) programs
B) dialogs
C) protocols
D) bits

Solution: **D**

10) In the TCP/IP protocol suite, a port number is the identifier at the_____.

A) application layer
B) transport layer
C) network layer
D) physical layer

Solution: **B**

11) In the TCP/IP protocol suite, a logical address is the identifier at the _____.

A) network layer
B) transport layer
C) data-link layer
D) application layer

Solution: **A**

12) The_____ layer is responsible for the delivery of a message from one process to another.

A) physical
B) transport
C) network
D) application

Solution: **B**

13) The Internet Protocol (IP) is _____ protocol.

A) a reliable
B) a connection-oriented
C) a reliable and connection-oriented
D) an unreliable

Solution: **D**

14) The application layer in the TCP/IP protocol suite is usually considered to be the combination of _____layers in the OSI model.

A) application, presentation, and session
B) application, transport, and network
C) application, data-link, and physical
D) network, data-link, and physical

Solution: **A**

15) In TCP/IP, a message at the application layer is encapsulated in a packet at the ____ layer.

A) network
B) transport
C) data-link
D) physical

Solution: **B**

16) In TCP/IP, a message at the transport layer is encapsulated in a packet at the _____ layer.

A) network
B) transport
C) data-link
D) physical

Solution: **A**

17) In TCP/IP, a message belonging to the network layer is decapsulated from a packet at the _____ layer.

A) network
B) transport
C) data-link
D) physical

Solution: **C**

18) In TCP/IP, a message belonging to the transport layer is decapsulated from a packet at the _____ layer.

A) network
B) transport
C) data-link
D) physical

Solution: **A**

19) In TCP/IP, a logical connection between an entity at the network layer can be made with another entity at the _____ layer.

A) network
B) transport
C) data-link
D) physical

Solution: **A**

20) In TCP/IP, a logical connection between an entity at the data-link layer can be made with another entity at the _____ layer.

A) network
B) transport
C) data-link
D) physical

Solution: **C**

21) In TCP/IP, a packet at the third layer carries data belonging to the _____ layer and the header belonging to the _____ layer.

A) third; third
B) third; fourth
C) fourth; third
D) fourth; fourth

Solution: **C**