1.

a. False. Multiple IP addresses can be put on a single physical interface.

b. False. Not all virtual circuit protocols provide reliable data communication.

c. False. We need the IP address and subnet mask of those two machines to determine if they are on the same local area network.

d. No, it is not necessary that every AS on the Internet uses the same intra-AS routing protocol. Because routing within an AS is internal to that AS and invisible to those outside it, each AS can determine what intra-AS routing protocol it should use without knowing what intra-AS routing protocol others use.

e. True. Token Ring cope better with high traffic rates than Ethernet.

2.

a.

Step	N	$D(B)$, $p(B)$	$D(C)$, $p(C)$	$D(D)$, $p(D)$	$D(E)$, $p(E)$	$D(F)$, $p(F)$
1	A	2, A	3, A	4, A	∞, $-$	∞, $-$
2	AB		3, A	3, B	5, B	∞, -
3	ABC			3, B	4, C	∞, -
4	ABCD				4, C	7, D
5	ABCDE					6, E

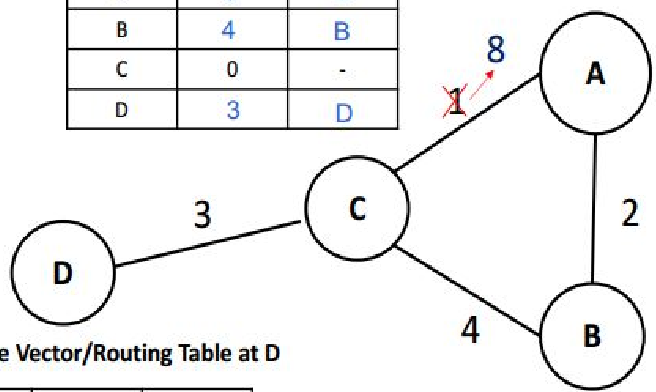
b.

Distance Vector/Routing Table at C

dest.	cost	next-hop
A	6	B
B	4	B
C	0	-
D	3	D

Distance Vector/Routing Table at A

dest.	cost	next-hop
A	0	-
B	2	B
C	5	B
D	8	B



Distance Vector/Routing Table at D

dest.	cost	next-hop
A	9	C
B	7	C
C	3	C
D	0	-

Distance Vector/Routing Table at B

dest.	cost	next-hop
A	2	A
B	0	-
C	4	C
D	7	C

c. The next-hop router that A will send the packet to is B. Upon receiving the packet from router A, B will send the packet to C.

3.

a. The path vectors AS U receives from AS V regarding V's routes to ASes A and B are path(V, X, A), path(V, B), and path(V, X, B)
The path vectors AS V receives from AS U regarding U's routes to ASes A and B are path(U, X, A) and path(U, X, B)

b. The route that AS U will use to forward packets destined to the host with the IP address 64.1.4.11 is 64.1.0.0/20 AX (U -> X -> A). Since the longest prefix that IP address of the host 64.1.4.11 can match is 64.1.0.0/20, the destination host would in AS A. AS U may know two routes to AS A: one is 64.1.0.0/20 AX, advertised by AS X. The other one is 64.1.0.0/20 AXV, advertised by AS V. However, U would prefer to choose 64.1.0.0/20 AX because X is the customer of U, which means X will pay U for the traffic.

c. All the path vectors that AS W receives from U and V are path(U, X, A), path(U, X, B), path(U, X), path(V, B), path(V, X), path(V, X, B), and path(V, X, A).
All the path vectors that AS C will receive from AS W and AS U are path(U, X, A), path(U, X, B), path(U, X), path(U, V, X, A), path(U, V, B), and path(U, V, X, B), path(W,

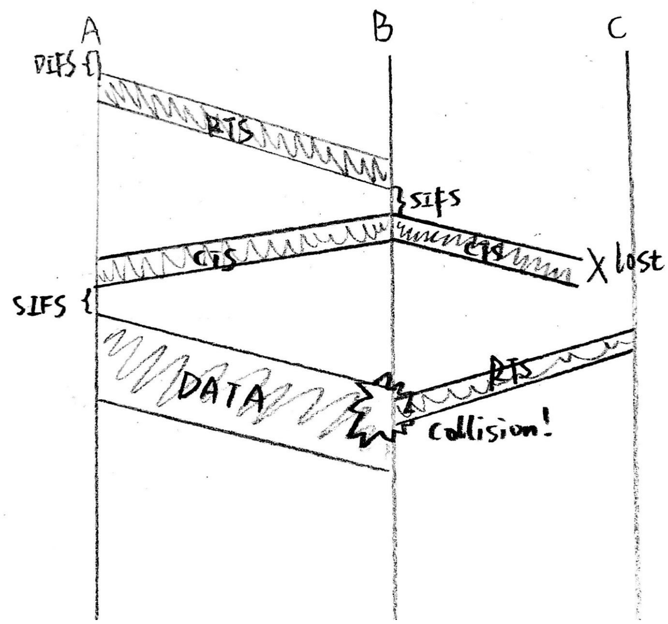
U, X, A), path(W, U, X, B), path(W, U, X), path(W, V, B), path(W, V, X), path(W, V, X, B), and path(W, V, X, A).

d. This packet will likely take C -> U -> X -> B path. By matching the network prefix, the destination IP address belongs to AS B, and the source IP address belongs to AS C. Since the path(U, X, B) that AS U advertises to AS C has the smallest number of providers and ASes passing by and only has a provider-customer relationship (C to U, U to X, X to B), this packet may take this path.

4.

a. No, wireless LAN (802.11) using CSMA/CA does not need to impose a minimum frame size requirement. The reason is that unlike CSMA/CD that requires a minimum frame size for collision detection (to estimate the maximum collision time), CSMA/CA does not detect any collision (because 802.11 cannot sense all collisions). Hence there is no need to have a minimum frame size requirement in 802.11.

b.



As shown in the figure above, even if CSMA / CA uses the RTS / CTS mechanism, collisions may still occur. The reason for these collisions is that a CTS sent by a host may not always be heard by all its neighbors.
In the figure above, there are three hosts A, B, and C. Firstly, a successful RTS-CTS exchange takes place between A and B, but the RTS message broadcasted by B fails to reach C. Then the data transmission from A to B starts and C wants to initiate a transmission to B during this time. However, since C does not receive the previous CTS

message and does not know there is an ongoing transmission from A to B, it still sends an RTS request to B, and then a collision happens.

5.

a. i) The destination IP address of the datagram will be 128.101.0.4

   ii) Address 1 of the WiFi frame will be wireless AP’s MAC address.

   iii) Address 2 of the WiFi frame will be N’s MAC address.

   iv) Address 3 of the WiFi frame will be R2’s MAC address.

   v) In the WiFi frame control header, To-AP will be set to 1. But From-AP will be set to 0.

b. i) The wireless AP knows it should forward the datagram to R2 via interface 1 by checking its forwarding table. This datagram will be delivered to S3 because S3 is in the halfway between AP and R2. However, the AP does not know the existence of S3. There is no need for the AP to know S3 because when the datagram arrives at S3, S3 knows the datagram should be delivered to R2 by checking its forwarding table.

   ii) The source MAC address of this Ethernet frame should be wireless AP’s MAC address and the destination MAC address should be R2’s MAC address.

c. Router R2 will forward the datagram to R1 via interface 1 after receiving this IP datagram. For the new Ethernet frame created by R2, the source MAC address will be R2’s MAC address and the destination MAC address will be R1’s MAC address.

d. i) Switch S3 will forward this Ethernet frame to all its interface, except for the interface that the ARP request come in (Host C).

   ii) Router R2 will drop this Ethernet frame and do nothing.

   iii) ARP works the same way in 802.3 and 802.11. The wireless AP will act as a switch and broadcast the ARP request to all the devices connected with it (via interface 2), but not interface 1 because it is the interface that the ARP message comes in.

   iv) Host L will receive this ARP request for 2 times.

v) No, this will not create a loop where the broadcast frame will circulate forever in the network. The reason is that host L will not forward this frame to any of its outgoing interfaces and will not even send an ARP response message since it knows the ARP request is not asking for its MAC address.