COMP-4320 Final Exam

Due Aug 3 at 10:30am **Points** 100 **Questions** 50
Available Aug 3 at 8am - Aug 3 at 10:30am 2 hours and 30 minutes
Time Limit 150 Minutes

Instructions

You will need to install the ProctorU Extension. Please download it here (https://chrome.google.com/webstore/detail/proctoru/goobgennebinldhonaajgafidboenlkl) for Chrome browser or here (https://www.proctoru.com/firefox) for Firefox.

There are 50 questions in this Final Exam.
This is a CLOSED note exam. Using your e-book, notes or textbook is NOT ALLOWED. **However, you are allowed two pages of blank scratch papers.** You may use two sheets of scratch paper. **You are also allowed to use a scientific calculator.** You must remain in front of your computer for the duration of the exam. NO BATHROOM BREAKS. Cell phones, tablets, laptops, smart watches, and any other electronic devices are NOT PERMITTED. Failing to follow these instructions could result in a violation.

This quiz is no longer available as the course has been concluded.

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	35 minutes	97 out of 100

Correct answers are hidden.

Score for this quiz: **97** out of 100
Submitted Aug 3 at 8:46am
This attempt took 35 minutes.

Question 1 — 1 / 1 pts

Consider a circuit-switched network shown in Figure 1, showing four channels/circuits in each of the links. There may be many hosts connected to each router.

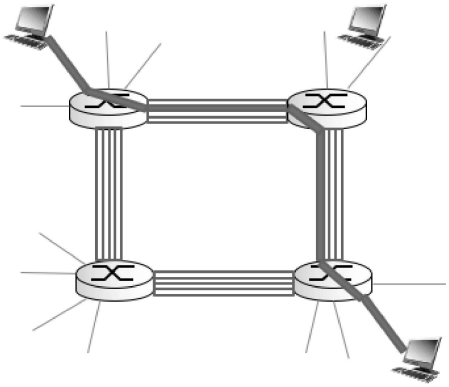

Figure 1.

The maximum number of simultaneous connections that can be in progress at any time is 16.

- (●) True
- ( ) False

Question 2

1 / 1 pts

HTTP response messages may contain an empty message body.

- (●) True
- ( ) False

Question 3

2 / 2 pts

In the Selective Repeat protocol, the sender window size and the receiver window size must be the same.

- ○ True
- ◉ False

Question 4

2 / 2 pts

Two-way handshakes can be used to establish TCP connections.

- ○ True
- ◉ False

Question 5

1 / 1 pts

Internet Control Message Protocol (ICMP) is mainly used for routing.

- ○ True
- ◉ False

Question 6

1 / 1 pts

Internet Protocol (IP) does not provide reliable delivery service for data.

- (●) True
- ( ) False

Question 7

1 / 1 pts

Maximum Transfer Unit (MTU) is a standardized value for all network links.

- ( ) True
- (●) False

Question 8

1 / 1 pts

Network Address Translation (NAT) is method of remapping an IP address to a machine's physical address.

- ( ) True
- (●) False

Question 9

1 / 1 pts

Routing algorithm determines end-to-end path through network.

- (●) True
- ( ) False

Question 10

1 / 1 pts

Dynamic Host Configuration Protocol (DHCP) allows host to dynamically obtain its MAC address from a server when it joins a network.

- ( ) True
- (●) False

Question 11

1 / 1 pts

Distance Vector mainly uses Bellman-Ford algorithm.

- (●) True
- ( ) False

Question 12

2 / 2 pts

Suppose there are N routers from source to destination. Let *L* denotes the number of bits in a packet, *R* denotes the transmission rate. What is the total end-to-end delay in sending one packet from source to destination?

- $\frac{L}{R}$
- $\frac{2N \times L}{R}$
- N
- **$\frac{N \times L}{R}$**

Answer Questions 13 and 14 using the following information. Suppose there are in total 15 users sharing a 200 Mbps link. Also suppose each user requires a bandwidth of 25 Mbps when transmitting, but each user transmits only 30 percent of the time.

Question 13

2 / 2 pts

Suppose **circuit switching** is used, what is the maximum number of users that can be supported?

- 6
- 8
- 15

- 13

Question 14

3 / 3 pts

Suppose **packet switching** is used, what is the probability that exactly one user is transmitting?

- 0.7
- 0.002
- 0.031
- 0.3

Question 15

2 / 2 pts

Suppose there is exactly one packet switch between a sending host and a receiving host. The transmission rates between the sending host and the switch and between the switch and the receiving host are *R1* and *R2*, respectively. Assuming that the switch uses store-and-forward packet switching, what is the total end-to-end delay to send a packet of length L? (Ignore queuing, propagation delay, and processing delay.)

- $\frac{2L}{R1+R2}$
- $\frac{L}{R1+R2}$

- $\frac{L}{R2}$
- **$\frac{L}{R1} + \frac{L}{R2}$**

Question 16

3 / 3 pts

Again, suppose as in the previous question that there is exactly one packet switch between a sending host and a receiving host. The transmission rates between the sending host and the switch and between the switch and the receiving host are both *R*. Assuming that the switch uses store-and-forward packet switching, what is the total end-to-end delay to send **three** packets of length L each? (Ignore queuing, propagation delay, and processing delay.)

- $\frac{3L}{R}$
- $\frac{3L}{2R}$
- $\frac{6L}{R}$
- **$\frac{4L}{R}$**

Answer Questions 17 to 19 using the following information:

Consider the scenario shown below, where there are 3 connections between the client and the server. Each connection consists of 5 links with transmission rates as shown in Figure 2. All connections use a shared link R, whose capacity of 120 Mbps is shared equally among the 3 connections.

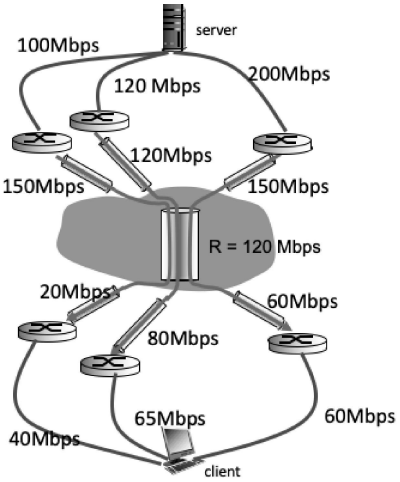

Figure 2.

Question 17

2 / 2 pts

What is the maximum achievable end-to-end throughput for the client and the server if only one connection can be used?

- 200 Mbps
- 120 Mbps
- 40 Mbps
- 20 Mbps

Question 18

2 / 2 pts

If the server can use all 3 parallel connections to send data, what is the maximum throughput that the server can achieve?

- [x] 100 Mbps
- [ ] 140 Mbps
- [ ] 715 Mbps
- [ ] 350 Mbps

Question 19

2 / 2 pts

Assuming that the server is sending at the maximum rate possible, what is the link utilization for the shared link R?

- [ ] 50%
- [ ] 48%
- [ ] 100%
- [x] 83%

Question 20

3 / 3 pts

The following are the Internetworking principles that are used for successfully developing the Internet:

i. Stateless routers

ii. Reliable connections

iii. Decentralized control

iv. Minimalism and autonomy

- All of the above
- ii, iii and iv only
- i, ii and iv only
- i, iii and iv only

Question 21

2 / 2 pts

What is the main reason for using layering principle for organizing the different modules of a complex network system?

- It prevents deadlocks
- It enables minimal interaction between the modules
- It makes network access more efficient
- Each layer is autonomous

Question 22

2 / 2 pts

To simplify development of complex network systems, we break the system into simpler modules, where each module consist of two parts: (1) interface which is well-known and accessible by users, and (2) implementation which is hidden from users. What is the main purpose for hiding the implementation?

It prevents dependency and deadlock

The implementation can be modified without modifying the user programs

Prevents information in the implementation from being revealed to the users

So that users will not damage the implementation

Question 23

2 / 2 pts

Why are most network applications in the Internet based on **stateless** client-server model, e.g. stateless HTTP protocol?

It is difficult to maintain states of the server and client that are consistent with each other

There are other more efficient reliability algorithms

It is inefficient to maintaining state information and store them in persistent storage

State information can be lost or corrupted

Answer Questions 24 and 25 using the following information.

Consider Figure 3 that shows the transmission of data segments and ACKs in TCP.

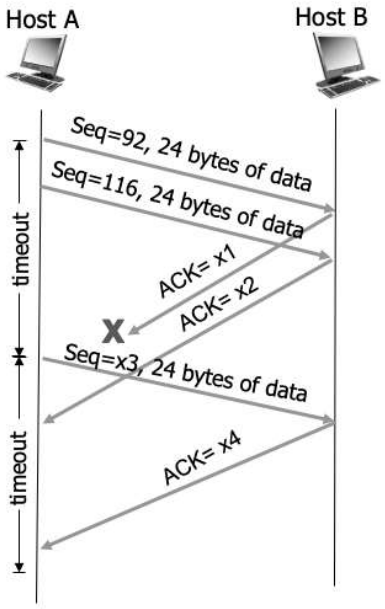

Figure 3.

Question 24

3 / 3 pts

What is the value of the Sequence Number x3?

- 116
- 140
- 164
- 92

Question 25

3 / 3 pts

What is the value of the ACK x4?

- (●) 140
- ( ) 92
- ( ) 164
- ( ) 116

Answer Questions 26 to 27 using the following information.

Consider Figure 4 that shows the transmission of data segments and ACKs in TCP.

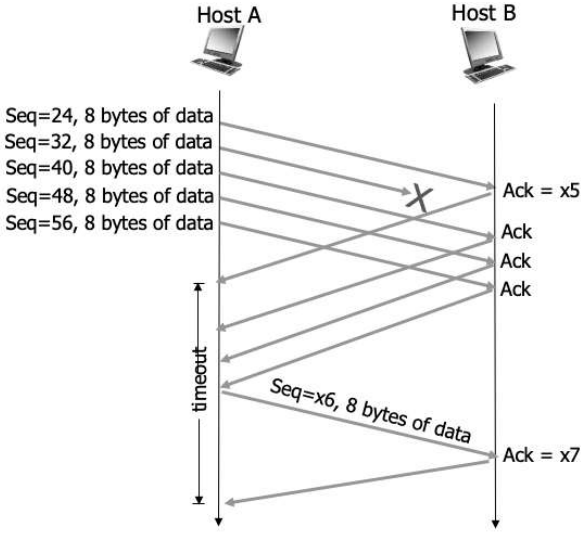

Figure 4.

Question 26

2 / 2 pts

What is the value of the Sequence Number x6?

- 56
- 64
- 32
- 40

Question 27

2 / 2 pts

What is the value of the ACK x7?

- 56
- 40
- 64
- 32

Answer Questions 28 and 29 using the following information.

Figure 5 shows a behavior of TCP Reno congestion control.

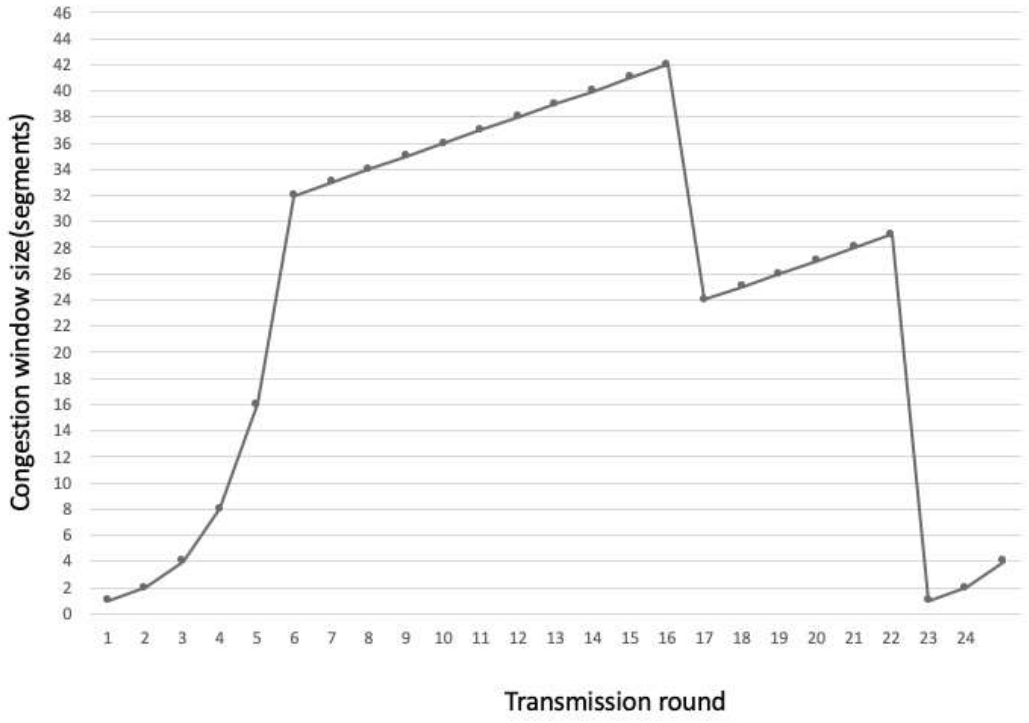

Figure 5.

Question 28

2 / 2 pts

What would be the most possible event that happen at 16th transmission?

- (●) Triple duplicate ACKs received.
- ( ) The connection is broken.
- ( ) The threshold is maxed out.
- ( ) There is a timeout.

Question 29

2 / 2 pts

What would be the most possible event happen at 22th transmission?

- The connection is broken.
- Triple duplicate ACKs received.
- There is a timeout.
- The threshold is maxed out.

Answer Questions 30 to 32 using the following information.

Consider the following institutional network that is connected to the Internet as shown in Figure 6.

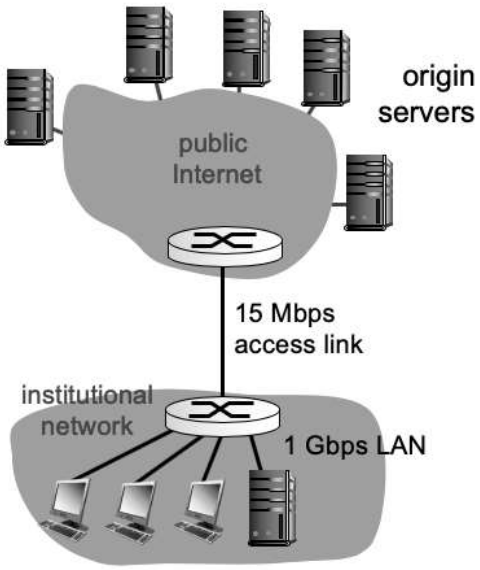

Figure 6.

Suppose that the average object size is 450,000 bits and that the average request rate from the institution's browsers to the origin servers is 32 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is 3 seconds on average. Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institution router) and the average

Internet delay. Assume that if the utilization at the access link is less than 60%, then the queuing delay is 0. (Ignore the propagation delay and processing delay at the access link.) Answer the following three questions.

Question 30

2 / 2 pts

What is the access link utilization?

- (●) 96%
- ( ) 60%
- ( ) 99%
- ( ) 30%

Question 31

3 / 3 pts

What is the total average response time?

- ( ) 1.8 sec
- ( ) 3 sec
- ( ) 3.75 sec
- (●) minutes

Question 32

3 / 3 pts

Now suppose a cache is installed in the institutional LAN. Suppose the cache hit rate is 0.4. Find the total average response time.

- ○ minutes
- ○ 3.75 sec
- ◉ 1.8 sec
- ○ 3 sec

Question 33

3 / 3 pts

TCP uses a variation of the following reliable data transfer protocol.

- ○ Selective Repeat protocol
- ◉ Go Back N protocol
- ○ Alternating Bit protocol
- ○ Stop and Wait protocol

Question 34

3 / 3 pts

Why does TCP use the variation of the protocol in Question 33 above?

- (●) Because the implementation is simpler and most networks are reliable.
- ( ) Because it requires fewest retransmission after a timeout.
- ( ) Because it recovers quickly after triple duplicate ACKs.
- ( ) Because each unacked segment has a separate timeout timer.

Question 35

3 / 3 pts

In the Selective Repeat protocol, what is the relationship between the sequence number size S and the sender window size W?

- ( ) S >= W
- ( ) S >= W + 1
- (●) S >= 2 X W
- ( ) S >= 2 X W + 1

Question 36

3 / 3 pts

In the Go Back N protocol, what is the relationship between the sequence number size S and the sender window size W?

- ( ) S >= 2 X W

- S >= 2 X W + 1
- S >= W
- (selected) S >= W + 1

Question 37

3 / 3 pts

To determine the appropriate timeout value to use for TCP, a sender X must estimate the round trip time (RTT) by sampling the RTT. Suppose, to compute this sample RTT, X sends a segment S at time t0 to Y but X did not receive the ACK before it times out and retransmits S at time t1. It then receives an ACK from Y at time t2. Suppose, X then computes the sample RTT as t2 - t1. Why is the sample RTT as computed incorrect?

- Because the ACK may be for a different segment transmission.
- Because the sample RTT should be computed as t2 – t0.
- (selected) Because the ACK may be for the first S transmission.
- Because the sample RTT may have some variation.

Question 38

3 / 3 pts

How does TCP handle the above scenario in Question 37?

- It will determine if the ACK is for the correct S transmission.
- It will calculate the average estimated RTT to correct the problem

- It will ignore the sample RTT for this segment.
- It will add the safety margin for the variation in RTT.

Incorrect

Question 39

0 / 3 pts

Suppose the Autonomous System AS1 learns from inter-AS protocol that Subnet *X* is reachable from AS3 and from AS2 (see Figure 7 below). Which is the next router that Router 1d will forward packets with Destination X?

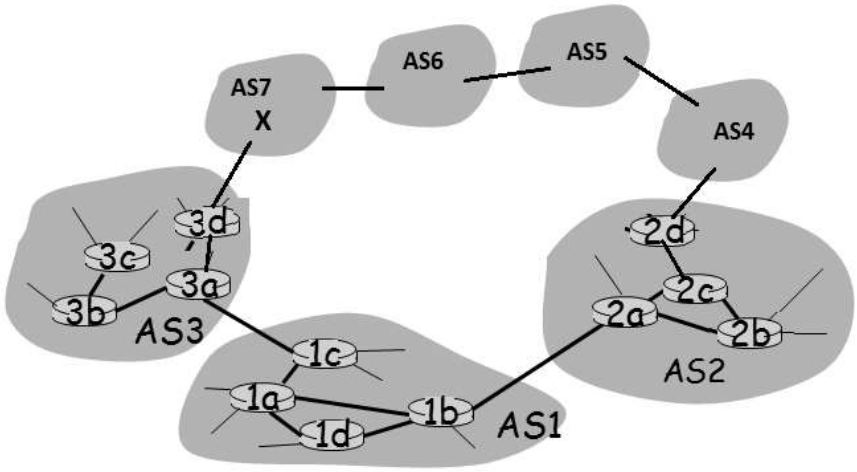

Figure 7. Hierarchical Routing in Autonomous Systems with Subnet X

- 1a
- 1c
- 1b
- None of these listed.

Answer Questions 40 to 43 using the following information.

Consider a Network Address Translation (NAT) router as shown in Figure 8.

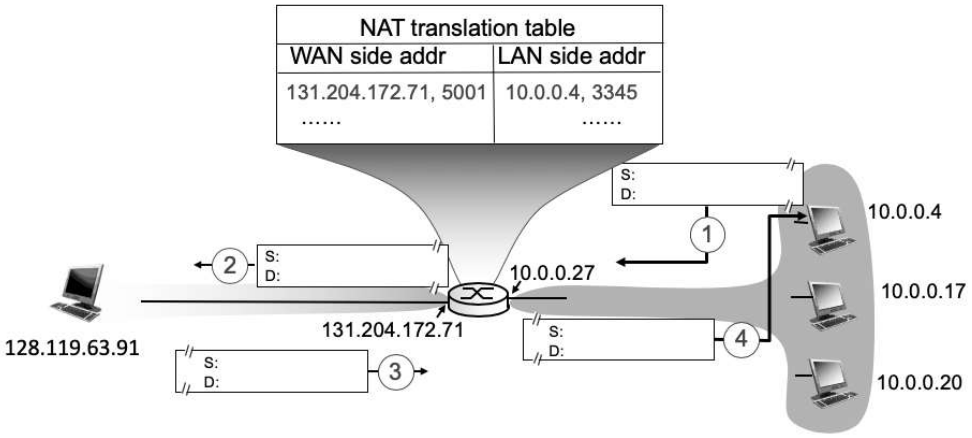

Figure 8

Three hosts, with private IP addresses 10.0.0.4, 10.0.0.17, 10.0.0.20, respectively, are in a local network behind a NAT router that sits between these three hosts and the Internet. IP datagrams being sent from, or destined to, these three hosts must pass through this NAT router. The router's interface on the LAN side has IP address 10.0.0.27, while the router's address on the Internet side has IP address 131.204.172.71.

Suppose that the host with IP address 10.0.0.4 sends an IP datagram destined to host 128.119.68.91. The source port is 3345 and the destination port is 80.

Question 40

1 / 1 pts

At Step 1, what are the source IP address, destination IP address and port numbers?

Source IP: 10.0.0.27, 3345

Destination IP: 128.119.68.91, 80

Source IP: 10.0.0.4, 3345

Destination IP: 128.119.68.91, 80

Source IP: 10.0.0.4, 3345

Destination IP: 131.204.172.71, 5001

Source IP: 10.0.0.27, 80

Destination IP: 131.204.172.71, 5001

Question 41

1 / 1 pts

At Step 2, what are the source IP address, destination IP address and port numbers?

Source IP: 10.0.0.27, 3345

Destination IP: 128.119.68.91, 80

Source IP: 10.0.0.27, 80

Destination IP: 131.204.172.71, 5001

Source IP: 131.204.172.71, 5001

Destination IP: 10.0.0.4, 3345

Source IP: 131.204.172.71, 5001

Destination IP: 128.119.68.91, 80

Question 42

1 / 1 pts

At Step 3, what are the source IP address, destination IP address and port numbers?

- Source IP: 131.204.172.71, 5001
  Destination IP: 10.0.0.4, 3345
- Source IP: 128.119.68.91, 80
  Destination IP: 10.0.0.27, 3345
- Source IP: 128.119.68.91, 5001
  Destination IP: 131.204.172.71, 3345
- Source IP: 128.119.68.91, 80
  Destination IP: 131.204.172.71, 5001

Question 43

1 / 1 pts

At Step 4, what are the source IP address, destination IP address and port numbers?

- Source IP: 128.119.68.91, 80
  Destination IP: 10.0.0.27, 3345
- Source IP: 128.119.68.91, 80
  Destination IP: 10.0.0.4, 3345

Source IP: 10.0.0.27, 3345

Destination IP: 10.0.0.4, 3345

Source IP: 131.204.172.71, 5001

Destination IP: 10.0.0.4, 3345

Answer Question 44 using the following information.

Consider the scenario as shown in Figure 9 below.

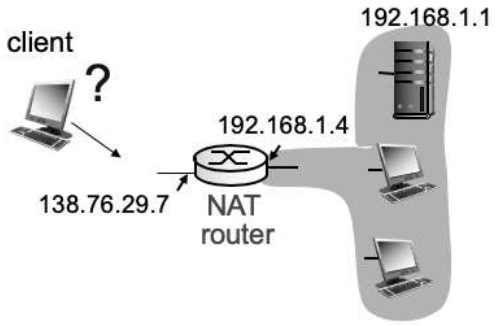

Figure 9

The client is in the outside world, and it is trying to connect to a server that is inside a local network, where a NAT router translates an address known to the outside world into the address of a host in the local network of an institution.

Question 44

1 / 1 pts

Which of the listed method can solve this problem?

- Universal Plug and Play (UPnP)
- Client creates connection to relay.
- Statically configure NAT to forward incoming connection.
- All of these listed

Answer Questions 45 to 47 using the following information.

Consider distance-vector algorithm.

Given the network shown in Figure 10 below and assume that each node initially knows the cost to each of its neighbors. Fill in the **FINAL** distance table entries at node z.

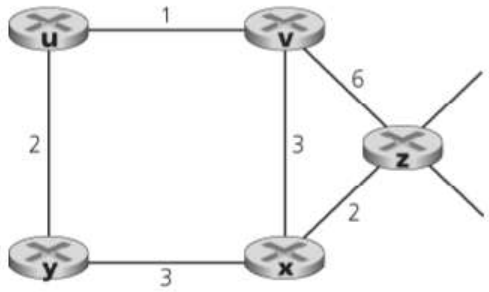

Figure 10.

Cost to						
From		**u**	**v**	**x**	**y**	**z**
	v	1	0	3	3	5
	x	4	3	0	3	2
	z	A	B	2	D	0

Table 1

Question 45

1 / 1 pts

What is the cost from z to u?

- None of the cost listed
- 7
- ∞
- 6

Question 46

1 / 1 pts

What is the cost from z to v?

- 6
- 5
- None of the cost listed
- ∞

Question 47

1 / 1 pts

What is the cost from z to y?

- 9
- 5
- ∞
- None of the cost listed

Answer Questions 48 to 50 using the following information.

Consider the scenario shown in Figure 11 below. The number on the link represents the cost from one node to another.

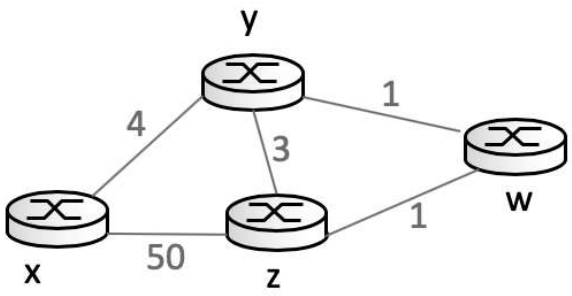

Figure 11.

Question 48

3 / 3 pts

Suppose after the distance vector routing is stabilized, the link cost between x and y increases to 60. What problem may occur?

- No route to host
- Flooding problem
- Hot potato routing
- Count to infinity

Question 49

3 / 3 pts

Which method will sometimes solve the problem in Question 48?

- Broadcast cost increase
- Split horizon with poisoned reverse
- Cut link between y and z
- Reverse path forwarding

Question 50

3 / 3 pts

Under what condition will the method in Question 49 above Not solve the problem in Question 48?

- When multiple paths can be used

- When there is a bottleneck node
- When a minimum spanning tree cannot be created
- When there is a loop in the network graph

Quiz Score: **97** out of 100