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I. Multiple Choices (20 points, 1 for each)

(　　) 1. What is the mask for a smallest subnet usable in practice?
A. 255.255.255.0　　　B. 255.255.255.254　　　C. 255.255.255.252　　　D. 255.255.255.255

(　　) 2. Which of the following IP address CANNOT be assigned to a host?
A. 141.107.255.80/16　　B. 201.255.0.11/24　C. 116.1.0.255/16　D. 198.121.254.255/24

(　　) 3. If a package is to be broadcasted to the local network, then the destination IP address of the package should be:
A. 255.255.255.255　　　　　　　B. 0.0.0.0
C. the lowest address of the subnet　　　D. the highest address of the subnet

(　　) 4. The core of the Internet protocols is:
A. IPX/SPX　　　B. PPP　　　C. TCP/IP　　　D. SLIP

(　　) 5. The lower layer of RIP protocol uses:
A. UDP　　　　B. TCP　　　　C. ARP　　　　D. IP

(　　) 6. Which of the following is true of the IP address 198.0.0.10 using default mask?
A. The netid is 198.　　　　　　　B. The hostid is 0.10.
C. The network address is 198.0.0.0　　　D. The hostid is 0.0.10

(　　) 7. Which of the following is true about IP routing?
A. The destination IP address changes at each hop.
B. The source IP address changes at each hop.
C. The frame does not change at each hop.
D. The frame changes at each hop.

(　　) 8. Which of the following ranges is considered as well-known port number?
A. 1~1023　　　　B. 1024 and above　　　C. 1~256　　　　D. 1~65534

(　　) 9. When we assign an IP address to a host, which of the following can be used?
A. 129.12.1.112　　　　　　　B. 127.0.1.1
C. 192.168.1.255　　　　　　　D. 220.1.25.0

(　　) 10. Concerning the following statements about Internet Control Message Protocol (ICMP), which is wrong?
A. ICMP data is encapsulated in the data part of IP datagrams
B. The transportation of ICMP messages is reliable
C. ICMP is a necessary part of IP protocol
D. ICMP can be used for congestion control

(　　) 11. The similarity of TCP and UDP is that both of them are:
A. connection-oriented protocols　　　　B. connectionless protocols
C. transportation-layer protocols　　　　D. none of above

(　　) 12. When a router receives an IP datagram, and the destination network is not recorded in the routing table, what action should the router take?
A. Discard the datagram
B. Broadcast the datagram to all ports of the router
C. Return the datagram to the upper level device
D. Request routing information to a particular router

(　　) 13. What is used at the Transportation layer to stop a receiving host's buffer from overflowing?
A. Segmentation　　　B. Packets　　　C. Acknowledgement　　　　D. Flow Control

(　　) 14. Which is the correct description that TCP sender needs to buffer?
A. Only last packet sent, since it may need to be retransmitted
B. Only first packet sent, since it may need to be retransmitted
C. All packet sent, since any of them may need to be retransmitted
D. No packet at all

(　　) 15. Which IP address range is allowable given an IP address of 172.27.2.56 and 28-bits of subnetting?
A. 172.37.2.48 to 172.37.2.63　　　　B. 172.37.2.48 to 172.37.2.62
C. 172.37.2.49 to 172.37.2.62　　　　D. 172.37.2.49 to 172.37.2.63

(　　) 16. The sequence number in TCP segment refers to:
A．the first byte of data part　　　　B．the last byte of data part
C．the first byte of the segment　　　　D．the last byte of the segment

(　　) 17. How many collision domains are there in the following network configuration?

A. 2　　　　　　B. 5　　　　　　C. 6　　　　　　D.10
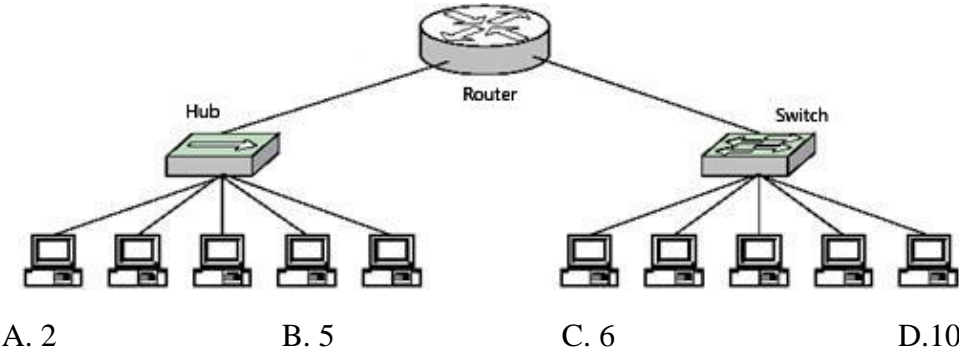
(   ) 18. What type of service does IP protocol provide?
A. Connection-oriented datagram service   B. Connectionless datagram service
C. Connection-oriented virtual circuit service   D. Connectionless virtual circuit service

(   ) 19. Concerning IPv4 addresses, which of the following statements is incorrect?
A. An IP address is always 32-bit-long.
B. Each IP address consists of network address and host address.
C. A class C address owns 8-bit host addresses, which can be assigned to 254 hosts.
D. A class A address owns the largest number of networks.

(   ) 20. Which of the following host addresses belongs to the same network as 10.110.12.29 with mask 255.255.255.224?

A. 10.110.12.0   B. 10.110.12.30   C. 10.110.12.31   D. 10.110.12.32

II. Fill in the Blanks (10 points, 1 for each blank)

1. _____ command will test the internal loopback of a computer. (Fill the complete command with parameters)

2. _____ (how many) usable subnets are created by applying the subnet mask 255.255.255.0 to a Class B network.

3. In Internet, we use_____as the identification of a process.

4. The MTU of Ethernet is of length_____ bytes.

5. The total digit number of IPv6 addresses is_____times of the total digit number of IPv4 addresses.

6. The IP address 11011011.00001101.00000101.11101110 can be written as_____with dotted decimal notation.

7. In Go-Back-N protocol, the sender has sent frames 0~7. When the timer expires, the sender only got acknowledgements to frames 0, 2, and 3. Then the amount of frames the sender need to retransmit is _____..

8. In Selective Repeat protocol, if the sequence number is 4-bit long, and the sizes of receive window and send window are the same, then the maximum size of the send window is _____.

9. Interior Gateway Protocols (IGP) are routing protocols used within an autonomous system. Now mostly used such protocols includes RIP and _____ .

10. The four congestion control algorithms include_____, congestion avoidance, fast retransmission and fast recovery.

III. True or False (10 points, 1 for each)

(   ) 1．Network Address Translation technology is a solution to expand the number of IP addresses available for public use.

(   ) 2．Latency through the store-and-forward switch varies with frame length.

(   ) 3．Security is one of the advantages of using static routes over dynamic routes.

(   ) 4．OSPF is an inter-AS routing protocol, while BGP is an intra-AS routing protocol.

(   ) 5．Encryption and decryption are functions of the presentation layer.

(   ) 6．Network layer is the key point of network interconnection. But network layer doesn't provide reliability guarantee, so TCP/IP networks don＇t have reliability mechanism.

(   ) 7．Router uses routed protocol to determine the best path for data transmission.

(   ) 8．Threshold window is smaller than congestion window.

(   ) 9．When calculating UDP segment checksum, a pseudo-header should be added.

(   ) 10．An autonomous system is an internet, and its most important feature is that the autonomous system can determine its internal routing protocols autonomously.

IV. Terminology (10 points, 2 for each)

1. Socket

2. Sliding Window Protocol
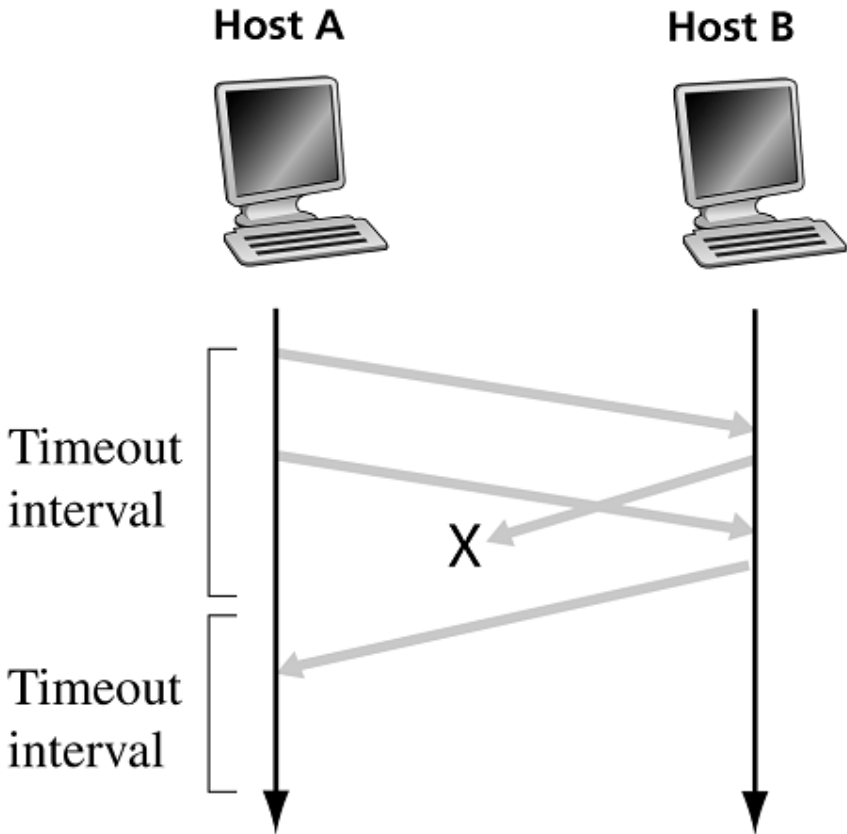
3. CIDR

4. BGP

5. ARQ

V. Comprehensive Questions (20 points)

1. Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 144. Suppose that Host A then sends two segments to Host B back-to-back. The first and second segments contain 20 and 40 bytes of data, respectively. In the first segment, the sequence number is 145, source port number is 303, and the destination port number is 80. Host B sends an acknowledgement whenever it receives a segment from Host A.

a. In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?

b. If the first segment arrives before the second segment, in the acknowledgement of the first arriving segment, what is the acknowledgment number, the source port number, and the destination port number?

c. If the second segment arrives before the first segment, in the acknowledgement of the first arriving segment, what is the acknowledgment number?

d. Suppose the two segments sent by A arrive in order at B. The first acknowledgement is lost and the second segment arrives after the first timeout interval, as shown in the figure below. Complete the diagram, showing all other segments and acknowledgements sent. (Assume there is no additional packet loss.) For each segment you add to the diagram, provide the sequence number and number of bytes of data; for each acknowledgement that you add, provide the acknowledgement number.

2. TCP Potpourri.

a. Consider two TCP connections, one between Hosts A (sender) and B (receiver), and another between Hosts C (sender) and D (receiver). The RTT between A and B is half that of the RTT between C and D. Suppose that the senders' (A's and C's) congestion window sizes are identical. Is their throughput (number of segments transmitted per second) the same? Explain.

b. Now suppose that the average RTT between A and B, and C and D are identical. The RTT between A and B is constant (never varies), but the RTT between C and D varies considerably. Will the TCP timer values of the two connections differ, and if so, how are they different, and why are they different?

c. Give one reason why TCP uses a three-way (SYN, SYNACK, ACK) handshake rather than a two-way handshake to initiate a connection.

d. It is said that a TCP connection "probes" the network path it uses for available bandwidth. What does this mean?

e. What does it mean when we say that TCP uses "cumulative acknowledgement"? Give two reasons why cumulative acknowledgment is advantageous over selective acknowledgment.

VI. Analysis and Design (30 points)

1. A company is assigned a Class B IP address with the net-id 129.250.0.0. The company has 4000 computers, distributed in 16 different locations averagely. If we choose 255.255.255.0 as the subnet mask, please assign a network (subnet) id for each location, and give the range of host IP addresses for each location.

2. In a subnet, there are six routers named A, B, C, D, and E. Router C is connected to Routers B, D, E, and F. Distance Vector Algorithm is used for routing. At some time, Router C got the following distance vectors (with the sequence of A, B, C, D, E, F):

from Router B: (5, 0, 8, 12, 6, 2）
from Router D: (16, 12, 6, 0, 9, 10）
from Router E: (7, 6, 3, 9, 0, 4）
The direct costs from C to B, D, and E are 6, 3 and 5 respectively.
Please give out the renewed routing table of Router C, including the output links and corresponding costs.

3. Host H connects to Internet via Fast Ethernet with the IP address of 192.168.0.8. The IP address of server S is 211.68.71.80. When H communicates with S via TCP, five IP packets captured on H are shown as follows:

Table 1. The first 40 bytes of IP packets. (in Hexadecimal)

No.	The first 40 bytes of IP packets. (in Hexadecimal)				
1	45 00 00 30	01 9b 40 00	80 06 1d e8	c0 a8 00 08	d3 44 47 50
	0b d9 13 88	84 6b 41 c5	00 00 00 00	70 02 43 80	5d b0 00 00
2	45 00 00 30	00 00 40 00	31 06 6e 83	d3 44 47 50	c0 a8 00 08
	13 88 0b d9	e0 59 9f ef	84 6b 41 c6	70 12 16 d0	37 e1 00 00
3	45 00 00 28	01 9c 40 00	80 06 1d ef	c0 a8 00 08	d3 44 47 50
	0b d9 13 88	84 6b 41 c6	e0 59 9f f0	50 f0 43 80	2b 32 00 00
4	45 00 00 38	01 9d 40 00	80 06 1d de	c0 a8 00 08	d3 44 47 50
	0b d9 13 88	84 6b 41 c6	e0 59 9f f0	50 18 43 80	e6 55 00 00
5	45 00 00 28	68 11 40 00	31 06 06 7a	d3 44 47 50	c0 a8 00 08
	13 88 0b d9	e0 59 9f f0	84 6b 41 d6	50 10 16 d0	57 d2 00 00

Please answer the following questions and give corresponding analysis and explanations.

(1) Concerning the five IP packets in Table 1, which is/are sent by H? Which complete the process of TCP connection setup? And which need(s) to be filled up for fast Ethernet transmission?

(2) According to the IP packets in Table 1, analyze how many bytes of application layer data has S received?

(3) For some IP packet in Table 1, if the first 40 bytes of it are as follows when it is sent by S, then how many routers has the packet passed?

Table 2. Header of IP Packet sent by S

45 00 00 28	68 11 40 00	40 06 ec ad	d3 44 47 50	ca 76 01 06
13 88 a1 08	e0 59 9f f0	86 6b 41 d6	50 10 16 d0	b7 d6 00 00

Notes: The header structures of IP packets and TCP segments are as follows:

Figure 1. IPv4 Packet Header Format

0 1 2 3	4 5 6 7	8 9 10 11 12 13 14 15	16 17 18	19 20 21 22 23 24 25 26 27 28 29 30 31
Version	IHL	DSCP	ECN	Total Length
Identification			Flags	Fragment Offset
Time To Live		Protocol		Header Checksum
Source IP Address				
Destination IP Address				

Figure 2. TCP Segment Header Format

0 1 2 3	4 5	6 7 8	9 10 11 12 13 14 15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Source port				Destination port
Sequence number				
Acknowledgment number (if ACK set)				
Data offset	Reserved 0 0 0 0 0 0	U R G, A C K, P S H, R S T, S Y N, F I N		Window Size
Checksum				Urgent pointer (if URG set)