

一、单项选择题（本大题共 20 小题，每小题 1.5 分，共 30 分）。

提示：在每小题列出的四个备选项中只有一个是符合题目要求的，请将其代码填写在下表中。错选、多选或未选均无分。

1. Which of the following protocols is an application protocol? _____
A. CSMA/CD B. ICMP C. OSPF D. IMAP
2. Which of the following provides reliable communication? _____
A. IP B. TCP C. UDP D. all of the above
3. Which of the following physical media belongs to unguided media? _____
A. Twisted-Pair Copper Wire B. Coaxial Cable
C. Fiber Optics D. Radio Channels
4. What is the use of Ping command? _____
A. to test a device on the network is reachable
B. to test a hard disk fault
C. to test a bug in application
D. to get the path from the source to destination
5. A user requests a Web page that consists of some text and 3 images. The browser's cache is empty. For this page, the client's browser: _____
A. sends 1 http request message and receives 1 http response messages.
B. sends 1 http request message and receives 4 http response messages.
C. sends 4 http request message and receives 4 http response messages.
D. sends 2 http request message and receives 4 http response messages.
6. The broadcast address of network 102.105.64.0/23 is _____
A. 102.105.64.255 B. 102.105.65.255
C. 102.105.255.255 D. 102.105.64.0
7. The Internet is an example of _____
A. cell switched network B. circuit switched network
C. packet switched network D. all of the above
8. The destination IP address in a DHCP discover message is _____.
A. the IP address of DHCP client B. the IP address of DHCP server
C. 255.255.255.255 D. 0.0.0.0
9. When the Time to Live(TTL) in an IP packet reaches zero and the destination has not been reached, an ICMP _____ error message is sent back to the sending machine.
A. destination-unreachable B. time-exceeded
C. parameter-problem D. none of the above.
10. Which of the following network is NOT an example of random-access media access protocols? _____.

- A. Ethernet B. Wi-Fi C. ALOHA D. Blue-tooth
11. What is the minimum header length of an IPv4 packet? _____.
A. 16 bytes B. 10 bytes C. 20 bytes D. 32 bytes
12. When a user retrieves his email from mail server, which of following protocols can't be used?
A. POP3 B. HTTP C. SMTP D. IMAP
13. Which of the following services CAN NOT be provided by the data link layer?

A. flow control B. congestion control C. error detection D. link access
14. A port number in UDP is _____ bits long.
A. 8 B. 16 C. 32 D. none of the above
15. The _____ utility allows you to query the DNS database from any computer on the network and find the host name of a device by specify its IP address, or vice versa
A. ipconfig B. tracert C. nslookup D. netstat
16. When a user needs to send the server some information using http, the request line method is _____.
A. GET B. HEAD C. SEND D. POST
17. In TCP, the timeout interval is a function of:
A. estimated RTT at the sender B. MSS and the overhead of a segment
C. the size of buffer at the receiver D. the size of sending window
18. Suppose host A sends host B one TCP segment with sequence number 418, acknowledgement number 571, and 24 bytes of data. Then the sequence number in the acknowledgement to this segment is _____.
A. 442 B. 418 C. 571 D. 595
19. In an Ethernet frame, the preamble is responsible for _____.
A. collision detection
B. error detection
C. synchronization of the receiver's clock to the sender's clock.
D. multiplexing/ demultiplexing
20. Let's assume there is 16-bit piece data 1011 1011 1001 1001, The 8-bit Internet checksum for this data should be _____.
A. 01010100 B. 01010101 C. 10101011 D. 10101010

二、判断并说明理由（本大题共 10 小题，每小题 2 分，共 20 分）。

1. Switches decrement the TTL field in the IP header.

2. TCP connection establishment uses a three-way handshake so the TCP sender, the TCP receiver and the sender's Internet Service Provider can all agree on a common set of options to be used for this session.
3. In networking, "best effort" service means the same thing as "reliable" service (as provided by TCP, for example), in contrast to "reasonable effort" service where there are no guarantees that the data will ever reach the destination.
4. A half-duplex link can carry data from Alice to Bob, or from Bob to Alice, but not in both directions at the same time.
5. In IP datagram, a checksum field in IP header is used to perform error detection for the whole datagram.
6. Ethernet provides unreliable, connectionless service.
7. In a datagram network (such as IP), routers keep track of connections between end systems.
8. The root domain name server is a single point of failure.
9. With nonpersistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.
10. The size of the TCP rwnd never changes throughout the duration of the connection.

三、简答题（本大题共 3 小题，共 8 分）。

1. What is the purpose of ARP, describe how it work? (3 points)
2. Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable? (3 points)
3. Why is it said that FTP sends control information "out-of-band"? (2 points)

四、计算及分析题（本大题共 5 小题，共 42 分）。

1. **(8 points)** For this problem, assume that Alice is transmitting data from the Sichuan University to Bob's lab at Mianyang city, Sichuan Province, using a dedicated point-to-point link that is 100 kilometers long and provides a data rate of 109 bits/sec.
 - A. If the length of each packet is exactly 10,000 bits, including all framing overhead, find the transmission time for a single packet. (1 point)
 - B. Find the one-way propagation delay from Alice to Bob, if signals travel at a speed of 2

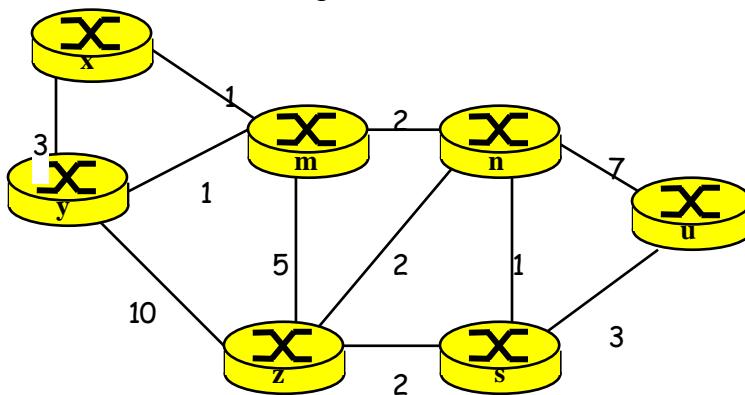
$/3C \equiv 2 \times 108 \text{ meters/sec.}$ (1 point)

- C. What is the maximum throughput, in packets per second, that Alice can send to Bob using the stop-and-wait protocol, assuming Bob's acknowledgments have zero length? Show your work! (2 points)
- D. If there are no errors, what happens to the maximum throughput if Alice and Bob switch to a sliding window protocol with a window size of 10, 100, or 1000 packets? (2 points)
- E. Suppose Bob is too lazy to implement the sliding window protocol, and instead suggest that they keep using stop-and-wait, but simply increase the packet size to 100,000 bits, 1,000,000 bits or 10,000,000 bits? How do the results of this approach compare to your answer to part D. Why is this? (2 points)
2. **(8 points)** Fill in the value of the congestion window size (number of segments) for each transmission round. Assume the threshold starts at 20 segments and the following events occur: (8 points)
- triple duplicate ACK during round 4
 - timeout during round 9
 - triple duplicate ACK during round 14

| Round | Congestion Window Size | Round | Congestion Window Size |
|-------|------------------------|-------|------------------------|
| 1 | | 9 | |
| 2 | | 10 | |
| 3 | | 11 | |
| 4 | | 12 | |
| 5 | | 13 | |
| 6 | | 14 | |
| 7 | | 15 | |
| 8 | | 16 | |

3. **(4 points)** Consider sending a large file from a host to another over a TCP connection that has no loss.
- A. Suppose TCP uses AIMD for its congestion control without slow start. Assuming cwnd increases by 1 MSS every time a batch of ACKs is received and assuming approximately constant round-trip times, how long does it take for cwnd increase from 6 MSS to 12 MSS (assuming no loss events)? (2 points)
- B. What is the average throughout (in terms of MSS and RTT) for this connection up through time = 6 RTT? (2 points)
4. **(10 points)** Consider the network topology shown below. The topology consists of

multiple routers interconnected by links. Each link has a static cost associated with it which represents the cost of sending data over that link.



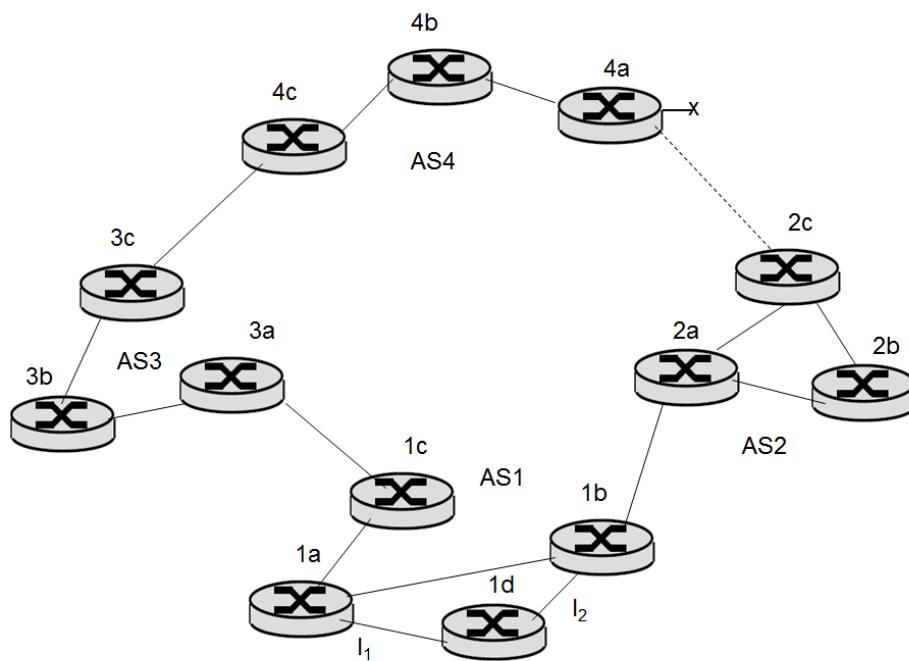
A. Please use Dijkstra's shortest-path algorithm to compute the shortest path from y to all network nodes. Show your work by computing a table similar to tables below.

| | D(x), P(x) | D(z), P(z) | D(m), P(m) | D(n), P(n) | D(s), P(s) | D(u), P(u) |
|-------|------------|------------|------------|------------|------------|------------|
| 1 {y} | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |

B. Give the forwarding table for node y

| Destination | link |
|-------------|------|
| X | |
| Z | |
| M | |
| N | |
| S | |
| U | |

5. (12 points) Consider the network shown below. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is no physical link between AS2 and AS4.



- A. Router 3c, 3a, 1c, and 1d learn about prefix x from which routing protocol, respectively? (3 points)
- B. Once router 1d learns about x will put an entry (x, l) in its forwarding table. Will l be equal to l1 or l2 for this entry? Explain why in one sentence. (3 points)
- C. Now suppose that there is a physical link between AS2 and AS4, shown by the dotted line. Suppose router 1d learns that x is accessible via AS2 as well as via AS3. Will l be set to l1 or l2? Explain why in one sentence. (3 points)
- D. Now suppose there is another AS, called AS5, which lies on the path between AS2 and AS4 (not shown in diagram). Suppose router 1d learns that x is accessible via AS2 AS5 AS4 as well as via AS3 AS4. Will l be set to l1 or l2? Explain why in one sentence. (3 points)