阅卷人							

1. (40) Questions
   (1) What are the two types of most important services that the Internet provides to its applications? What are some characteristics of these services? (8)
   (2) Describe how ARP protocol works in LAN. (8)
   (3) What are the two important network-layer functions in a datagram network? What is the difference between them? (8)
   (4) What is client program? What is server program? Does a server program request and receive services from a client program? (8)
   (5) Please describe the functions of Internet protocol stack and the corresponding PDU names of each layer. (8)

2. (12) There are two hosts A and B connected by a router R and two links. Each link transmits at 10*Mbps*. The propagation rate is $2*10^8 m/s$ and the distance is 5000*km* of each link. Consider sending a message of 30*Mbits* from A to B. Queuing delay and processing delay are negligible.
   (1) Consider sending the message without message segmentation. How long does it take to move the message from A to B?
   (2) Now suppose that the message is segmented into 30 packets, with each packet being 1*Mbits*. The size of header of these packets is negligible. How long does it take to move the message from A to B?

3. (12) Consider distributing a file of 10G bytes to 12 peers using a **client-serve** architecture. The upload rate of the server is u_s = 1Gbps. Assume a fluid mode where the server can simultaneously transmit to multiple peers, transmitting t each peer at different rates, as long as the combined rate does not exceed u_s. L

d_{min} denotes the download rate of the peer with the lowest download rate, if d_{min}=100Mbps, please give the minimum distribution time.

4. (12) Consider sending an object of size O = 400KBytes from server to client. There are three links between server and client, as shown Fig1. Let S (maximum segment size) = 512Bytes. Suppose the transport protocol uses congestion windows with constant size W = 8 segments. And each link has a transmission rate of R=100Kbps. Queuing delay, propagation delay and processing delay of this object are negligible. The time for the client to transmit each acknowledgement from client to server is 500msec. How long does it take to transmit the entire object from the server to the client?

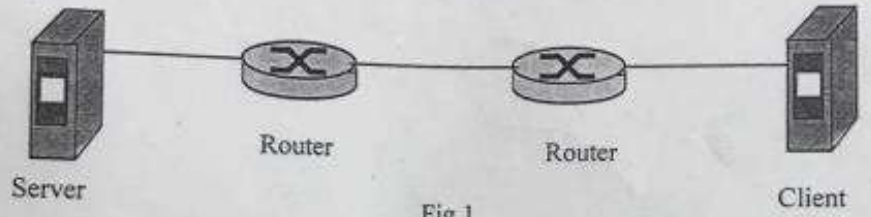

Fig 1

5. (12) Suppose a router has 5 links in a datagram network using 32-bit IP addresses. the datagrams are to be forwarded to the link interfaces as follows:

Destination Address	Interface
202.112.64.0/24	1
202.112.71.128/28	2
202.112.71.128/30	3
202.121.0.0/16	4
default	5

1) Suppose the router receives a datagram whose destination address is 202.114.34.26, which interface does the router determine? Why?
2) The router receives a datagram whose destination address is 202.112.71.132, which interface does the router determine? Why?
3) Consider a subnet with prefix 202.112.64.0/24 which is divided into three subnets: the subnet1 is required to support up to 123 interfaces, and subnets 2 and 3 are required to support up to 58 interfaces respectively. Please provide three network addresses of the form a.b.c.d/x that satisfy these constraints.

6. (12) Suppose two nodes, A and B, are attached to opposite ends of a 900 m cable, and that they each have one frame of 10,000 bits (including all headers and preambles) to send to each other. Both nodes attempt to transmit at time t = 0. Suppose there are two repeaters between A and B, each inserting a 400-bit delay. Assume the transmission rate is 100Mbps, and CSMA/CD with backoff intervals