1. General (2 points for each question: total 12 points)

a. When you ping the loopback address, a packet is sent where?

A	On the network
B	Down through the layers of the IP architecture and then up the layers again
C	Across the wire
D	through the loopback dongle
E	None of the above

b. In CRC there is no error if the remainder at the receiver is _____.

A	equal to the remainder at the sender
B	zero
C	nonzero
D	the quotient at the sender

c. Which of the following technique is used for Time-To-Live (TTL)?

A	a technique used in best-effort delivery system to avoid endlessly looping packets.
B	a technique used by protocols in which a lower level protocol accepts a message from a higher level protocol and places it in the data portion of the low level frame
C	One of the pieces that results when an IP gateway divides an IP datagram into smaller pieces for transmission across a network that cannot handle the original datagram size.
D	All of the above
E	None of the above

d. Which of the following statement is incorrect?

A	if a host moves from one network to another, its IP address must change
B	routing uses the network portion of the IP address, the path taken by packets travelling to a host with multiple IP addresses depends on the address used.
C	IP addresses encode both a network and a host on that network, they do not specify an individual machine, but a connection to a network.
D	All of the above
E	None of the above

e. You have a network ID of 134.57.0.0 and you need to divide it into multiple subnets in which at least 600 host IDs for each subnet are available. You desire to have the largest amount of subnets available. Which subnet mask should you assign?

A	255.255.224.0	B	255.255.240.0
C	255.255.248.0	D	255.255.255.0
E	255.255.255.255	F	None of the above

f. Error control is needed at the transport layer because of potential errors occurring.

A	from transmission line noise	B	In routers
C	from out-of-sequence delivery	D	from packet losses.

2. Network Layer (3 points)

Consider sending a 1500-byte datagram into a link that has an MTU of 500 bytes. Suppose the original datagram is stamped with the identification number 1. Assume that IPv4 is used.
Hint: The IPv4 header is 20 bytes long.

a. Where does fragmentation happen?
Fragmentation happens in the router preceding the link with the small MTU.

b. Where are the fragments reassembled?
The fragments are reassembled in the end system.

c. How many fragments are generated?
The maximum size of the data field in each fragment = 480 (because there are 20 bytes IP header). Thus the number of required fragments = (1500−20)/480 = 4.

d. In addition to the identification number, what are the fields in the generated IP datagram(s) that are related to fragmentation?
Flag and fragmentation offset.

e. What are the values of the fragmentation-related fields in the generated IP datagram(s)?
Each fragment will have an identical identification number (1). Each fragment except the last one will be of size 500 bytes (including the IP header). The last datagram will be of size 60 bytes (including the IP header). The offsets of the 4 fragments will be 0, 60, 120, 180. Each of the first 3 fragments will have flag=1; the last fragment will have flag=0.

f. What changes if DF=1 flag is used?
The router preceding the link with the small MTU will drop the packet and send an ICMP error message "Packet Too Big" back to the source. The source is responsible for adjusting the packet size.

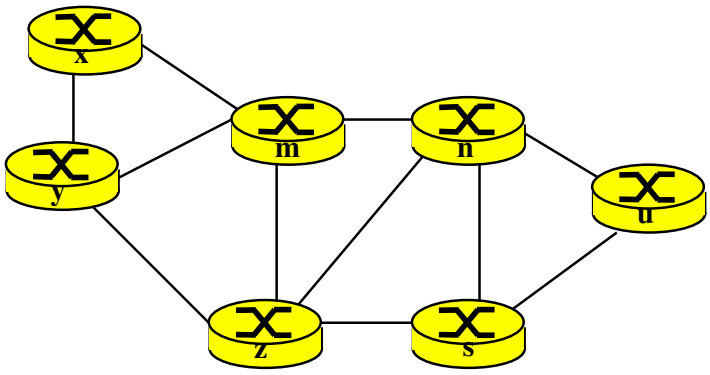
3. ARP (3 points)

Assume that all ARP tables are up to date and host A (192.168.1.2/24) wants to send an IP datagram to host C (192.168.2.2/24). Enumerate all the steps that should be taken to send this datagram. Please write the IP and MAC addresses of datagram and frames in routers and host.

(a) Datagram at host A: should be sent to 192.168.1.2
(b) Ethernet packet made at host A: destination MAC address R
(c) Router 1 determines that the datagram should be forwarded to 192.168.2.2
(d) Router 1 makes an Ethernet packet with destination address R
(e) Router 2 determine that the datagram should be delivered to C.
(f) Router 2 makes an Ethernet packet with destination MAC address C.

4. IP Addressing (6 points)

In the following picture place the missing IP addresses using the smallest possible IP range



1. There are 11 p-to-p networks.
2. Each network needs 4 addresses (/30 network)
3. The smallest IP set to be used is 64 address (/26) so, I need a /26 IP set
4. The /26 IP set can be divided in 2 /27 IP, then in 4 /28, in 8 /29 and, finally, in 16 /30 networks.
5. 11 out of the 16 networks can be used for this exercise

1. Given the following Ethernet frame capture, tags the missing fields. [6 pts]

```
|ff|ff|ff|ff|ff|ff|00|08|74|4f|36|23|                    Ethernet
|08|00|                                                   IP
|45|00|01|48|b3|10|00|00|                                 IPv4
|80|
|11|
|86|95|                                                   Header Checksum
|00|00|00|00|ff|ff|ff|ff|
|00|44|00|43|01|34|e9|7b|                                 UDP
|01|01|06|00|3e|5e|0c|e3|00|00|00|00|00|00|00|00|
.....
.....
|54|20|35|2e|30|37|0b|01|0f|03|06|2c|2e|2f|1f|21|
|f9|2b|ff|00|00|00|00|00|00|00|00|00|  C R C    |       Padding
```

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Version				IHL				Type of Service								Total Length															
Identification																Flags			Fragment Offset											
Time to Live								Protocol								Header Checksum															
Source Address																															
Destination Address																															
Options																												Padding			

Answer

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
4				5				00								0148															
B310																0			000											
80								11								8695															
00.00.00.00																															
ff.ff.ff.ff																															
There is no padding: here begins the UDP section																															