Control de Xarxes de Computadors (XC)	Group MAS – 03/05/2007
NAME:	**SURNAME:**

Duration: 1 hour. Answer the quiz and the problems in the same sheet.

Quiz. (6 points) All the questions are multi-answer: 0,6 point if correct, 0,3 if there is one error, 0 otherwise.

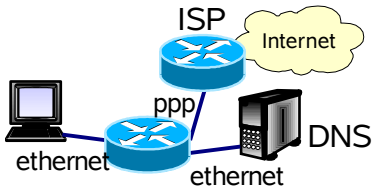

Figure 1

1. Say which statements are true regarding Figure 1 if the host router and DNS server have just booted and the following command is executed at the host:
`ping www.cisco.com`

- [x] The host will do 1 ARP resolution.
- [x] The router will do 1 ARP resolution.
- [ ] The DNS server will do 1 ARP resolution.
- [ ] When the host receives the echo reply, the host ARP table will contain 2 entries.

2. Say which statements are true regarding an IP network:

- [x] The IP datagram payload can be higher than 1500 bytes.
- [ ] The only protocols that an IP datagram can encapsulate are UDP and TCP.
- [ ] IP is a connection oriented protocol.
- [x] The maximum mask that can be used for a subnet is 30 bits.

3. Say which statements are true regarding the following TCP/IP protocols:

- [ ] ICMP messages are encapsulated in UDP datagrams.
- [x] DHCP messages are encapsulated in UDP datagrams.
- [ ] ICMP protocol uses the client/server paradigm.
- [ ] UDP protocol can use the MTU path discovery algorithm.

4. Say which of the following subnet partitions are valid if the base address is 200.0.0.0/24:

- [ ] One subnet with 200 hosts and another with 30 hosts.
- [ ] 200.0.0.240/27 and 200.0.0.224/27.
- [ ] 200.0.0.240/28 and 200.0.0.224/27.
- [ ] 200.0.0.240/27 and 200.0.0.224/28.
- [x] 200.0.0.240/28 and 200.0.0.224/28.

5. Say which of the following messages use broadcast addresses:

- [x] RIP version 1 update
- [ ] NS query
- [x] ARP request
- [ ] ARP reply
- [x] DHCP-DISCOVER
- [ ] ICMP echo request

6. Say which statements are true regarding DNS:

- [ ] The DNS replay message is always generated by an authoritative server.
- [x] The root servers have the addresses of the top level domain authorities.
- [x] A name server may return different IP addresses for the same name.
- [x] Several names may may identify the same IP address.
- [x] A name resolution can be iterative or recursive.

7. Say which statements are true regarding the routing protocols:

- [x] In general, OSPF is more convenient for large networks than RIP.
- [x] BGP protocol is more similar to RIP than to OSPF.
- [ ] OSPF uses the same metric as RIP.
- [ ] OSPF send link updates using TCP.

8. Say which of the following statements are true for the subnet 170.0.0.0/27:

- [ ] The broadcast address is 170.0.0.255.
- [ ] The mask in dotted point notation is 255.255.255.0
- [x] The base address is a class B address.
- [x] There are addresses to number at most 1 router and 29 hosts.

9. Say which statements are true regarding a NAT router:

- [ ] If basic NAT is used, none of the TCP header fields have to be changed by the NAT router.
- [ ] PAT may change the destination port of the TCP/UDP headers of the packets going from the internal to the external network.
- [x] PAT may change the destination port of the TCP/UDP headers of the packets going from the external to the internal network.
- [x] When PAT is used, multiple entries of the NAT table may belong to connections initiated at the same host.

```
12:40:37.443835 IP 192.168.1.100.23098 > 216.88.181.228.80: S 321330945:321330945(0) win 5840 <mss
   1460,sackOK,timestamp 3631118 0,nop>
12:40:37.602829 IP 216.88.181.228.80 > 192.168.1.100.23098: S 2831251529:2831251529(0) ack 321330946 win
   16384 <mss 1460,nop,nop,nop,timestamp 0 0,nop,nop,sackOK>
12:40:37.602903 IP 192.168.1.100.23098 > 216.88.181.228.80: . ack 1 win 46 <nop,nop,timestamp 3631158 0>
 ...
```

10. The previous dump shows the first 3 lines of a tcpdump capture done at the client side. From the following lines, select those that would be possible for the dump line number 4.

- [x] 12:40:37.603176 IP 192.168.1.100.23098 > 216.88.181.228.80: P 1:1501(1500) ack 1 win 5840 <nop,nop,timestamp 3631158 0>
- [ ] `12:40:44.603176 IP 192.168.1.100.23098 > 216.88.181.228.80: . ack 1 win 5840 <nop,nop,timestamp 3631158 0>`
- [x] 12:40:44.603176 IP 216.88.181.228.80 > 192.168.1.100.23098: S 2831251529:2831251529(0) ack 321330946 win 16384 <mss 1460,nop,nop,nop,timestamp 0 0,nop,nop,sackOK>
- [ ] `12:40:44.603176 IP 192.168.1.100.23098 > 216.88.181.228.80: S 321330945:321330945(0) win 5840 <mss 1460,sackOK,timestamp 3631118 0,nop>`

Question 1. (4 points) One host downloads a web page of 29.200 bytes from an Internet server (20 segments of 1.460 bytes). In the following we will refer to these segments as s_1, ... s_{20}, and to the ack acknowledging each of these segments as a_1, ... a_{20}. Assume that TCP uses only Slow Start/Congestion Avoidance, delayed ack are not used and the delay between the client and the server is 100 ms. Assume that during the web page download, **the segment s_6 is lost**. No other segments or acks are lost.

1.A Complete the following table showing what is going on since s_1 is sent by the server, until a_{20} is received by the client. Give some explanations of the relevant events shown in the table. If you need any parameter not given in this question, assume a value, and briefly justify why you chose that value. The following conventions are used:

- The first column indicates time in 100 ms intervals. The s_1 transmission is chosen as the time origin.
- The ssthresh/cwnd columns give these values measured in MSS units at the server for the time given in the same row. If no value is written in one of these cells, the value of the previous cell is assumed.
- The segment/ack column indicates the segments (s_1, ... s_{20}) or acknowledges (a_1, ... a_{20}) sent by the server, respectively client, at the time given at the same row.

t/100 ms	ssthresh/ MSS	cwnd/ MSS	segment / ack
0	∞	1	s_1
1			a_1
2		2	s_2, s_3
3			a_2, a_3
4		4	s_4, s_5, s_6, s_7
5			a_4, a_5, a_5
6		6	s_8, s_9, s_{10}, s_{11}
7			a_5, a_5, a_5,a_5
8	3	1	s_6
9			a_{11}
10		2	s_{12}, s_{13}
11			a_{12}, a_{13}
12		3+1/3	s_{14}, s_{15}, s_{16}
13			a_{14}, a_{15}, a_{16}
14		4+1/4	s_{17}, s_{18}, s_{19}, s_{20}
15			a_{17}, a_{18}, a_{19}, a_{20}
16		5+1/5	
17			
18			

We assume RTO ≈ RTT, thus, the RTO triggers at t = 800 ms.
We assume also that the TCP receiver stores the out of sequence segments.
At t = 1200 ms cwnd = 3 MSS, and the TCP sender changes from slow-start to congestion avoidance.

1.B Assume that the host is connected to Internet with an ADSL line of 2 Mbps. Compute the optimal window in bytes and segments. Comment your assumptions.

Assumptions: the TCP sender sends a window every RTT. The botleneck is the ADSL 2 Mbps access line:

$$v_{ef}[\text{bps}] \simeq \frac{W_{opt}[\text{bytes}]\times 8}{RTT} \rightarrow W_{opt}[\text{bytes}] = \frac{v_{ef}\times RTT}{8} = \frac{2\times 10^6 \times 200\times 10^{-3}}{8} = 50\,\text{kB}$$

$$\rightarrow W_{opt}[\text{segments}] = \left\lceil \frac{50}{1.46} \right\rceil = 35$$