Always explain your answers concisely

1a Explain the benefits of the layered architecture of network protocols.   *5pt*

1b Name at least one case discussed in class in which the layer separation has been violated. Discuss the reasons behind this choice and the possible consequence in the near future.   *5pt*

1c Briefly characterize the main difference between packet-switched networks and circuit-switched networks, and highlight the pros and cons of each solution   *5 pt*

1d Based on the answer to the above question motivate why telephone networks and the Internet are designed differently.   *5 pt*

2a Referring to the figure below, explain the basics of the MACA protocol and show how it can effectively solve the hidden station and exposed station problem (give also a concise description of the two phenomena).   *5pt*
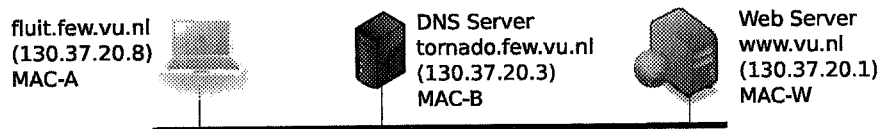

(a)   (b)
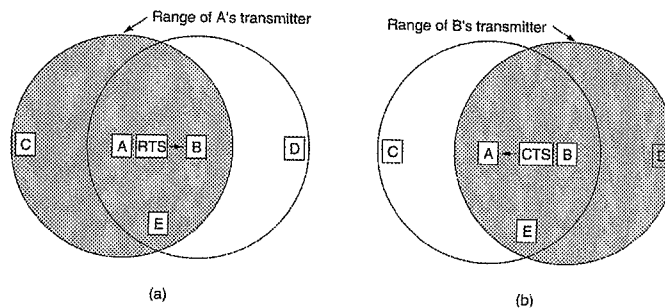
2b IEEE 802.11 exploits a variant of the MACA protocol, called MACAW. Describe the main difference and discuss why MACAW suffers from the exposed station problem   *5pt*

2c Bridges and switches are part of the infrastructure of modern LANs. They operate at data link layer and are therefore unable to handle network addresses. Explain how they can still properly deliver messages to the intended nodes.   *5pt*

3a Explain why different protocols are used for inter-AS and intra-AS routing.   *5pt*

3b Suppose a router has built up the routing table shown below. The router can deliver packets over interfaces 0 and 1 or it can forward packets to routers R2, R3, or R4. Describe what the router does with a packet addressed to each of the following destinations:

   1. 128.96.171.92
   2. 128.96.167.151
   3. 128.96.163.151
   4. 128.96.169.192
   5. 128.96.165.121

                    5pt

ROUTING TABLE		
SubnetNumber	**Subnet Mask**	**NextHop**
128.96.170.0	255.255.254.0	Interface 0
128.96.168.0	255.255.254.0	Interface 1
128.96.166.0	255.255.254.0	R2
128.96.164.0	255.255.252.0	R3
0.0.0.0	0.0.0.0	R4

3c Briefly describe how MobileIP and DHCP provide two different solutions for nomadic user and motivate why DHCP enjoyed larger diffusion than MobileIP   *5pt*

4a Assuming a typical client-server interaction (e.g., fetching a page from a web server), consisting of a client request and reply, explain how many packets respectively are sent if TCP or UDP are used.   *5pt*

4b Beside reducing the number of packets sent, is there any other reason why sometimes UDP is preferred?   *5pt*

4c When downloading large files some applications open more than one TCP connection to the server. Why ? [*Hint: compare what would happen if you had a congestion window of 10 Mb and a packet gets lost every minute against the case in which you have ten TCP connections with 1 Mb congestion window each and, again, only a single packet is lost per minute (regardless the connection it belongs to)]*   *5pt*

4d Assume that two host *A* and *B* are connected through a 10 Gbps fiber connection with a one-way speed-of-light-delay of 50ms. If TCP is used, with a window size of 64KB, what is the actual throughput?   *5pt*

5a Provide a <u>short</u> description of the mechanism adopted by BitTorrent to incentive users to share their upload bandwidth and explain why it prevents selfish behavior.   *5pt*

5b Consider the network depicted below in which hosts are identified by their symbolic name, IP address and MAC address. Suppose that a user connected to `fluit` wants to access the Web site located at `http://www.vu.nl`. Fill the table with all the messages exchanged on the network, indicating for each of them the protocol used and the addresses used in the Ethernet, IP and TCP header. *X* means that a given address cannot be known, while *n/a* indicates that the specific protocol is not used ((e.g., TCP for an ARP packet). For simplicity, assume that the ARP table is empty and no DNS or HTTP cache is used.   *5pt*

fluit.few.vu.nl
(130.37.20.8)
MAC-A

DNS Server
tornado.few.vu.nl
(130.37.20.3)
MAC-B

Web Server
www.vu.nl
(130.37.20.1)
MAC-W

MAC Src	MAC Dest.	IP Src	IP Dest.	TCP/UDP Src	TCP/UDP Dest.	Protocol	Request / Reply
...	...	...	...	...	...	...	...

6a Many firewalls preclude any incoming connections while opening TCP connections to outside host is allowed. Nevertheless, clients behind the firewall are still able to receive replies from outside servers (e.g., html pages). How is that possible ?   *5pt*

6b In the SSL protocol, the public key is used only at the begining to exchange a session key. Why is the latter needed? Would it be possible to use the public key encryption throughout the entire session?   *5pt*

Grading: The final grade is calculated by accumulating the scores per question (maximum: 90 points), and adding 10 bonus points. The maximum total is therefore 100 points.