Dept. Math. & Comp. Sc.	Computer Networks
Vrije Universiteit	10.06.2002

Always explain your answers concisely and be sure to be to-the-point.

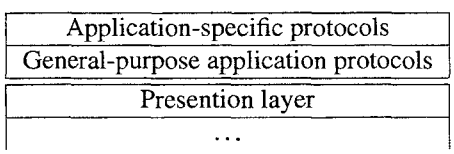
Part I

This part covers the same material as the midterm exam.

1a What is the role of the session layer in the OSI reference model? Give two typical examples of services that belong in this layer. *5pt*

1b The presentation layer transforms application-level data into a machine- and network-independent format. Is this transformation also necessary when transferring files? *5pt*

1c One could argue that the application layer should be split between a sublayer that contains general-purpose protocols and one that contains application-specific protocols, as shown below. Give an example of each type of protocol. *5pt*



2a What is the difference between an analog and a digital signal? *5pt*

2b Consider an audio signal that is sampled at a frequency of f Hz with a sample size of b bits.

(b1) What is the required bandwidth to send this signal uncompressed across a network? *3pt*

(b2) Considering that humans cannot hear audio tones higher than 20 kHz, what is a reasonable maximum value for f? *3pt*

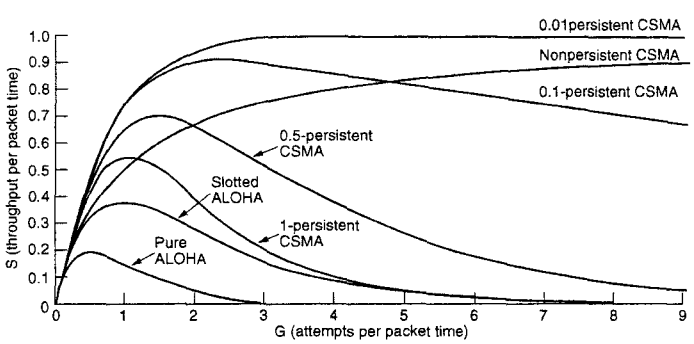
(b3) What is the effect of taking $b = 1$? And $b = 32$? *9pt*

3a The data link layer converts raw bit streams into frames. Why is this conversion necessary? *5pt*

3b Consider a two-layered protocol stack in which layer L_{low} provides an interface for unreliably sending and receiving frames at B_{low} bits per second. Layer L_{high} offers exactly the same interface, but with higher transmission reliability. How can this higher reliability be achieved without making use of retransmissions, and what effect does this have on B_{high}? *5pt*

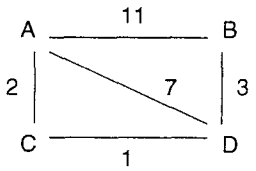
4a Explain why the use of slots in slotted Aloha doubles the maximum throughput in comparison to pure Aloha. *5pt*

4b Can we conclude from the following figure that p-persistent CSMA is always better than q-persistent CSMA for $p < q$? Explain your answer. *5pt*



Part II

5a Consider the following network. Using distance vector routing, what is the distance to B that A will eventually store in its tables? Explain your answer! *5pt*



5b Suppose that the link BD breaks. What happens then? *5pt*

5c Suppose that after some time, the link AB also breaks. What happens then? *5pt*

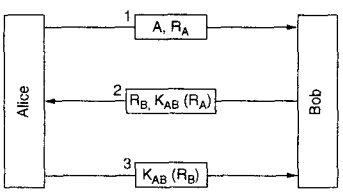
6a Which problem does the three-way handshake protocol solve? *5pt*

6b Is it possible to release a connection such that both parties *always* agree? Explain your answer. *5pt*

6c Assume the transport layer has a limited number of buffers available for managing reliable connections. How can this lead to a deadlock situation between sender and receiver, and how is this problem solved? *5pt*

6d Explain how inappropriate buffer management in TCP can lead to the *silly window syndrome*. *5pt*

7a What is a fundamentally weak point in the following authentication protocol? *5pt*



7b Provide a simple, efficient protocol so that Alice can digitally sign a public (i.e., nonconfidential) document and send it securely to Bob. *5pt*

Final grade: *(1) Add, per part, the total points. (2) Let T denote the total points for the midterm exam ($0 \leq T \leq 45$); $D1$ the total points for part I; $D2$ the total points for part II. The final number of points E is equal to* $\max\{T, D1\} + D2 + 10$.