B1. Networks (25 points)

A given network host implements OSPF, PPP, ATM, http, X.25, Ethernet, FR, EGP, SNMP, UDP, LLC, SMTP, BGP, TCP, ICMP, ASN.1 and IP protocols. Draw a layered protocol stack at this host, carefully indicating the protocols at each layer.

At which layers and for which protocols would the concepts of connection-oriented transmission and flow control apply? Why?

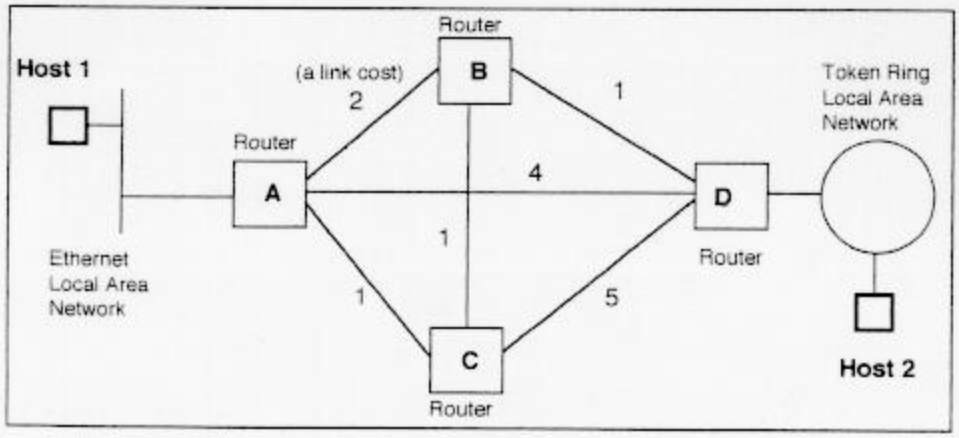
B2. Networks (25 points)

Carefully observe the networking environment below:

a) (9 points) Assuming that a link state OSPF routing algorithm is used, show all steps in computing the least cost paths from router A to all other router nodes.

b) (8 points) Assign consistent network addresses to all the interfaces shown. How many unique networks have you identified?

c) (8 points) Using the results of a) and b), determine the routing table at router node A.



B3. Networks (25 points)

Because of different maximum transmission units (MTU) in a particular packet-switched network, routers are often forced to perform fragmentation and reassembly.

a) (5 points) Explain what determines the MTU size. In your answer, consider both a broadcast medium such as an Ethernet, and a point-to-point link such as a serial line using PPP.

b) (15 points) When an end-to-end path involves multiple hops, fragmentation/reassembly can be handled in several ways. Tanenbaum calls two approaches: transparent and non-transparent fragmentation. (Note: IPv4 uses non-transparent.) Yet a third approach is used in IPv6. Explain these three methods for handling network layer fragmentation/reassembly, and discuss their tradeoffs. (If you do not know these 3 particular approaches, explain and discuss three 'reasonable' approaches.) In your answer, present a simple example that clearly delineates how your three methods handle fragmentation/reassembly differently.

c) (5 points) What is meant by a path-MTU? Briefly explain how an end host in today's Internet determines the path-MTU to another end host.

B4. Networks (25 points)

Using timing diagrams and annotations (as demonstrated below), explain the difference between the following:

- Non-persistent http connections
- Persistent http connections without pipelining
- Persistent http connections with pipelining

As an example to distinguish among the three cases, consider a client fetching a particular web page on the server that contains text and URL pointers to 3 embedded images, which are also located on the same server. Your diagrams should show details of both the application (http) layer and transport (TCP) layer traffic between a hypothetical client and server in all three cases.