CS 421: Computer Networks **SPRING 2005**

MIDTERM II
April 28, 2005
120 minutes

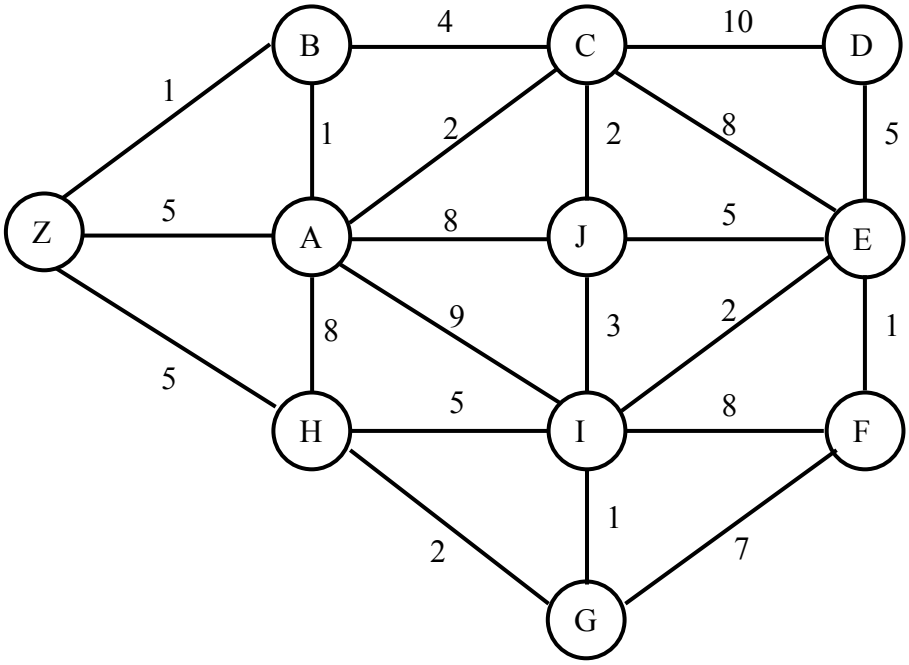
Name: _____

Student No: _____

Show all your work very clearly. Partial credits will only be given if you carefully state your answer with a reasonable justification.

1)

a) (10 pts) Execute the Dijkstra algorithm at node Z for the network shown below by filling in the following table. In the table, you need to give both the distance *D(v)* and previous node *p(v)*.



iter.	*N*	*D(A), p(A)*	*D(B), p(B)*	*D(C), p(C)*	*D(D), p(D)*	*D(E), p(E)*	*D(F), p(F)*	*D(G), p(G)*	*D(H), p(H)*	*D(I), p(I)*	*D(J), p(J)*

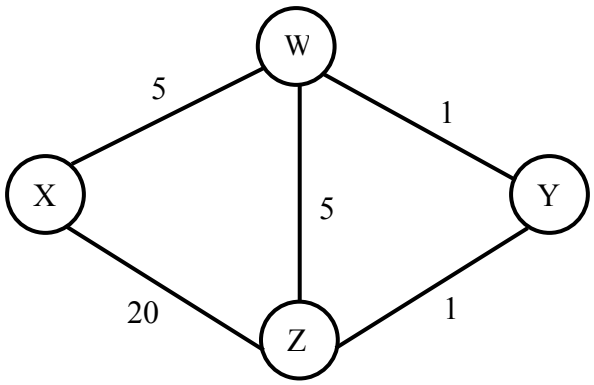
b) The network below uses the distance-vector routing algorithm **with poisoned reverse**. Assume the following:

- Links have the same cost in both directions.
- Nodes exchange their routing info once every second, in perfect synchrony and with negligible transmission delays. Specifically, at every t = i, i = 0, 1, 2, 3,..., each node sends and receives routing info instantaneously, and updates its routing table; the update is completed by time t=i+0.1.
- At time t = 0, the link costs are as shown below and the routing tables have been stabilized. At time t = 0.5, the cost of the link (X,W) becomes 30. There are no further changes in the link costs.
- Route advertisements are **only exchanged periodically**, i.e., there are no immediate route advertisements after a link cost change. Hence the first route advertisement after the link cost

change at t = 0.5 sec occurs at t = 1.0 sec. *Note:* However, whenever a link cost change occurs, the two nodes at the endpoints of this link immediately make corresponding changes in their distance tables.

i. (10 pts) Give the evolution of the distance tables with respect to destination 4. Specifically, give the distance table entries for destination X at nodes W,Y, Z, for t = 0.1, 0.5, 1.1, 2.1, ..., **until** all distance vectors stabilize. Present your final answer in the table given below where $D^i(j)$ is the distance vector denoting the distance from i to j .

ii. (5 pts) Suppose you have a packet generated by node Y at t = 2 sec which is destined for node X. Determine the path traversed by this packet before distance vectors converge.



Time, t	$D^W(X)$ via			$D^Y(X)$ via		$D^Z(X)$ via		
	X	Y	Z	W	Z	W	X	Y
0.1								
0.5								
1.1								
2.1								
3.1								
4.1								
5.1								
6.1								
7.1								
8.1								
9.1								
10.1								
11.1								

2)

a) (10 pts) Suppose host A transmits a 1900 byte IP packet over a 2-hop path to host B. The MTU of the first link (A to router) is 700 bytes, and the MTU of the second link (router to B) is 500 bytes. Assuming that IP header does not contain any options, indicate the length (in bytes), more flag, and offset field values **(specify the offset values in units of 8 bytes)** of the fragment(s) transmitted over each link in the tables below.

First link

Fragment	Length	Offset	Flag
1			
2			
3			
4			
5			
6			

Second link

Fragment	Length	Offset	Flag
1			
2			
3			
4			
5			
6			

b) (8 pts) Divide the network with CIDR prefix 139.179.128.0/17 into /20 subnetworks.

c) (7 pts) Suppose the following four subnetworks are aggregated into a single subnetwork: 139.179.64.0/20, 139.179.80.0/20, 139.179.96.0/20, 139.179.112.0/20. Find the CIDR prefix that should be used in order to advertise this aggregated subnetwork.

3)

a) (6 pts) Give two key differences between virtual-circuit and datagram based packet networks. **(Use at most two sentences.)**

b) (6 pts) List two protocols/methods used for more efficient address assignment in IPv4.

c) (6 pts) Which of the header fields of an IPv4 packet are (or may be) changed as the packet is forwarded through an IP router?

d) (6 pts) Why does IPv4 perform fragment reassembly at the destination host? **(Use at most two sentences.)**

e) (6 pts) A routing loop in inter-AS routing occurs when a path passes through the same AS multiple times, e.g., a path such as AS3, AS5, AS7, AS1, AS5, AS8. Describe how BGP does not allow routing loops. **(Use at most two sentences.)**

4)

a) I recently bought ADSL service from Türk Telekom. Türk Telekom gives a single IP address, and in order to share the Internet connection with my wife and daughter ach of us using separate PCs, I installed NAT.

   i) (6 pts) From behind the NAT, can both my wife and I connect simultaneously to the same remote FTP server on the Internet, assuming the remote server has only one IP address and accepts connections only on the well-known FTP port 21? Why or why not?

   ii) (6 pts) Both of us also want to share our mp3 and movie files with our friends, so we decided to run an FTP server on our separate PCs on the well-known FTP port 21. Is this possible, i.e., can both of us simultaneously run our FTP servers on our PCs from behind the NAT and have our friends connect via port 21? Explain why or why not.

b) (8 pts) Suppose we want to build a 10-port router using a memory based switching fabric with output buffering but with no input buffering. Assume that the line rate for each port is 1 Gbits/sec, i.e., 1 x 10^9 bits/sec. Calculate the required memory access time (defined as the time to access 1 Byte of data through the system bus) for the RAM, which can be used as the switching fabric for this router. State-of-the-art RAMs today use a 800MHz 16-bit bus for access. Is this speed enough for building this router?