CS 421: Computer Networks **FALL 2006**

MIDTERM II
December 6, 2006
120 minutes

Name: ______________________________

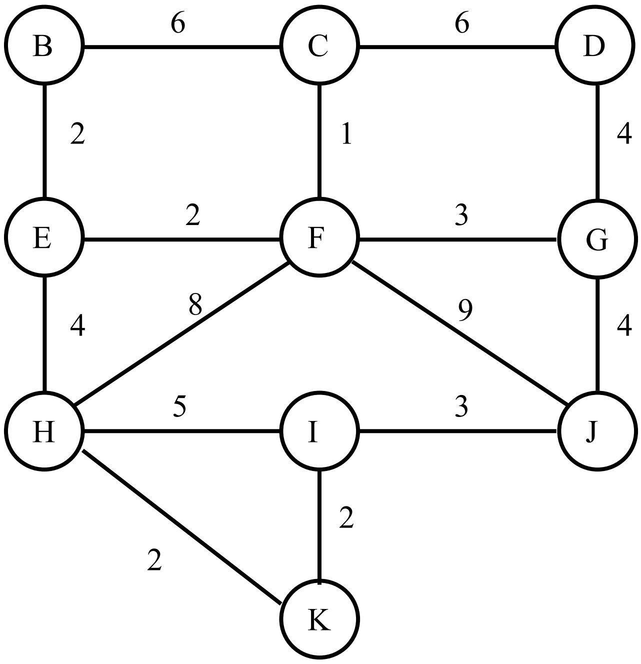
Student No: ___________________________

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

Q1	
Q2	
Q3	
TOT	

1)

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



iter.	*N*	*D(B), p(B)*	*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)*	*D(K), p(K)*

b) The network below uses the distance-vector routing algorithm. 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 = k, k = 0, 1, 2, 3,..., each node sends and receives routing info instantaneously, and updates its routing table; the update is completed by time t=k+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 (1,4) becomes 15. 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 occurs at t = 1.0. *Note:* However, whenever a link cost change occurs, two nodes at the endpoints of this link immediately make corresponding changes in their distance tables.

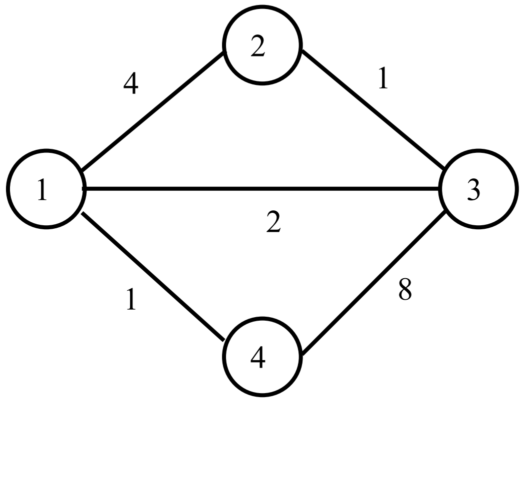
i. (10 pts) Assume that the distance vector algorithm **does not use poisoned reverse**. Give the evolution of the distance tables with respect to destination 4. Specifically, give the distance table entries for destination 4 at nodes 1-3, for t = 0.1, 0.5, 1.1, 2.1, ..., **until** all distance vectors 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 .

Time, t	$D^1(4)$ via			$D^2(4)$ via		$D^3(4)$ via		
	2	3	4	1	3	1	2	4
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								

ii. (10 pts) Redo part i. assuming that the distance vector algorithm **uses poisoned reverse**.

Time, t	$D^1(4)$ via			$D^2(4)$ via		$D^3(4)$ via		
	2	3	4	1	3	1	2	4
0.1								
0.5								
1.1								
2.1								
3.1								
4.1								
5.1								

iii. (5 pts) Using the forwarding tables valid at t=2.5, find the paths followed by a packet sourced at node 1 and destined to node 4 for both parts i and ii above, i.e., with and without poisoned reverse.



2)

a) You are given the assignment of setting subnet addresses for 4 buildings of your company. The number of Internet connected PCs in each building is given in the following table. Assume that the 151.118.96.0/20 address block is given to you for this purpose.

i) (10 pts) Use the following table to show the addresses of the four subnets that you have created.

Building	# of PCs	Subnet address (CIDR format)
1	1200	
2	420	
3	470	
4	230	

ii) (5 pts) What is the size of the **largest single** CIDR address block that you can assign from the unassigned addresses in the address block 151.118.96.0/20 remaining after you assigned the addresses to these four buildings?

b) (10 pts) Suppose a host transmits a 3500 byte IP packet over a link with an MTU of 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 fragments transmitted over the link in the table below.

Fragment	Length	Offset	Flag
1			
2			
3			
4			
5			
6			
7			
8			

3)

a) (6 pts) Where are IP fragments reassembled: at the destination host or at intermediate routers? Explain the reason for this choice.

b) (6 pts) What are the most significant three changes included in IPv6 for speeding the processing of IP packets at the routers?

c) (6 pts) Why does TCP/IP perform error checking using the checksum both at the transport and network layers?

d) (6 pts) Explain why there is a need for an internal Border Gateway Protocol (iBGP) session when there is already an intra-Autonomous System (intra-AS) routing protocol in use.

e) (6 pts) Give (at least) three reasons why NAT is currently widely used in small office and home networks.

f) Assume that we have an IP router with 64 input and 64 output ports. Assume further that the router uses the switching via a single shared bus architecture we discussed in class. Each input and output port operates at the line speed of 2.4 Gbps (2.4×10^9 bits/sec) and each IP packet contains 1000 bytes.

   i) (5 pts) If forwarding decisions are made locally at each input port, what should be the speed of table lookup operations so that input port processing can be done at the line speed?

   ii) (5 pts) What should be the speed of the shared bus, in bits/sec, so that the bus will not become a bottleneck?