1. A computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled with a rate 1 Mbps. The bucket is initially filled to capacity with 1 Mb. How long can the computer transmit at the full 6 Mbps?

The net outflow from the token bucket is 5Mbps. As a result, the time it takes for the full bucket to empty is 1Mb/5Mbps=0.2sec. Thus, during the first 0.2 seconds the computer transmits at the maximum 6-Mbps rate and then it switches to 1-Mbps.

2. Consider an ATM network using tokenbucket scheme in which : a new token is put into the token bucket once every 5 µsecs one cell (48 bytes) uses one token

ans: the maximum sustainable datarate in Mbps

1 token = 5 µsecs in one second, no. of tokens = 2 x 105

No. of bytes per token = 48

= 384 bits

Data rate = 2 x 105 x 384 bps

= 76.8 Mbps

burst length = S seconds

token bucket capacity = C bytes

token arrival rate = ρ bytes per second

maximum output rate = M bytes per second

$(C + \rho S) = MS$

$S = C \div (M - \rho)$

3. Traffic from a host on a 6-Mbps network is shaped by a token bucket, Token bucket is initially filled to its capacity of 8 Mb Token bucket is filled @ 1 Mbps. How long the computer can transmit @ full 6 Mbps

Ans: C = 8 Mb

M = 6 Mbps

ρ = 1 Mb / sec

$S = C \div (M - \rho)$

S = 1.6 seconds

4. Given : Max. packet size = 1000 bytes

Token bucket rate = 10 million bytes / sec

Token bucket size = 1 million bytes

Max. transmission rate = 50 million bytes/sec

Compute :how long can a burst at maximum speed last

Ans: ρ = 10 MB / sec

C = 1 MB

M = 50 MB / sec

S = length of burst = C ÷ (M - ρ)

= (1 MB) ÷ (50 - 10 MB / sec) = 25 msec

5. suppose, for long intervals, routers work best at rates not exceeding 2 MB / sec a leaky bucket with the following specifications could be used to reduce the average rate to 2 MB / sec:

ρ = 2 MB / sec and a capacity of C = 1 MB

input to leaky bucket : 25 MB/sec for 40msec

output : 2 MB / sec for 500 msec

bursts upto 1 MB can be handled without data loss and such bursts are spread over 0.5 sec or 500 msec

6. Outline traffic shaping in QoS? Show how token bucket algorithm addresses the issues of leaky bucket algorithm.

Given the arrival rate in the table below, how long will it take to clear the traffic with a leaky bucket traffic shaper having a leak rate of 5 packets per sec and bucket size 20packets. Compute how many packets does it need to drop.

Start time (sec)	End time (sec)	Arrival rate (pkts per sec)
0	4	6
4	7	10
7	9	8
9	12	4

Traffic shaping is a mechanism to regulate/control the amount and the rate of the traffic sent to the network. Two techniques can shape traffic: leaky bucket and token bucket.

- if bucket is full in token Bucket , tokens are discard not packets. While in leaky bucket, packets are discarded.
- Token Bucket can send Large bursts at a faster rate while leaky bucket always sends packets at constant rate.

Sol:5 packets dropped

7. Specify where fragmentation typically occurs, why and when.

An IP router with a Maximum Transmission Unit (MTU) of 200 bytes has received an IP packet of size 520 bytes with an IP header of length 20 bytes. Fill in the values of the relevant fields in the IP header.

Sol:fragmentation typically occurs in a router when it receives an IP datagram that is larger than the MTU of the network to which the packet is to be forwarded

unique identifier is chosen by the sending host, all fragments carry this and enables reassembly of fragments at the receiving host

Since MTU is 200 bytes and 20 bytes is header size so, the maximum length of data = 180 bytes but it can't be represented in fragment offset since it is not divisible by 8 so, the maximum length of data feasible = 176 bytes.
Number of fragments = (520/200) = 3.
Header length = 5 (since scaling factor is 4 therefore, 20/4 = 5)
Efficiency, e = (Data without header)/(Data with header) = 500/560 = 89.2 %

	20 | 176	20 | 176	20 | 148
Fragment Offset	0	22	44
MF	1	1	0
Header length	5	5	5
Total length	196	196	168

8. Assume there are 3 flows 1, 2 and 3. The weight of the flows is 1:1:2. The arrival time, length and the flow details are given in the below table. Explain how the weighted fair queuing works and the order of their finishing times.

Packet No.	Arrival Time	Length	Flow
1	0	8	1
2	4	6	1
3	4	8	2
4	6	10	3
5	8	15	3
6	10	18	2

Queue length = 2

Token I/p – 1token/ms

Maximum taken - 3

Packet Number	Arrival Time (msec)	Token Count	Departure time	Token count remaining	Queued/dropped packet
		3			
1	1		1	2	
2	1.2		1.2	1	
3	1.4		1.4	0	
4	2		2	0	
5	2.2		3	0	5
6	2.6		4	0	5->6
7	2.8		5	0	5->6->7
8	3		6	0	6->7->8

9. Computer A has 40 MB to send on a network and transmits the data in a burst @ 8 Mbps. The maximum transmission rate across routers in the network is 6 Mbps. If Computer A's transmission is shaped using a leaky bucket, how much capacity must the queue in the

Or 1 sec – 8Mb

? – 40*8 Mb

=40 sec

O/p for 1 sec – 6Mb

40sec - ? = 240Mb

bucket hold not to discard any data? (Show your work)

Capacity of bucket = 320 – 240 = 80Mb

10. Computer A has 250Mb to send on a network and transmits the data in bursts of 8 Mbps. The minimum sustainable transmission rate across routers in the network is 6 Mbps. If Computer A's transmission is shaped using a leaky bucket, what is the minimum size of the queue to prevent lost data? (Show your work)

In 1 sec – 8 Mb

? - 250 Mbits

= 250/8 = 31.25 sec

O/p rate is 6Mbps

1 sec – 6Mb

31.25 sec - ? = 187.5Mb

Hence capacity = 250 – 187.5 = 62.5Mb Soln 2+ steps 2