R11: Answer:
One packet switch between a sender and a receiver. The switch has received the full packet from the sending host, it transmits it to the receiving host.
Here, transmission rate from sender to switch is R1 and transmission rate from switch to receiver is R2 and packet length is L, where ignore queuing, propagation and processing delays.
Transmission delay = L/R
1st, From sender to switch, transmission delay = L/R1
2nd, From switch to receiver, transmission delay = L/R2
Total End-to-End transmission delay = (L/R1) + (L/R2), that is total delay.

R13(a): Answer:
In circuit switching, each user is allocated a dedicated circuit. Each user uses continuously at 1Mbps, so the system must reserve 1Mbps for each user.
Total available = 2Mbps
Each user needs = 1Mbps
Max users = 2Mbps / 1Mbps = 2 users

R13(b): Answer:
In packet switching, there is no fixed allocation. Here each user requires 1Mbps and total link capacity is 2Mbps.
If two or fewer users are active, then users use full capacity. There will be no queuing delay, enough to handle it.
If three users transmit at a time, the switch can not transmit all packets at once because available bandwidth is less then the shared link. So, there will be queuing delays before the link.

R16: Answer:
The four main End-to-End delay components: Processing Delay, Queuing Delay, Transmission Delay and Propagation Delay.
Constant: Processing Delay, Transmission Delay and Propagation Delay.
Variable: Queuing Delay.

R18: Answer:
Packet length, L = 1000 bytes = 8000 bits
Distance, d = 2500 km = 2500000 meters
Propagation speed, s = 2.5 * 10^8 m/s
Transmission rate, R = 2 * 10^6 b/s
Propagation Delay = d/s = 10 msec (0.01 s)
Transmission Delay = L/R = 4 msec (0.004 s)
Total Delay = 10 + 4 = 14 msec

No, this propagation delay depends on distance and medium.
No, again this propagation delay is based on distance and propagation speed.

R19: Answer:
Here, R1 = 500 kbps = 500,000 bps
R2 = 2 Mbps = 2000 kbps = 2000,000 bps
R3 = 1 Mbps = 1000 kbps = 1000,000 bps

(a). Throughput = min(R1, R2, R3) = min(500, 2000, 1000) = 500 kbps
(b). Here 4 million bytes to bits is, 4 * 10^6 * 8 = 32 * 10^6 bits
It take to transfer the file to Host B is,
time = File Size (bits) / Throughput (bps) = 32 * 10^6 / 500 * 10^3 = 64 sec
(c). Now R2 reduced to 100 kbps.
So, R1 = 500 kbps = 500,000 bps
R2 = 100 kbps = 100,000 bps
R3 = 1 Mbps = 1000 kbps = 1000,000 bps
Throughput = min(R1, R2, R3) = min(500, 100, 1000) = 100 kbps
Transfer Time = File Size (bits) / Throughput (bps) = 32 * 10^6 / 100 * 10^3 = 320 sec

P3: Answer:
(a). Circuit switched network is more appropriate because it provides a dedicated communication path with guaranteed bandwidth requirements. This suits a steady, long-term data transmission session without interruption or delays.
(b) No, congestion control is needed if traffic load is always below link capacity. Congestion occurs only when demand exceeds link capacity or due to bursty traffic, which is not the case here.

P5: Answer:
Given,
Propagation Speed, s = 100 km/h
Distance, d = 150 km
There are 3 tollbooths and tollbooth processing time per car is 12 sec.
(a). Here, car caravan has 10 cars,
Tollbooth delay = 10 * 12 * 3 = 360 s
Propagation delay = d/s = 150 / 100 = 1.5 h = 5400 s
End-to-End delay = Tollbooth delay+Propagation delay = 360+5400 = 5760 sec = 96 min
(b). Here, car caravan has 8 cars,
Tollbooth delay = 8 * 12 * 3 = 288 s
Propagation delay = 5400 s
End-to-End delay = Tollbooth delay+Propagation delay = 288+5400 = 5688 sec = 94 min and 48 sec.

P6: Answer:
(a). Propagation delay, dprop = m/s
(b). Transmission delay, dtrans = L/R
(c). End-to-End delay, dend-to-end = m/s + L/R
(d). The bit is leaving Host A.

(e). The first bit is still in the link and has not reached Host B.
(f). The first bit has already arrived at Host B.
(g). Given, s = 2.5 * 10^8 m/s

L = 120 bits

R = 56 kbps = 56000 bps

Distance, m = (L/R) * s = (120/56000) * 2.5 * 10^8 = 535714 m = 536 km.

P7: Answer:

Consider the first bit in a packet. Before this bit can be transmitted, all of the bits in the packet must be generated. This requires, 448/(64000) s = 7msec

The time required to transmit the packet is, 448/64000 s = 0.224 msec.

Propagation delay = 10 msec.

Total delay is, 7 msec + 0.224 msec + 10 msec = 17.224 msec.