Q1

(1)

Distance to E **Set P**

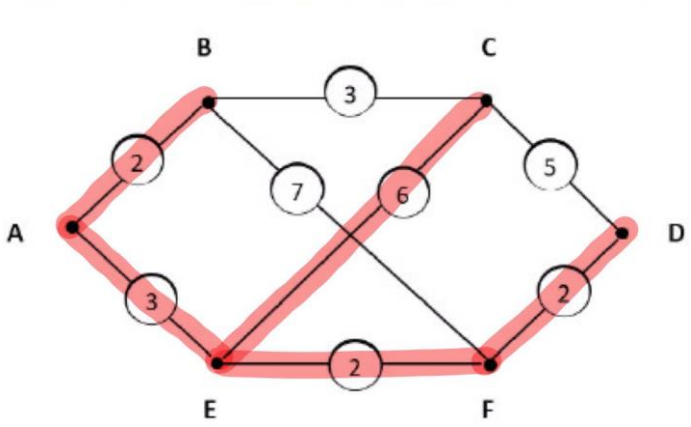
n	A	B	C	D	E	F	
1	∞	∞	∞	∞	0	∞	{E}
2	3	∞	6	∞	– –	2	{E, F}
3	3	9	6	4	– –	– –	{E, F, A}
4	– –	5	6	4	– –	– –	{E, F, A, D}
5	– –	5	6	– –	– –	– –	{E, F, A, D, B}
6	– –	– –	6	– –	– –	– –	{E, F, A, D, B, C}

Hence, the weights of shortest paths from E to other 5 nodes are:

A	B	C	D	F
3	5	6	4	2

(2)

The link BC, CD, and BF are not in the sink tree of node E. (As shown in the graph below, the sink tree is outlined in red.)



Q2

Application	**Bandwidth**	**Delay**	**Jitter**	**Loss**
Zoom Meeting	High	High	High	Low
Online Shopping	Medium	Medium	Low	Medium
VoIP	Low	High	High	Low
Bank Transactions	Low	High	High	High

Q3

The maximum data size is 1,500 bytes (20 bytes IPv4 header + 20 bytes TCP header + 1,460 TCP payload from application) when using the TCP protocol on ethernet.

If the transport layer protocol is UDP, my answer will still be 1,500 bytes. (20 bytes IPv4 header + 8 bytes UDP header + 1472 bytes UDP payload from application)

Q4

(1) On the sender side, congestion window is for congestion control, to reduce sender's transmission rate when network congestion happens. The size of congestion window (cwnd) is the number of bytes the sender could have in the network at any time, which is based on the network capacity.

On the receiver side, the buffer window (or rwnd) is for flow control, to inform sender of the remaining buffer size. It specifies the number of bytes that the receiver can buffer, which shows the receiver capacity.

Both windows are tracked in parallel, and the maximum transmission rate is the smaller of the two windows.

(2) If congestion window is set too large, it could be beyond the current network capacity and then congestion could happen within the network; if congestion window is too small then it could waste(not fully use) the network capacity or bandwidth.

If receiver window is set too large, then buffer overflow could happen and the receiver might have to discard some data; if receiver window is too small, it could waste(not fully use) the receiver's buffer capacity.

Q5

After time out occurs, threshold will be reset to half of previous, which is 20KB (39/2 = 19.5KB$\approx 20KB$). After that slow start is reinitiated and the size of congestion window will start as 1 segment (1 KB). The process of slow start is like:

The 1st transmission: 1 segment, 1KB;

The 2nd transmission: 2 segments, 2KB;

The 3rd transmission: 4 segments, 4KB

The 4th transmission: 8 segments, 8KB

(The upcoming 5th transmission will be: 16 segments, 16KB)

Hence, after these 4 transmissions, the congestion window size will reach 16KB ($\leq$ threshold 20KB).