Exercise 1

Question 1:

Tcp1 has to traverse more routes that tcp2, so tcp1 has longer delay

Question 2:

Tcp 1 is using slow-start mechanism to detect available bandwidth

Question 3:

Four flow are sharing the bandwidth. During time 0.5-2.0, although tcp 1 is solely using the bandwidth, but in still in slow-start phase and after 2 sec, it must compete with other flows.

Exercise 2

Question 1:

1) The size of 2000 and 3500 bytes of data has caused fragmentation, because the MTU of the link is 1500 bytes(1480 bytes payload and 20 bytes header).

2) The initiating host (192.168.1.103)causes the fragmentation.

3) Two fragments have been created when data size is 2000.

```
[2 IPv4 Fragments (2008 bytes): #16(1480), #17(528)]
    [Frame: 16, payload: 0-1479 (1480 bytes)]
    [Frame: 17, payload: 1480-2007 (528 bytes)]
    [Fragment count: 2]
    [Reassembled IPv4 length: 2008]
    [Reassembled IPv4 data: 080008f5d90500005b51dd800009a51108090a0b0c0d0e0f…]
```

```
[3 IPv4 Fragments (3508 bytes): #52(1480), #53(1480), #54(548)]
    [Frame: 52, payload: 0-1479 (1480 bytes)]
    [Frame: 53, payload: 1480-2959 (1480 bytes)]
    [Frame: 54, payload: 2960-3507 (548 bytes)]
    [Fragment count: 3]
    [Reassembled IPv4 length: 3508]
    [Reassembled IPv4 data: 0800387edb0500025b51dd8b0007496808090a0b0c0d0e0f…]
```

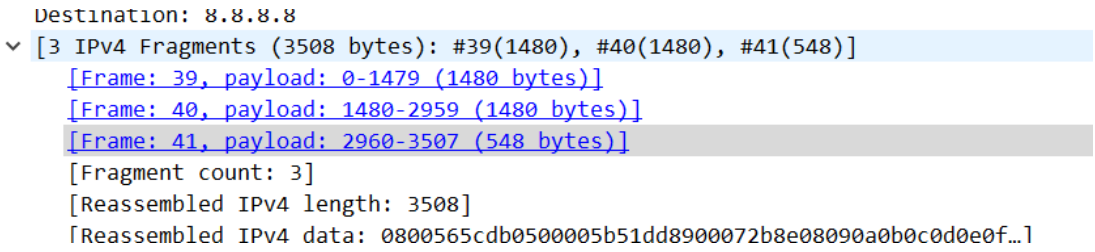
Question 2:

The reply from the destination 8.8.8.8. for 3500-byte data size also get fragmented. As the MTU for the link is 1500 bytes.

Question 3:

ID	Length	Flag	Offset

Frame 39	0x7a7b	1500	1	0
Frame 40	0x7a7b	1500	1	185
Frame 41	0x7a7b	568	0	370



Question 4:

We cannot be sure whether the fragmentation of fragments happens for request from 192.168.1.103 towards 8.8.8.8 as the wireshark report just includes the packet information at 192.168.1.103

Question 5:

The sender will retransmit all fragments again. And the packet with one fragment missing will be discarded

Exercise 3

Question 1:

Node 0 sends packets to Node 5, the packets follow the route 0-1-4-5, and the routes does not change over time.

Node 2 sends packets to Node 5, the packets follow the route 2-3-5, and the routes does not change over time.

Question 2:

At time 1.0, link 1-4 goes down, but the route between Node 0 and Node 5 doesn't change. At that time Node 0 cannot reach Node 5.

At time 1.2, link 1-4 goes up, the packets can be forwarded again. Node 0 can reach Node 5.

Question 3:

Yes, when 1-4 goes down, the DV routing protocol learn the change of network and change the route to 0-1-2-3-5, when 1-4 goes up, the protocol change the route to 0-1-4-5, because 0-1-4-5 has lower cost.

Question 4:

The code changes the cost of link 1-4, and according to the protocol the route will become 0-1-2-3-5. This is because the cost(4) of route 0-1-2-3-5 is lower than 0-1-4-5(cost = 5).

Question 5:

The cost of link 1-4 changes to 2, and the cost of link 3-5 changes to 3. The node 2 is transmitting its data using two routes to reach node 5, one is 2-1-4-5, another is 2-3-5, as these two routes have same cost.

The effect of "Node set multipath_1" makes the network use multipath routing, to choose different path to transmit data, so the data from node 2 will split traffic equally on both paths.