Part 1.

1. Source IP: 192.168.1.102
   TCP Port: 1161

2. Destination IP: 128.119.245.12
   TCP Port: 80

```
No.     Time           Source                Destination           Protocol Length Info
     1 0.000000       192.168.1.102         128.119.245.12        TCP      62     1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460
SACK_PERM
```

3. Source IP: 192.168.31.193
   TCP Port: 1814

```
No.     Time           Source                Destination           Protocol Length Info
     1 0.000000       192.168.31.193        128.119.245.12        TCP      66     1814 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460
WS=256 SACK_PERM
```

4. Sequence number equal to 0. It has [SYN] flag

```
[SYN] Seq=0
```

5. Its sequence number is set to 0. Acknowledgment number is set to 1. It has [SYN] and [ACK] flags.

```
No.     Time           Source                Destination           Protocol Length Info
     2 0.023172       128.119.245.12        192.168.1.102         TCP      62     80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0
MSS=1460 SACK_PERM
```

6. Its sequence number is set to 1.

```
No.     Time           Source                Destination           Protocol Length Info
     4 0.026477       192.168.1.102         128.119.245.12        TCP      619    1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520
Len=565
Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)
Ethernet II, Src: ActiontecEle_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysGroup_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 1, Ack: 1, Len: 565
Data (565 bytes)
0000  50 4f 53 54 20 2f 65 74 68 65 72 65 61 6c 2d 6c   POST /ethereal-l
0010  61 62 73 2f 6c 61 62 33 2d 31 2d 72 65 70 6c 79   abs/lab3-1-reply
0020  2e 68 74 6d 20 48 54 54 50 2f 31 2e 31 0d 0a 48   .htm HTTP/1.1..H
```

7. 1. Sequence number is 1
   2. Sequence number is 566
   3. Sequence number is 2026
   4. Sequence number is 3486
   5. Sequence number is 4946
   6. Sequence number is 6406

Segments	Sent time	ACK	RTT
1	0.026477	0.053937	0.02746
2	0.041737	0.077294	0.035557
3	0.054026	0.124085	0.070059

4	0.054690	0.169118	0.11443
5	0.077405	0.217299	0.13989
6	0.078157	0.267802	0.18964

Estimated RTT = (1 - a) * Estimated RTT + a * Sample RTT; a = 0.125.

1. Estimated RTT = 0.02746
2. Estimated RTT = 0.875 * 0.02746 + 0.125 * 0.035557 = 0.02847
3. Estimated RTT = 0.875 * 0.02847 + 0.125 * 0.070059 = 0.03366
4. Estimated RTT = 0.875 * 0.03366+ 0.125 * 0.11443 = 0.04375
5. Estimated RTT = 0.875 * 0.04375 + 0.125 * 0.13989 = 0.05576
6. Estimated RTT = 0.875 * 0.0558 + 0.125 * 0.18964 = 0.07249

8.

1. 565 bytes
2. 1460 bytes
3. 1460 bytes
4. 1460 bytes
5. 1460 bytes
6. 1460 bytes

9. 5840 bytes in the first acknowledgement shown by window

```
No.     Time           Source                Destination           Protocol Length Info
     2 0.023172       128.119.245.12        192.168.1.102         TCP      62     80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0
MSS=1460 SACK_PERM
```

10. No. Sequence numbers are increasing steadily and acknowledgment numbers equal to the number of bytes sent. There is no sequence number that is less than its neighbours.
11. 1460 bytes with exception of the first and the seventh ACK (566 and 1147 respectively). Numbers 60 and 61 acknowledge 2920 bytes.

```
No.     Time           Source                Destination           Protocol Length Info
    59 1.200421       128.119.245.12        192.168.1.102         TCP      60     80 → 1161 [ACK] Seq=1 Ack=35049 Win=62780 Len=0
    60 1.265026       128.119.245.12        192.168.1.102         TCP      60     80 → 1161 [ACK] Seq=1 Ack=37969 Win=62780 Len=0
    61 1.362074       128.119.245.12        192.168.1.102         TCP      60     80 → 1161 [ACK] Seq=1 Ack=40889 Win=62780 Len=0
    62 1.389886       128.119.245.12        192.168.1.102         TCP      60     80 → 1161 [ACK] Seq=1 Ack=41781 Win=62780 Len=0
```

12. The sequence numbers of the first and the last segments are 1 and 164091. The total bytes sent were 164090. The delta time between the first and the last segments is 5.455830 - 0.026477 = 5.4294s. The throughput equals to the total bytes divided by time 164090/5.4294 = 30222.492 bytes/sec.
13. TCP slow start starts after 3 way handshake but due to the lack of congestion doesn't end. Congestion avoidance doesn't start because slow start doesn't end. Packet sizes double each time until the end.
14. 12. The sequence numbers of the first and the last segments are 1 and 152948. The total bytes sent were 152947. The delta time between the first and the last segments is 1.233106 - 0.250754 = 0.982s. The throughput equals to the total bytes divided by time 152947/0.982 = 155,750.509 bytes/sec.

13. TCP slow start starts after 3 way handshake but due to the lack of congestion doesn't end. Congestion avoidance doesn't start because slow start doesn't end.Packet sizes double each time until the end.