Question 1

a) $d_{prop} = \frac{m}{s}$

b) $d_{trans} = \frac{L}{R}$

c) $d_{end-to-end} = d_{prop} + d_{trans}$

d) Host A

e) On the link

f) Host B

g)

$$d_{prop} = d_{trans}$$

$$\frac{m}{s} = \frac{L}{R}$$

$$m = \frac{sL}{R} = \frac{2.5 \times 10^8 \times 120}{56 \times 10^3} = 5.35 \times 10^5 (m)$$

Question 2

a) Supposed the packet being transmitted on the outbound link is precisely $\frac{1}{2}$ way through

$$d_{queue} = 4.5 \times 1,500 \times \frac{1}{2 \times 10^6} = 3.375 \times 10^{-3}$$

b)

$$d_{queue} = (nL + L - x) \times \frac{1}{R}$$

Question 3

a) $d_{12\_nose} = \frac{8 \times 10^6}{2 \times 10^6} = 4s$

b) $d_{n2n\_nose} = 3 \times d_{12\_nose} = 12s$

c) How long to move the first packet from source to switch $d = \frac{10^4}{2 \times 10^6} = 0.005s$

Time when second packet fully received: $t = 2d = 0.01s$

d) The last packet has to wait until all the other packets leave the source

$$t_1 = 799d$$

The last packet takes its time to move to the first switch, then second,... with total 3 jumps between nodes.

$$t_2 = 3d$$

The time when the last switch arrive:

$$t = t_1 + t_2 = 802d = 4.01s$$

The time it takes to deliver segmented message is remarkably shorter than delivering in chunk.

e)

- If the data is corrupted, the segmented method only need to resend the faulty packet, instead of resending the whole object

- The amount of data in one switch at a time is lower, less likely to cause a bottleneck (congestion)

- Can deliver large file

- If someone steal the transmitted data, they might only get a piece of it (packet) instead of the whole file.

f)

- Complicated implementation

- High processing delay

Question 4

a) $N - 1$

b) $\frac{N \times (N-1)}{2}$

c) - **sparse network:**

- pros: cheap, easy to implement, algo is straightforward

- cons: easily compromised by cutting one link, slow, prone to congestion, might leak information

- **dense network:**

- pros: fast, unlikely to have congestion, reserved connection guaranteed

- cons: expensive, might be impossible over long distance