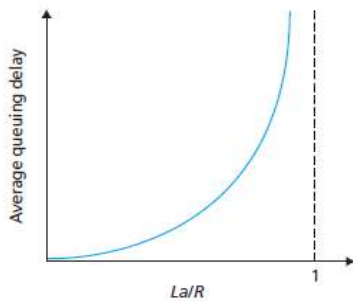


1.

a) False, according to below figure for traffic intensity near to 1, the average queuing delay would be infinite.



b) False; since there are lots of other components in the network such as routers and layer2 switches.

c) True; End systems attached to the Internet provide an **Application Programming Interface (API)** that specifies how a program running on one end system asks the Internet infrastructure to deliver data to a specific destination program running on another end system.

d) False; the statement is false because of two following reasons: 1. Establishing end-to-end circuits and reserving end-to-end transmission capacity is complicated and requires complex signaling software to coordinate the operation of the switches along the end-to-end path.

2. Packet switching is not suitable for real-time services (for example, telephone calls and video conference calls) because of its variable and unpredictable end-to-end delays (due primarily to variable and unpredictable queuing delays).

E) False; A protocol defines the format and the order of messages exchanged between two or more communicating entities, as well as the actions taken on the transmission and/or receipt of a message or other event.

F) False; In the DSL, On the customer side, a splitter separates the data and telephone signals arriving to the home and forwards the data signal to the DSL modem. On the telco side, in the CO, the DSLAM separates the data and phone signals and sends the data into the Internet.

G) true.

H) False; A single optical fiber can support tremendous bit rates, up to tens or even hundreds of gigabits per second. They are immune to electromagnetic interference, have very low signal attenuation up to 100 kilometers, and are very hard to tap. These characteristics have made fiber optics the preferred long-haul guided transmission media, particularly for overseas links. Many of the long-distance telephone networks in the United States and elsewhere now use fiber optics exclusively. Fiber optics is also prevalent in the backbone of the Internet.

I) A protocol layer can be implemented in software, in hardware, or in a combination of the two.

J) True.

2. The main difference is that **Viruses** are malware that require some form of user interaction to infect the user's device on the other hand **Worms** are malware that can enter a device without any explicit user interaction.

3.

a)

Packet arrival ratio follows the poisson distribution according to the formula in the question and transmission rate follows a uniform distribution, and also it should be noted that transmission rate and packet arrival rate are independent to each other so we will have:

$$E\left[\frac{a}{R}\right] = 8E\left[\frac{a}{R}\right] \Rightarrow \text{independenpence of the distributions} \Rightarrow 8.E[a]E\left[\frac{1}{R}\right]$$

$$*E[a]=3.35 \text{ packet/sec}$$

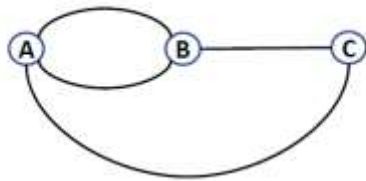
$$**E\left[\frac{1}{R}\right] = \int_a^b \frac{1}{b-a} \frac{1}{R} dR = \frac{\ln b - \ln a}{b-a}$$

$$\text{From * and **} \Rightarrow 8 \times 3.35 \times \frac{\ln 40 - \ln 35}{5} = 0.804$$

b)

average transmission ratio=3.35 packet/sec $\Rightarrow \frac{1 \text{ packet}}{3.35 \text{ packet/sec}} = 0.298 \text{ sec} \Rightarrow$ average transmission delay has nothing to do with the number of the packets and is equal to 0.298sec.

4.



Path AB failure probability= p^2

Path ACB failure probability= $1-(1-p)^2$

Desired probability= $1-((1-(1-p)^2) \times p^2) = 1-((2p-p^2) \times p^2) = 1-2p^3+p^4$

5.

this situation will happen if two A-F paths out 4 A-F paths are failed, to calculate the probability of this situation we will have:

$$\binom{4}{2} ((1-p)^2)^2 (1-(1-p)^2)^2 \cdot (1-p) \cdot (1-p)$$

6.

$$\text{a) transmission delay} = \frac{1 \text{ kbyte}}{1000 \text{ kbps}} = 0.008 = 8 \text{ ms}$$

b)

$$\text{propagation delay} = \frac{200m}{2 \times 10^8 m/s} = 1 \mu s$$

transmission delay = 8ms

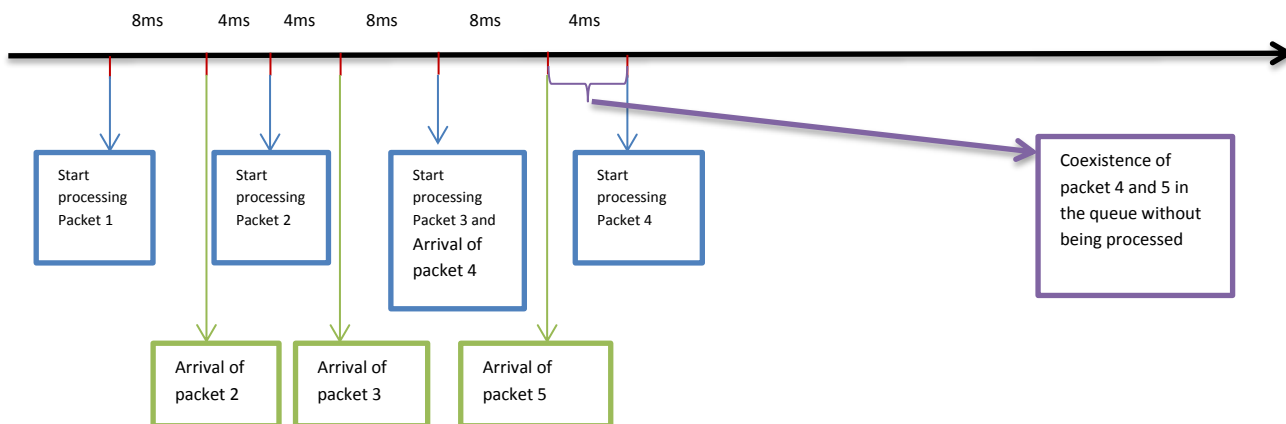
queuing delay = 4ms

processing delay = 12ms

total delay for 2nd packet = 24.001ms

c)

To answer this question it would be more convenient to draw a timeline as below:



According to the above timeline the answer to this question is 4ms.