

1.

2a. With the information given, propagation speed is 100km/hr, traveling distance is 150 km and each tollbooth services a car at a rate of one car per 12 seconds. In addition, there are 10 cars. The time taken by a car to travel 150km is $150\text{km}/100\text{km/hr} = 1.5 \text{ hr} = 90 \text{ min}$. Then the overall tollbooths service time for 10 cars would be $12 \times 3 \times 10 = 360 \text{ seconds} = 6 \text{ min}$. So the end to end time delay for 10 cars is $90 \text{ min} + 6 \text{ min} = 96 \text{ min}$.

b. For 8 cars, the overall tollbooths service time should be $12 \times 3 \times 8 = 288 \text{ seconds} = 4.8 \text{ min}$. Finally, the end to end time delay for 8 cars is $90 \text{ min} + 4.8 \text{ min} = 94.8 \text{ min}$.

3.

4.

$$d_{\text{end-end}} = \frac{L}{R_1} + \frac{L}{R_2} + \frac{L}{R_3} + \frac{d_1}{s_1} + \frac{d_2}{s_2} + \frac{d_3}{s_3} + d_{\text{proc}} + d_{\text{proc}}$$

The calculated end-to-end delay = $3 \times 6 + 20 + 16 + 4 + 3 + 3 = 64 \text{ msec}$

5.

6.