Box Model equation: $$q = \frac{S * \tau}{V}$$

1. The emissions rate of NO in downtown Metropolis is 5.8×10^{27} molecules of NO per day. If the lifetime of NO in downtown is ¼ day, calculate the concentration (molecules/cm^3) of NO in the downtown area. Use a volume of 4.7×10^{16} cm^3**.**

2. Convert your answer from #3 to a mixing ratio (ppbv). Assume that 1 cm^3 of air contains 2.5×10^{19} molecules.

3. The city of Metropolis has an approximate volume of 1.5×10^{18} cm^3. The total SO_2 emissions in that basin are 1×10^{30} molecules of SO_2 per day and the residence time of SO_2 is ½ a day. What is the concentration in molecules/cm^3 of SO_2 in the city?

4. The mixing ratio of carbon monoxide in Metropolis is 300 ppb. What is its concentration in molecules/cm^3? Remember that 1 cm^3 of air contains 2.5×10^{19} molecules, and that 1 ppb means "one part per billion" (billion=10^9).

5. Let's assume that the residence time, τ, of carbon monoxide in the Metropolis basin is 1 day and that 14 Million people live in the basin. How many CO molecules does each person emit per day? The volume of the basin is 1.875×10^{18} cm^3**.**

To solve this question transform the steady state box model equation to calculate the source rate, S, from the concentration, q, the volume V, and the residence time τ.

$$q = \frac{S * \tau}{V} \quad \Rightarrow \quad S = \frac{q * V}{\tau}$$