1. (5 points) During a sunny summer day, the chemistry of photochemical smog is governed, in first approximation, by the following two reactions:

\[
\text{NO}_2 + \text{O}_2 \rightarrow \text{NO} + \text{O}_3 \quad \text{with rate } k_f = 1.2 \times 10^{-4} / (\text{ppm} \times \text{hour})
\]

\[
\text{NO} + \text{O}_3 \rightarrow \text{NO}_2 + \text{O}_2 \quad \text{with rate } k_r = 1300 / (\text{ppm} \times \text{hour})
\]

The following concentrations are measured: \([\text{NO}_2] = 0.2 \text{ ppm}, [\text{NO}] = 0.02 \text{ ppm}, [\text{O}_2] = 21\%\) and \([\text{O}_3] = 0.1 \text{ ppm}\. Is the ozone concentration growing or decaying?

Answer:

2. (4 points) What is the mathematical equation that represents the mass balance of a pollutant of time-varying concentration \(C\) when there is a single influx with flowrate \(Q\) at concentration \(C_{\text{in}}\), one outlet of equal flowrate \(Q\), there is no internal source, and there is no internal decay. The volume of the system is \(V\).

Equation is:

3. (4 points) What is the steady-state solution of the previous equation? What happens to this concentration if the volume is doubled but everything else remains the same?

- Steady-state solution: \(C = \)

- If \(V\) is doubled, the steady-state concentration is...

4. (2 points) How would you call a person who for each of 350 days in the year drinks 2 liters of water, breathes 30 m\(^3\) of air, and ingests 100 mg of soil?

Answer: