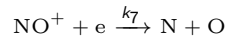
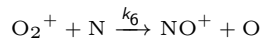
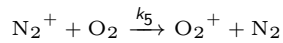
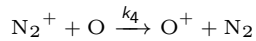
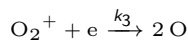
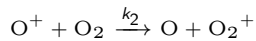
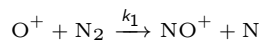
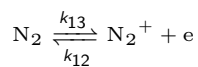
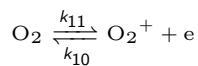
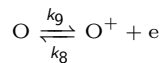


Exercise 5: Simplified ionosphere chemistry (derived from [Schunk, 1988])

Chemistry



Ionization



Question

Complete the provided template. Simulate the system at the provided conditions. For simulation, use `scipy.integrate.solve_ivp` and specify 'LSODA' as method high-performance method.

Rate coefficients

$$k_1(T) = 1.533 \times 10^{-12} - 5.92 \times 10^{-13} \frac{T}{300 \text{ K}} + 8.6 \times 10^{-14} \left(\frac{T}{300 \text{ K}} \right)^2$$

$$k_2(T) = 2.82 \times 10^{-11}$$

$$k_3(T) = 1.6 \times 10^{-7} \left(\frac{300 \text{ K}}{T} \right)^{0.55}$$

$$k_4(T) = 1 \times 10^{-11} \left(\frac{300 \text{ K}}{T} \right)^{0.23}$$

$$k_5(T) = 5 \times 10^{-11} \frac{300 \text{ K}}{T}$$

$$k_6(T) = 1.2 \times 10^{-10}$$

$$k_7(T) = 1 \times 10^{-11} \left(\frac{300 \text{ K}}{T} \right)^{0.85}$$

$$k_8(T) = k_{10} = k_{12} = 1 \times 10^{-8}$$

$$k_9(T) = k_{11} = k_{13} = 1 \times 10^{-5}$$