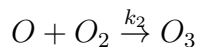
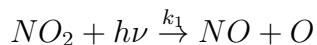


Project 1

Study the ozone photo-chemistry problem. This is a stiff ODE. The following chemical reaction is from atmospheric science. The reaction involves oxygen(O), nitrogen oxides(NO, NO₂), and (O₃):



Here, $h\nu$ denotes a photo of solar radiation. Let c_1, \dots, c_4 be the concentrations of O, NO, NO₂ and O₃, respectively. The reaction system is

$$\dot{c}_1 = k_1 c_3 - k_2 c_1$$

$$\dot{c}_2 = k_1 c_3 - k_3 c_2 c_4$$

$$\dot{c}_3 = k_3 c_2 c_4 - k_1 c_3$$

$$\dot{c}_4 = k_2 c_1 - k_3 c_2 c_4$$

The numerical reaction rates are

$$k_1 = 10^{-2} \max[0, \sin(2\pi t/t_d)] s^{-1}, t_d \text{ the length of 1 day,}$$

$$k_2 = 10^5 s^{-1}, k_3 = 10^{-16} cm^3 molecule^{-1} s^{-1}$$

The initial concentration at sunrise is

$$(c_1, c_2, c_3, c_4) = (0, 0, 5 \times 10^{11}, 8 \times 10^{11}) molecules/cm^3$$

Find the concentration in the next two days. Plot your answers.