We are going to study the following chemical reaction

$$\mathrm{A} \xrightarrow{\mathrm{k_1}} \mathrm{B}$$
$$\mathrm{B} \xrightarrow{\mathrm{k_2}} \mathrm{C}$$

where A, B and C are the concentrations of three substances and k_1, k_2 are the reaction rates.

The initial concentrations $A(t_0), B(t_0), C(t_0)$ should be $1.0, 0.0, 0.0$, respectively. In the following we will investigate four different cases $k_2 = 1, 10, 100, 1000$, with $k_1 = 1$ in all cases. The first $10s$ of the reaction dynamics should be calculated using different numerical methods. The following questions should be answered:

- the corresponding (linear) system of first order ODEs needs to be determined: $\dot{\mathrm{x}} = \mathrm{f}(\mathrm{x}, t)$
- implement the following numerical methods and compare the performance and stability: explicit Euler, Heun, (implicit Euler)
- compare with the analytical solution (or with the timeintegrators provided by `scipy.integrate`)

$$C(t) = A_0 \left[1 - e^{-k_1 t}\left(1 + k_1 t\right)\right] \qquad \text{if } k_1 = k_2$$
$$C(t) = A_0 \left[1 - \frac{k_2\, e^{-k_1 t} - k_1\, e^{-k_2 t}}{k_2 - k_1}\right] \qquad \text{if } k_1 \neq k_2$$

- What are the maximum step-sizes that lead to stable results? Calculate the eigenvalues of the Jacobian matrix $J = \frac{\partial \mathrm{f}}{\partial \mathrm{x}}$ and compare the stability behaviour with the theoretical predictions (optional)
- visualize the stable solution