1 Background

Once in your bloodstream, drugs take some time before they are completely eliminated from the boy. This process can take from a few hours to days, depends in the drug. Pharmaceutical laboratories thus report the time-scale in which their products will be eliminated let us call this number $1/K$. For example, for aspirin this number is $1/K = 5$ hours, which means that the concentration of acetylsalicylic acid in the blood will significantly reduce after approximately 5 hours. Note that this does *no* mean that the drug will completely disappear after this time.

Experiments show that the speed at which the drug will be eliminated will depend on how much of it is present on the body, i.e, if the concentration is low the drug will be quickly eliminated, but if the concentration drops the process will take longer. Let us suppose that Q_n represent the concentration of acetylsalicylic acid at $t_n = n\Delta$. The previous statement can be written as

$$\frac{Q_{n+1} - Q_n}{t_{n+1} - t_n} = -KQ_n,$$

Or equivalently

$$Q_{n+1} = Q_n - \Delta K Q_n.$$

2 Problems

Assume that originally a patient is given an aspirin such that the concentration of acetylsalicylic acid in his blood-stream is 200 μg/mL. By using $\Delta = 0.1$ hours, answer the following questions

(P1) What is the concentration after 10h?

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>> 27.067
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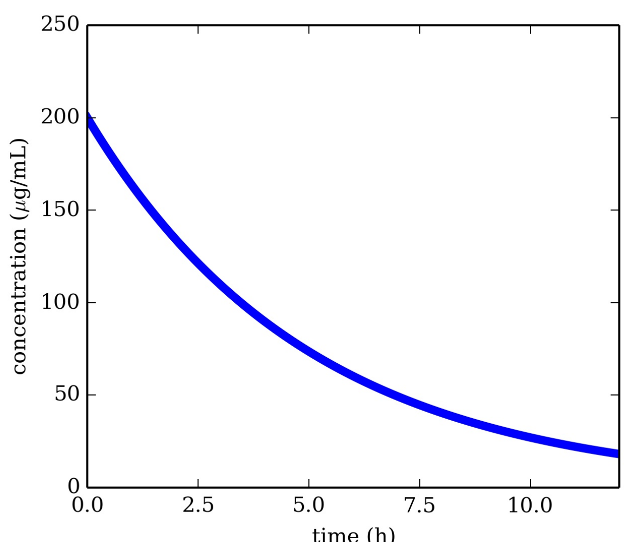
(P2) Make a plot of Q as a function of time



3 Solutions

(P1)
```
import numpy as np
import matplotlib.pyplot as plt

tmax = 10
dt = 0.1
Q0 = 200.
k = 1 / 5.

Nmax = int(tmax / dt)
t = np.zeros(Nmax + 1)
Q = np.zeros(Nmax + 1)

t[0] = 0
Q[0] = Q0

for i in range(0, len(t) - 1):

    Q[i + 1] = Q[i] + dt * (-k * Q[i])
    t[i + 1] = t[i] + dt

print t[Nmax], Q[Nmax]
```

(P2)
```
plt.plot(t, Q)
plt.show()
```