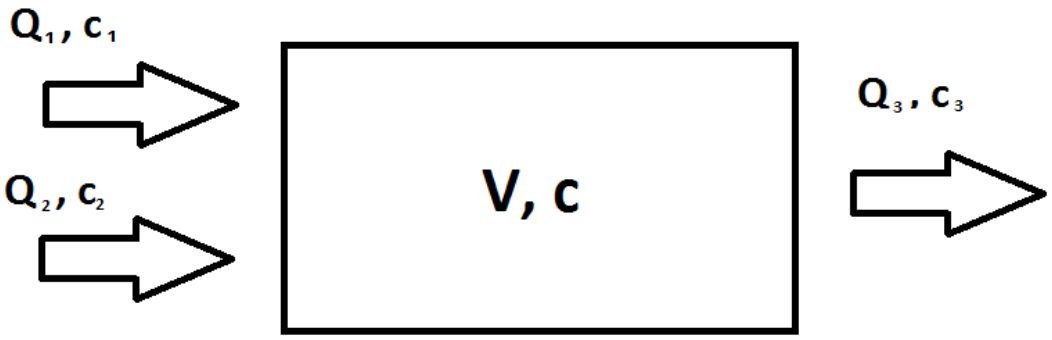
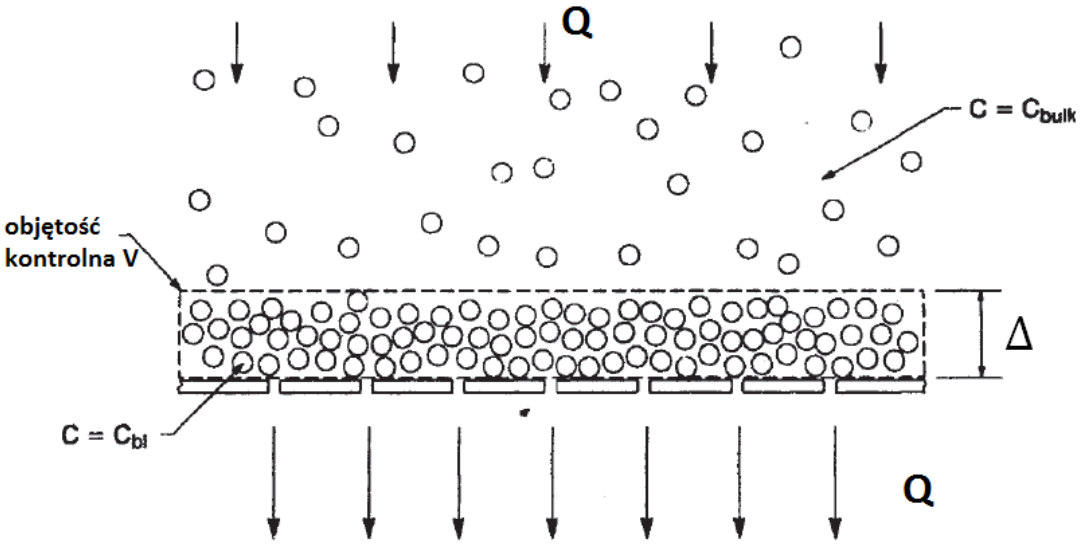
Exercise 1.1. In the picture below, a system with incoming and outgoing fluxes is presented:



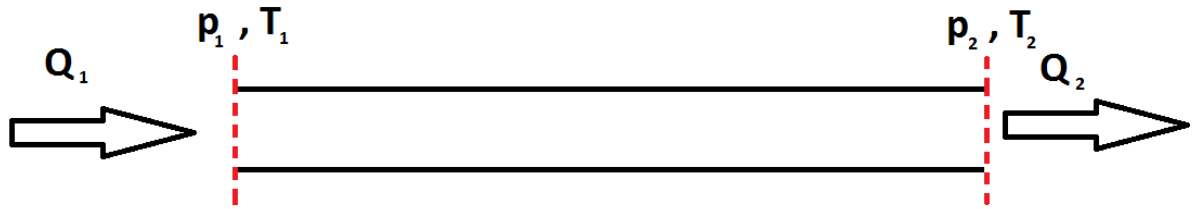
Assuming, that incoming fluxes with contamination started at certain moment of time t=0 and that $Q_1+Q_2=Q_3$, determine the concentration of contaminant in the system over time c(t). Our initial condition, is that $c(t=0)=c_0$.

Exercise 1.2. The inflow to a lake is Q. At a certain point in time t=0, contamination of the inflow to the lake starts. Thereafter, the contaminant concentration in the lake inflow is c_{in}. Our initial condition are $c(t=0)=c_0$ and $v(t=0)=v_0$. **Hint:** integrate mass balance equation when it is in the form of equation (1.2) and formulate function V=V(t).

Exercise 1.3. Let's consider a ultrafiltration membrane of area A, through which a suspension of particles is flowing. Pores in the membrane are such, that all particles are being stopped on the membrane, while the liquid can pass through with ease. Calculate the thickness of the particle layer on the membrane as a function of time.



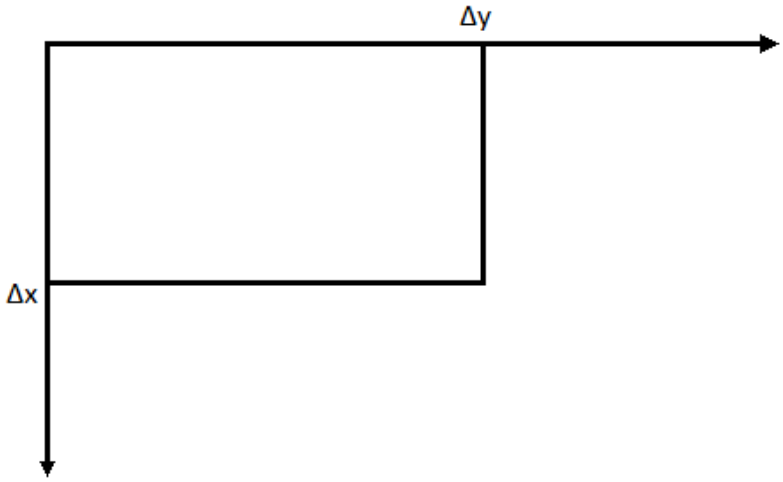
Exercise 1.4. Let's consider a steady state gas transport through a pipe:



a) Knowing a molar weight of the flowing gas find its density ρ=ρ(p,T)

b) Find Q_2 assuming that Q_1, p_1, T_1, p_2, T_2 are known

Exercise 1.5. Using similar approach to this presented for cuboid in the second paper, derive differential form of mass conservation law for two-dimensional case.



Exercise 1.6. Let's make a following thought(or even real in this case) experiment: we have a glass of clear water, to which we are adding a droplet of ink. A result is easy to predict-the drop will diffuse, what means that there must be some kind of mass flux (since the ink is moving):

$$\vec{J}_{ink} = \rho_{ink}\vec{u}_{diff}$$

Now imagine, that we are adding our droplet to a running river, which has velocity u_{drift}. Try to formulate mass conservation equation (differential form).