7. Soap film ***(6 points)*** Suppose the area of a broken part of the soap film is S. The corresponding surface energy is $E_S = 2\sigma S$. The mass of the soap water that was previously located at the broken part is $m = Sh\rho$, where $\rho = 10^3\,\mathrm{kg/m^3}$. Assuming that the surface energy is transformed to the kinetic energy of the moving front, we get an equation for the speed of the front:

$$2\sigma S = \frac{1}{2}mv^2, \qquad 4\sigma S = Sh\rho v^2.$$

Therefore

$$v = \sqrt{\frac{4\sigma}{h\rho}} = \sqrt{\frac{4 \cdot 0.025}{10^{-6} \cdot 10^3}}\,\mathrm{m/s} = 10\,\mathrm{m/s}$$

and we can estimate the time of breakup of the soap film to be

$$t = D/v = \frac{1}{100}\,\mathrm{s}.$$