National Student Team Contest (first stage)
Solution of task 1. Laser transfer of nanoparticles

The motion equation of NP with a mass *m* along the axis *x* is:

$$ma = m\frac{dv}{dt} = -krv$$

Using separation of variables and integration one will have:

$$v = v_0 e^{-\frac{kr}{m}t},$$

where v_0 – initial velocity, and *k* – proportionality coefficient of resistance force.

Taking into account that $v = \frac{dx}{dt}$, the law of motion along the axis *x* can be obtained by the additional integration:

$$x = \frac{m}{kr} v_0 (1 - e^{-\frac{kr}{m}t})$$

It is obvious that the distance between NP and the film surface converges the maximum value (in the limit of infinite time):

$$x_{\max} = \frac{m}{kr} v_0 = \frac{4/3\,\pi r^2 \rho}{k} v_0$$

Let $r_1 = 200$ nm, $r_2 = 400$ nm, $k_2 = 50k_1$, $x_{\max 1} = 250$ nm (1- air, 2 - water).

Finally: $x_{\max 2} = \frac{k_1}{k_2}\frac{r_2^2}{r_1^2} x_{\max 1} = \frac{1}{50} \cdot 4 \cdot 250$ nm $=$ **20 nm**.