Problem №26
Soap Boat

Team of Belarus
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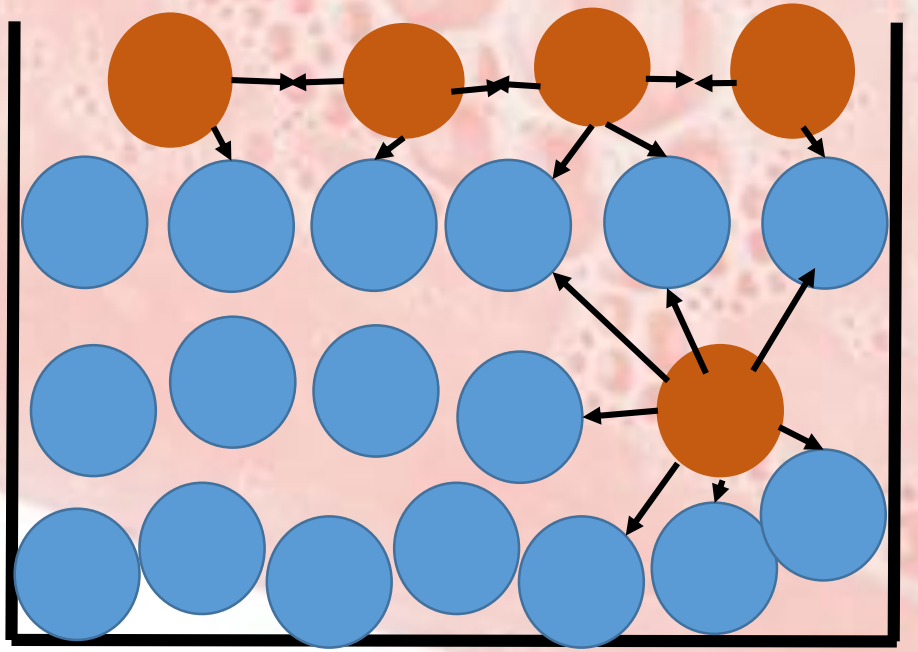
Problem

- Make a flat soap powered boat from paper or plastic. Investigate the parameters affecting the maximum speed of the boat

Theoretical part

Surface tension



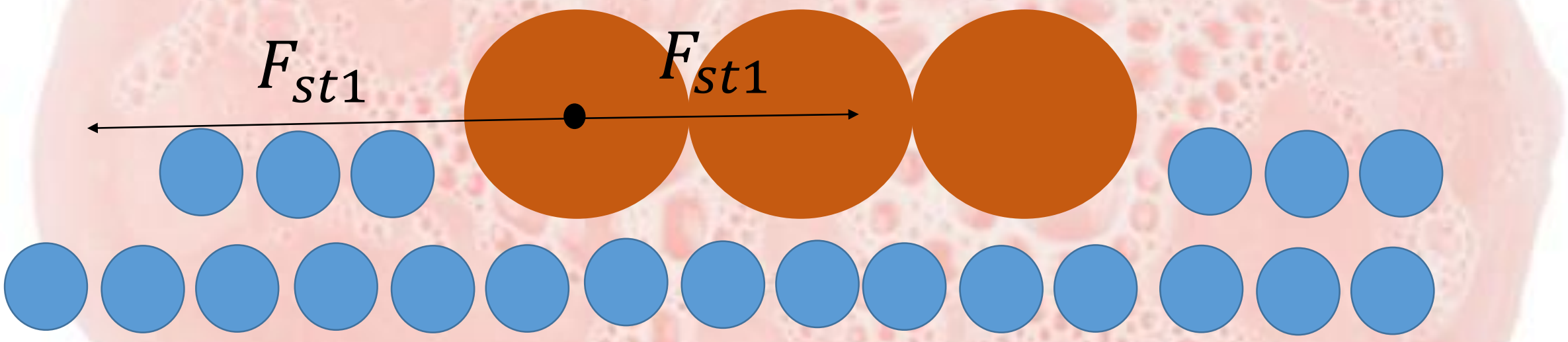
$$E_{pin} < E_{pout}$$

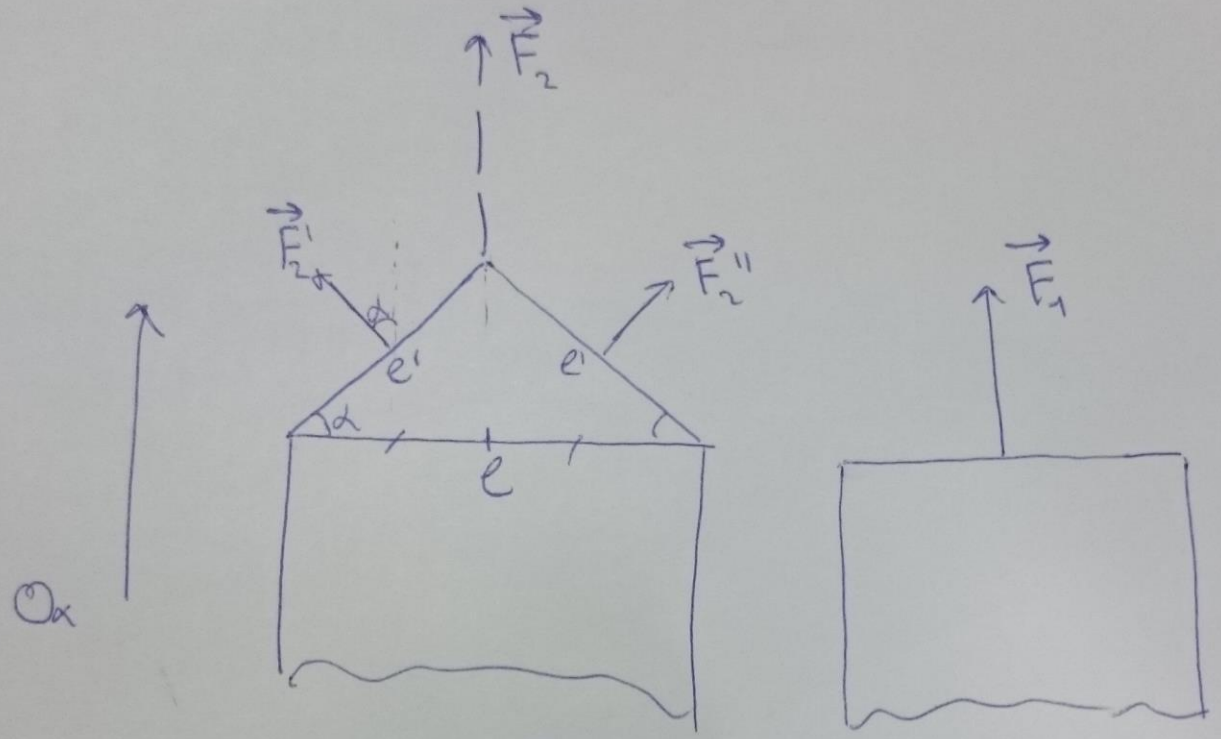
Surface tension

$$F_{st} = \sigma l$$

$$\sigma = \frac{E_s}{S}$$

$$E_s = E_{pin} - E_{pout}$$


F_{st1}
F_{st1}



$$\ell' = \frac{\ell}{2\cos\alpha} \qquad |\vec{F}_2'| = \frac{\ell\upsilon}{2\cos\alpha}$$

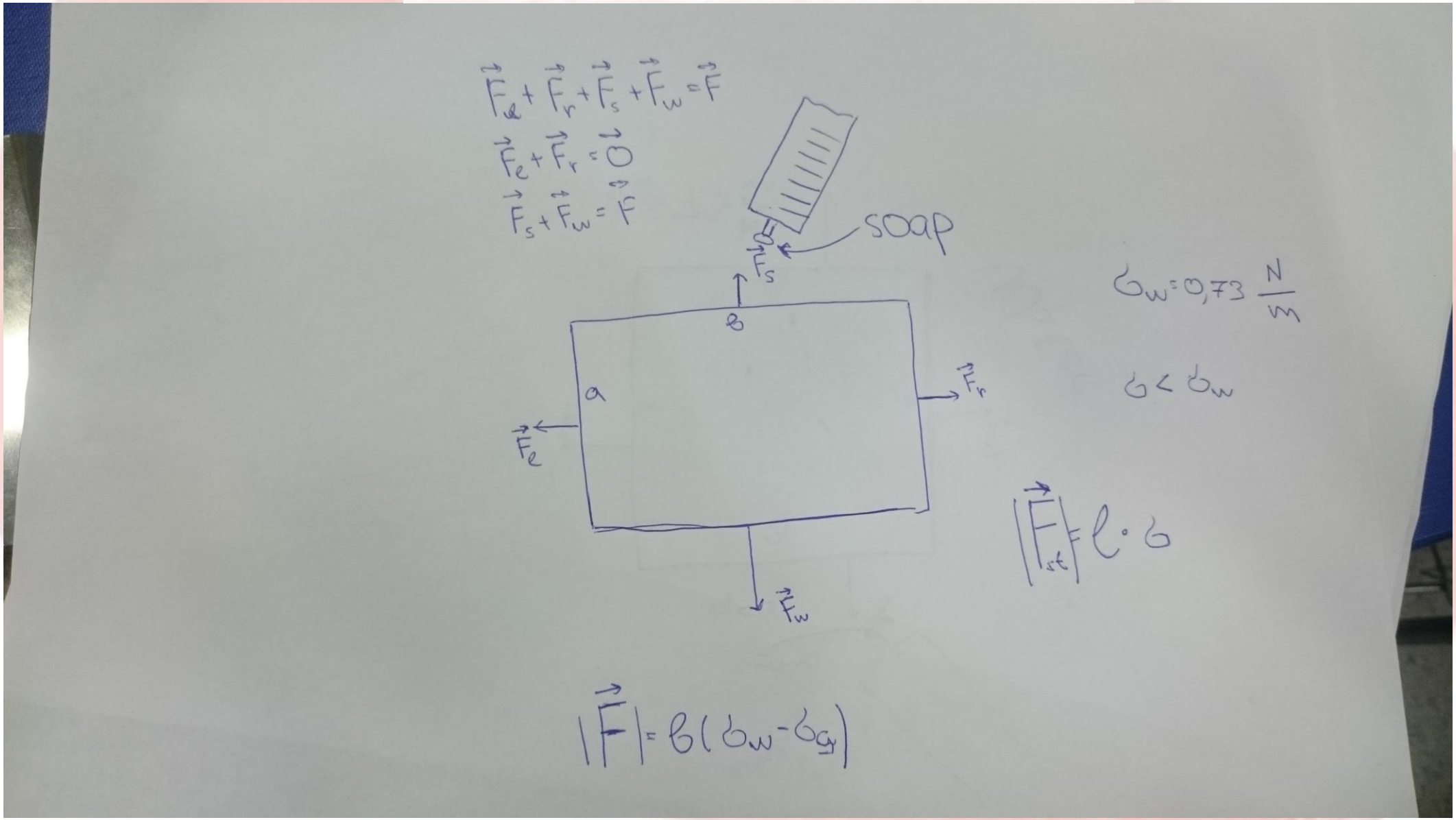
Ox: $F_2^* = \frac{\ell\upsilon\cdot\cos\alpha}{2\cos\alpha} = \frac{\ell\upsilon}{2}$

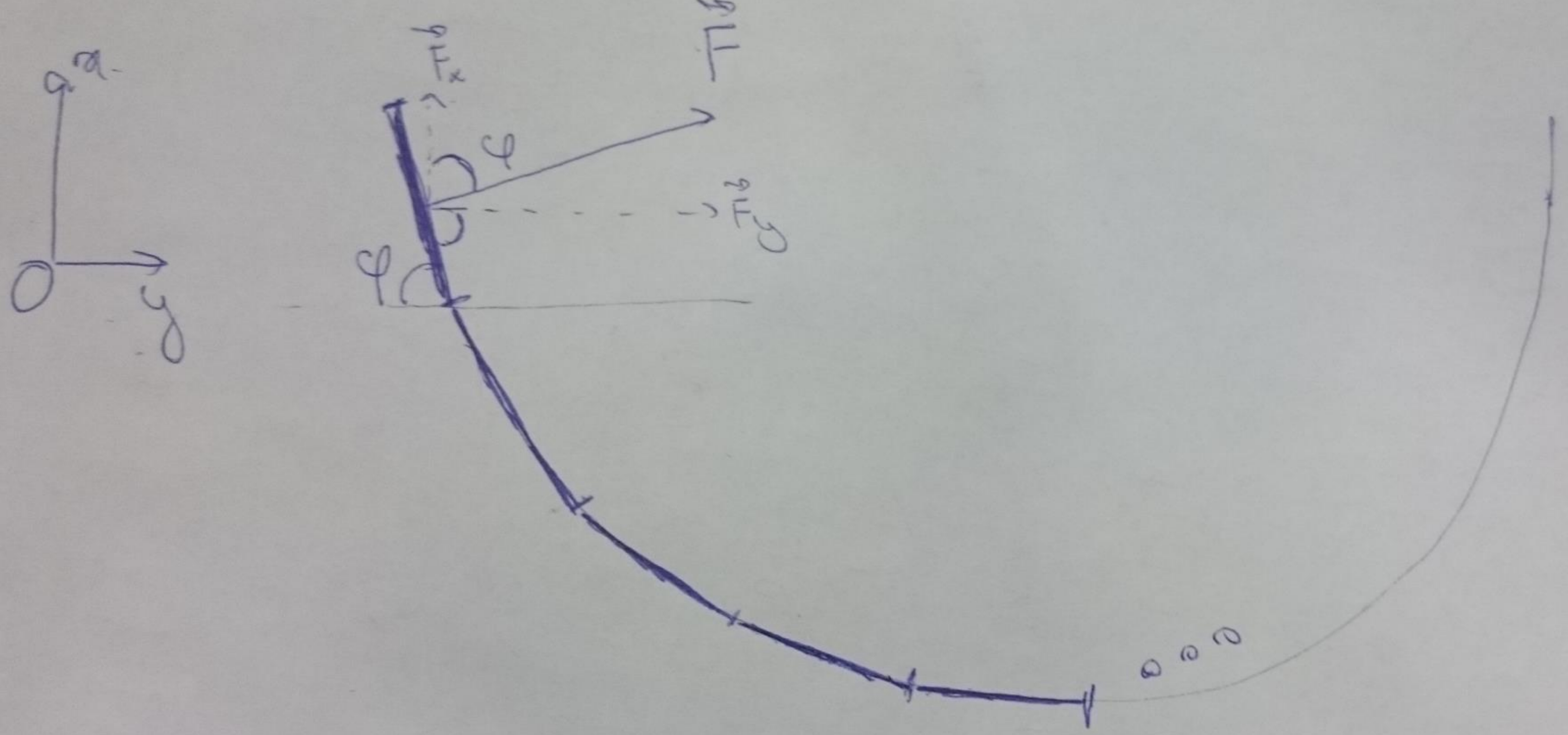
$\vec{F}_2 = \vec{F}_2' + \vec{F}_2''$ #

$|\vec{F}_2| = 2\cdot\frac{\ell\upsilon}{2} = \ell\upsilon = |\vec{F}_1|$

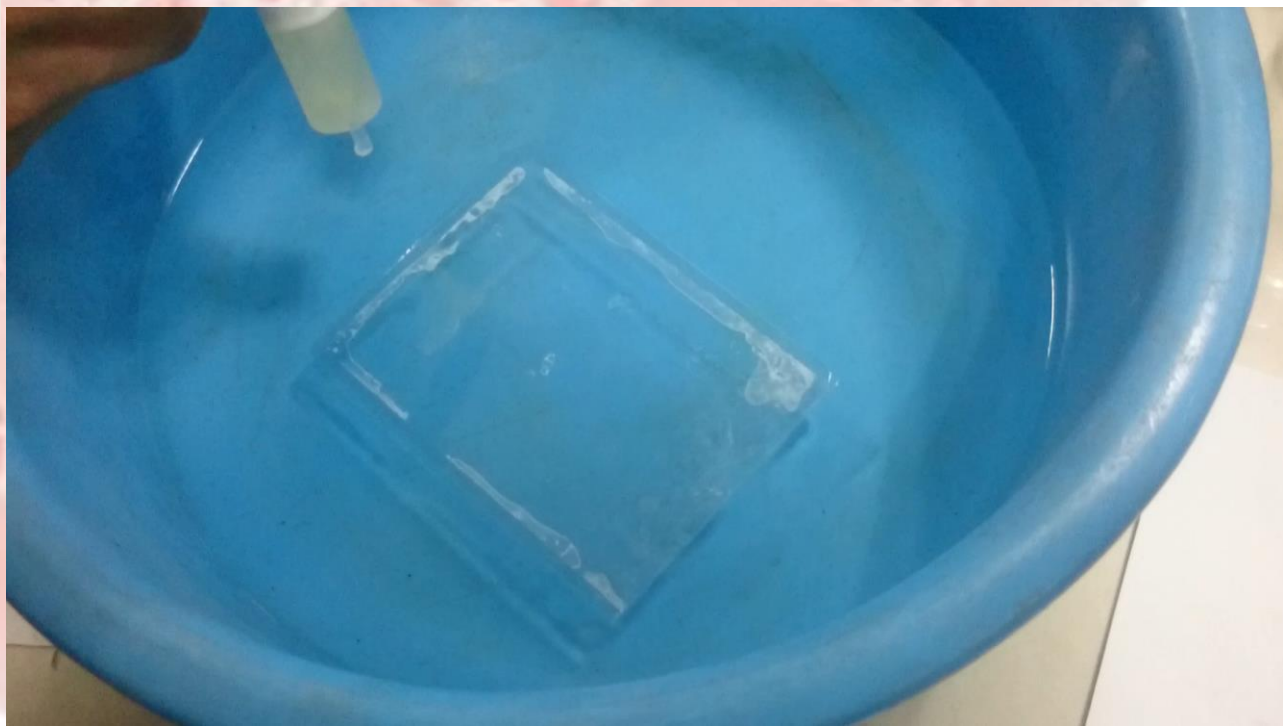
Experimental part

Set-up

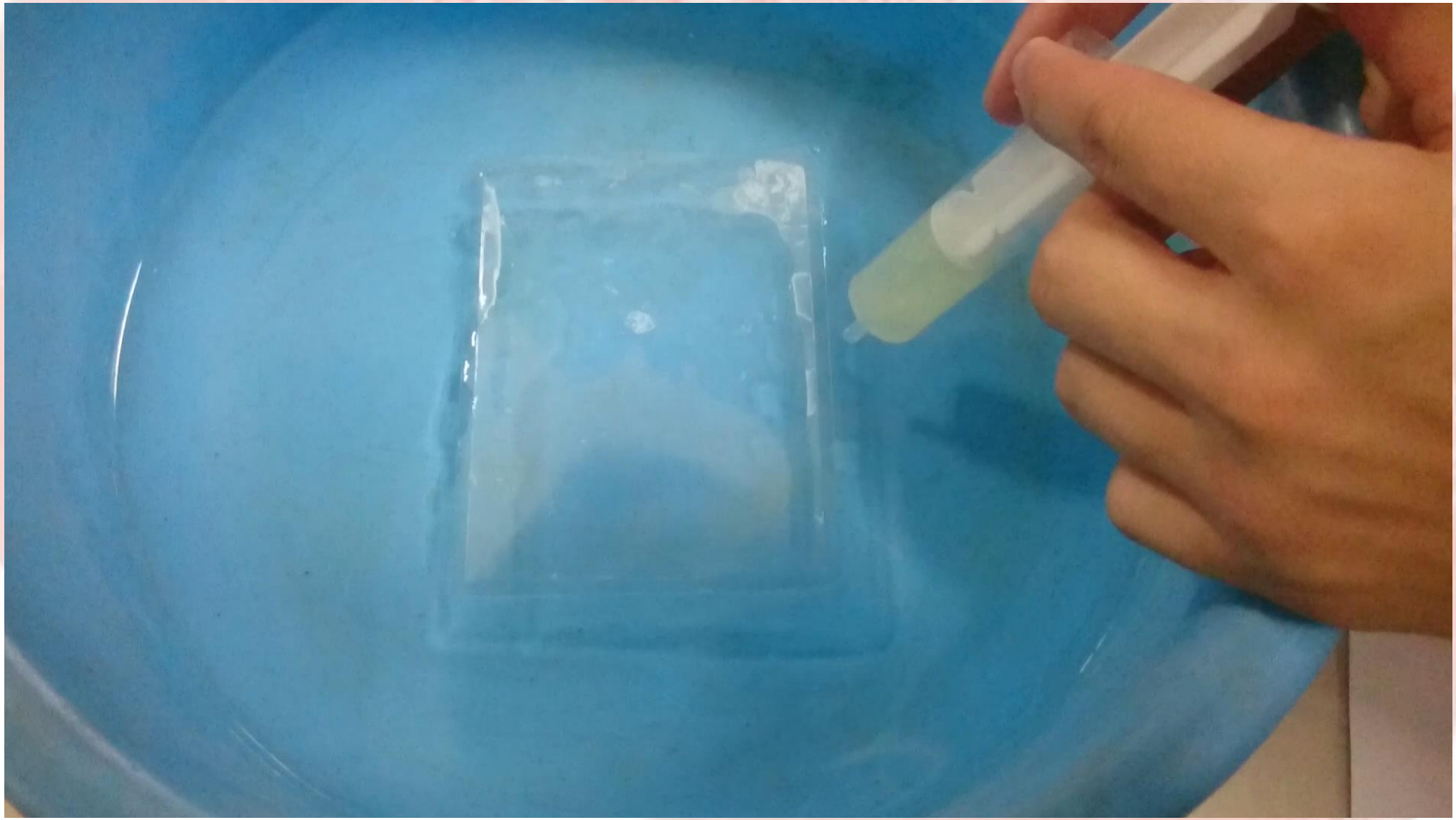

$\vec{F}_e + \vec{F}_r + \vec{F}_s + \vec{F}_w = \vec{F}$
$\vec{F}_e + \vec{F}_r = \vec{0}$
$\vec{F}_s + \vec{F}_w = \vec{F}$
soap
$\vec{F}_s$
b
a
$\vec{F}_r$
$\vec{F}_e$
$\vec{F}_w$
$\sigma_w = 0{,}73 \frac{N}{m}$
$\sigma < \sigma_w$
$|\vec{F}_{st}| = l \cdot \sigma$
$|\vec{F}| = b(\sigma_w - \sigma)$



Experiments with clear water



Experiments with soap in water



Conclusions

- The molecule in the surface of the surface of the liquid has addition potential energy in comparison with the molecule, which is inside
- The object in the liquid surface moves due to the difference between the forces of surface tension
- The difference between the tension coefficients of the soap and water exists only during some time
- The resultant force doesn't depend on the form of the border, but only on the extreme left and right points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Thank you for attention!