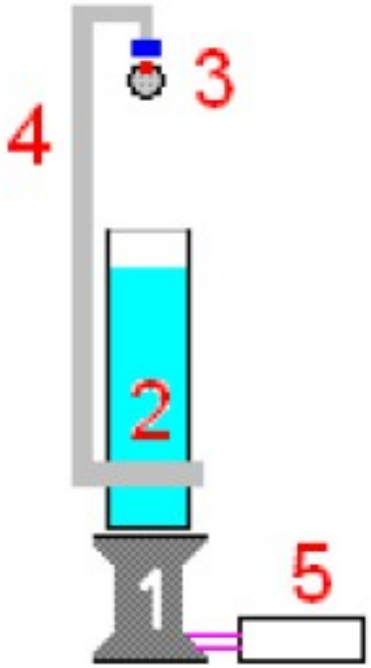
III IYNT 2015

Problem № 5
«Falling ball»

Team *«MG 12»*

№5. Falling ball

An electronic balance (1) is connected to a PC (5) in order to record the time dependence of the measured weight. A light frame (4) is mounted on a tall beaker (2) filled with water. The frame has a holder (3) allowing controlled release of a small ball such that it falls into the water. The beaker is placed on the balance as depicted in the Figure. Investigate how the readings of the balance reflect the different phases of the motion of the ball.



Hypothesis: if on the falling into water ball, as it moves in the water, influence different magnitude power, the total mass of the construction will change.

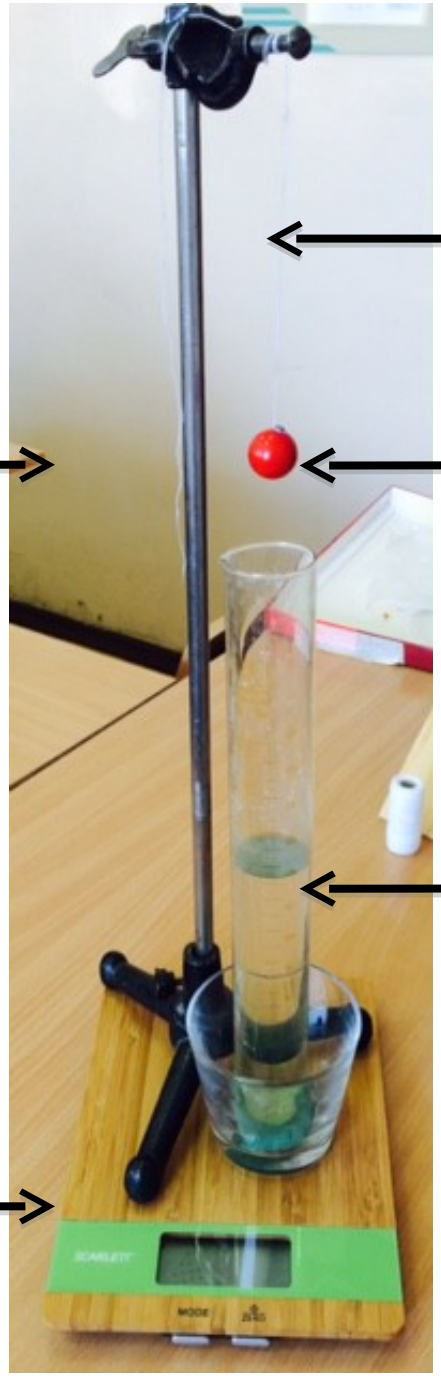
The purpose of research: To establish the dependence of the ball weights at different stages of it movements.

Problems

- To carry out literature research on the topic of the problem
- To explain changes in indications of weight of installation during examined experiment.
- To establish dependence:

-Of installation weight in different stages of movement of a ball on a liquid accepting it.

-Of indications of scales on the power of ball blow on a surface of an accepting liquid (initial height of a ball).



Keeping thread (during experiment it was burnt through)

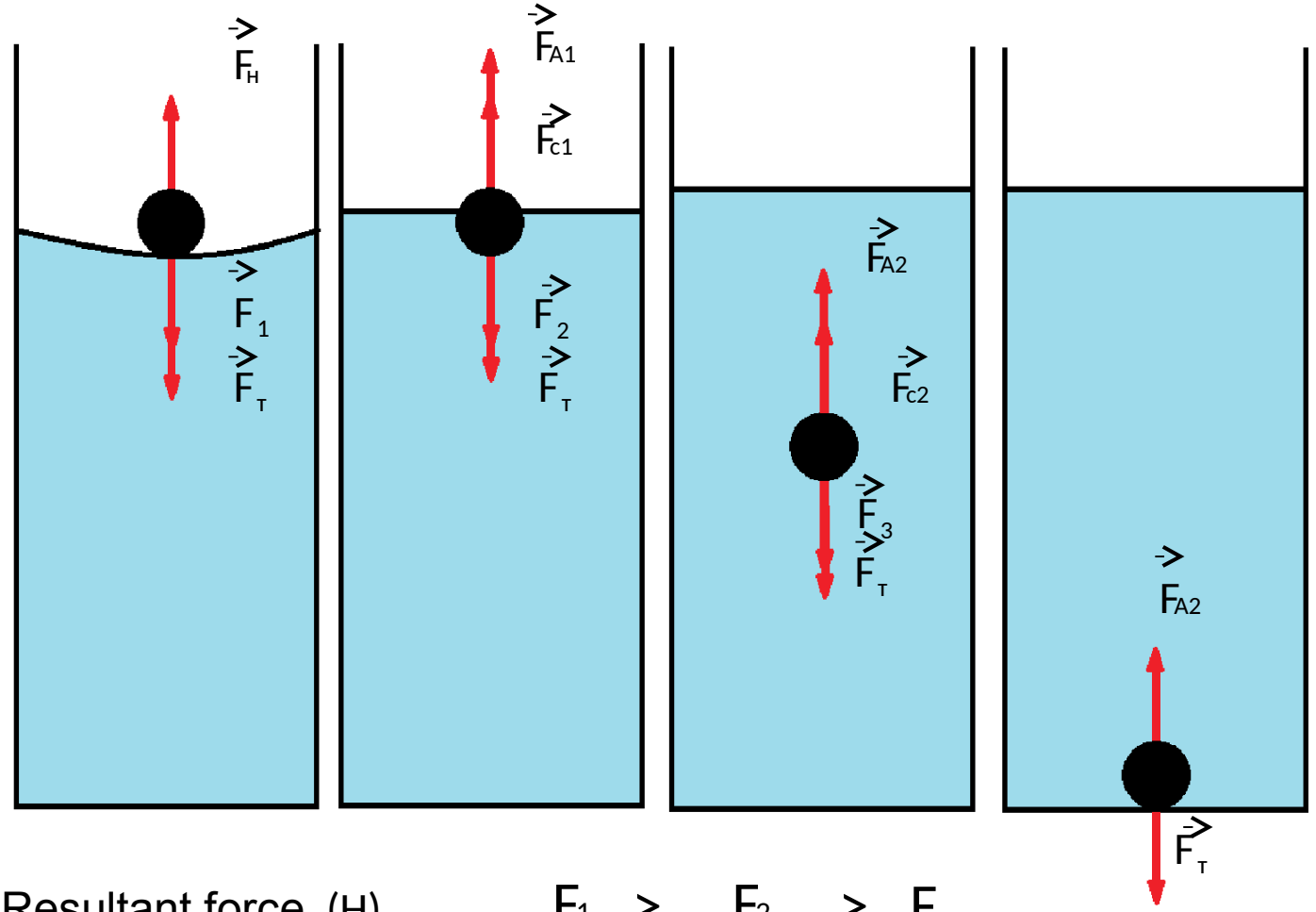
Support with the holder

Plastic ball

Beaker filled with water

Electronic-machanical scales (margin of error is 1 gram)

Let's consider the forces operating on a ball, falling on a water surface and at movement in it.



$F_{1,2,3}$ - Resultant force, (H)

$F_{A1,2}$ - Archimedes force, (H)

F_T - Gravity, (H)

$F_{c1,2}$ - Force of resistance to movement, (H)

$F_1 > F_2 > F_3$

$F_{A1} < F_{A2}$

$F_{c1} > F_{c2}$

$$F_A = \rho g V$$

$$F = -6\pi r \eta v$$

Experiment 1

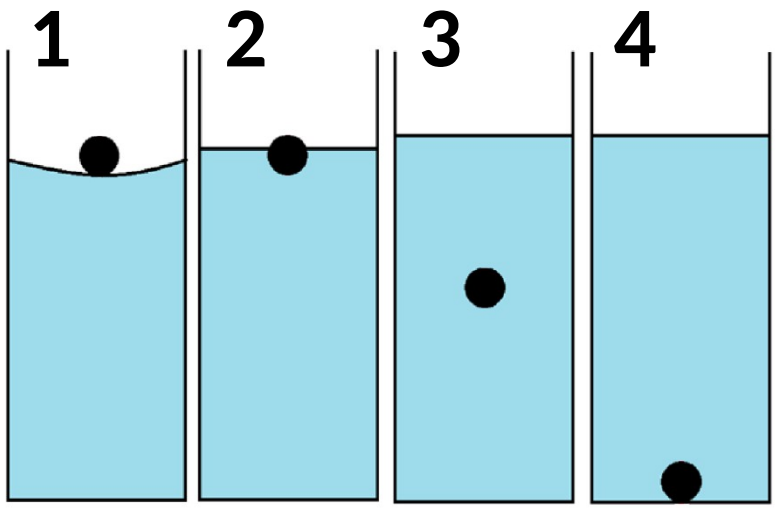
The aim of the experiment: establish the dependence between the mass of the container and the king of fluid, that receive the ball at the different step of it movement.

Changeable parameter: a surface of an accepting liquid.

- Distilled water with a free surface
- Surface-active agent (the water with the cleanser on the top)
- The water with the thin film of oil on the surface
- Saturated brine

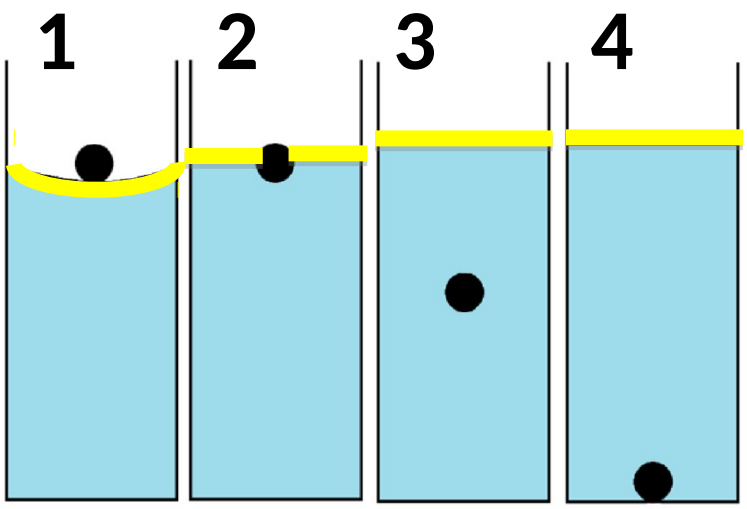
Indications of scales at use of water with a free surface

1) m=133**8** g
2) m=133**6** g
3) m=133**5** g
4) m=133**3** g



Indications of scales at Drawing on a water surface of an oil film

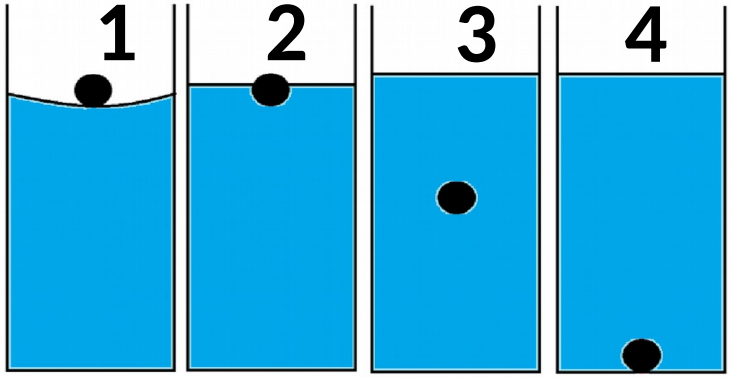
1) m=134**2** g
2) m=133**7** g
3) m=133**5** g
4) m=133**3** g



Conclusion: the oil film on the surface of the water is some kind of the membrane, it provides additional resistance to the ball, when it entering the water.

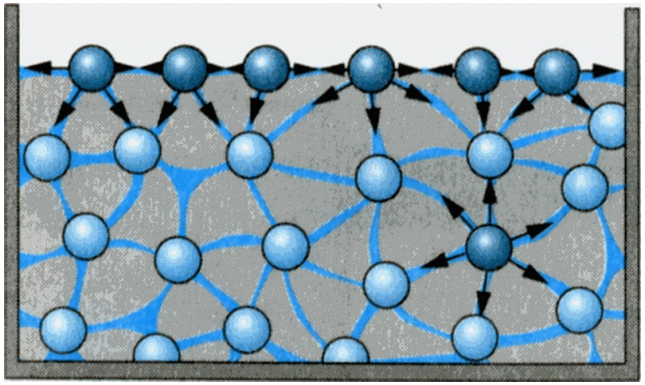
Indications of scales at applying to a water surface of a washing-up liquid

1) m=1333 g
2) m=1333 g
3) m=1333 g
4) m=1333 g



Indications of scales at use of the sated(saturated) salt solute with a free surface

1) m=1410 g
2) m=1409 g
3) m=1407 g
4) m=1404 g



Conclusion: The increase the surface tension of fluid has additional resistance at the time of ball entering.

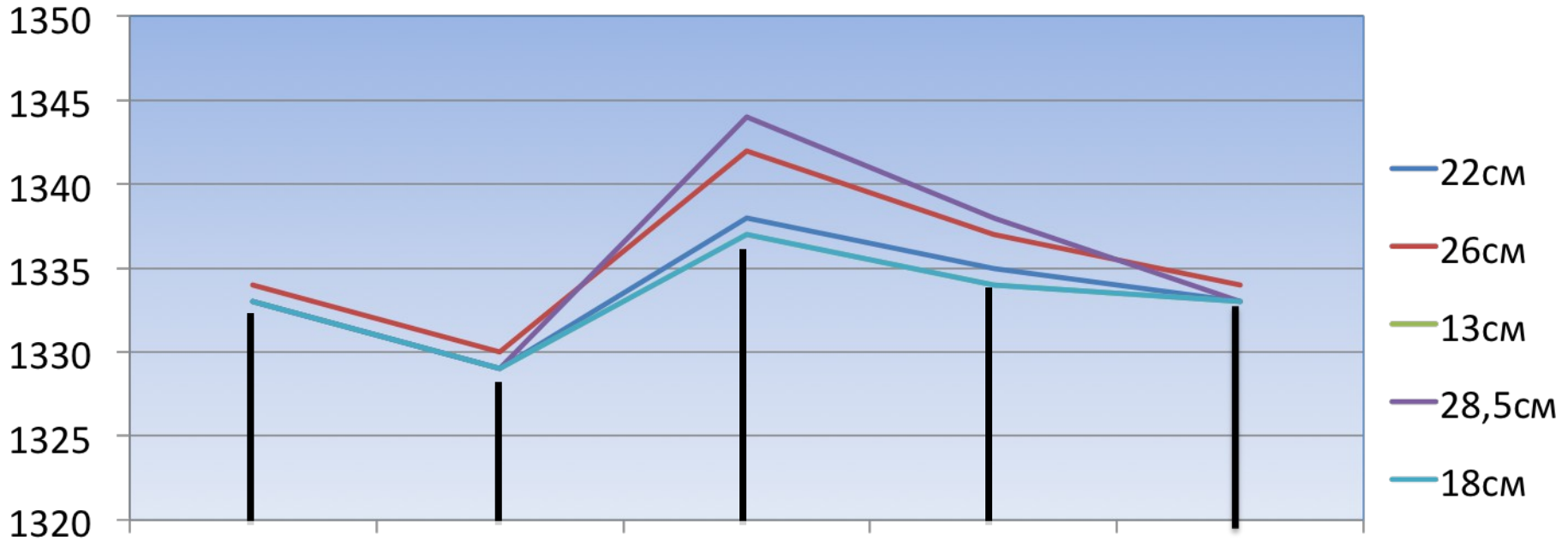
Experiment 2

- The aim of the second experiment is to establish the relationship between the changes of scales' values and the ball's stroking force on the surface of the receiving liquid.

Changeable parameter: height of falling of a ball over a surface of an accepting liquid.

Force of blow of a ball about a liquid surface according to Newton's who has been written down in the pulse form second law, depends on change of speed of a falling body. We will consider thus that blow time in all spent(lead) experiments equally.

Falling of the ball into water with free surface



Initial weight

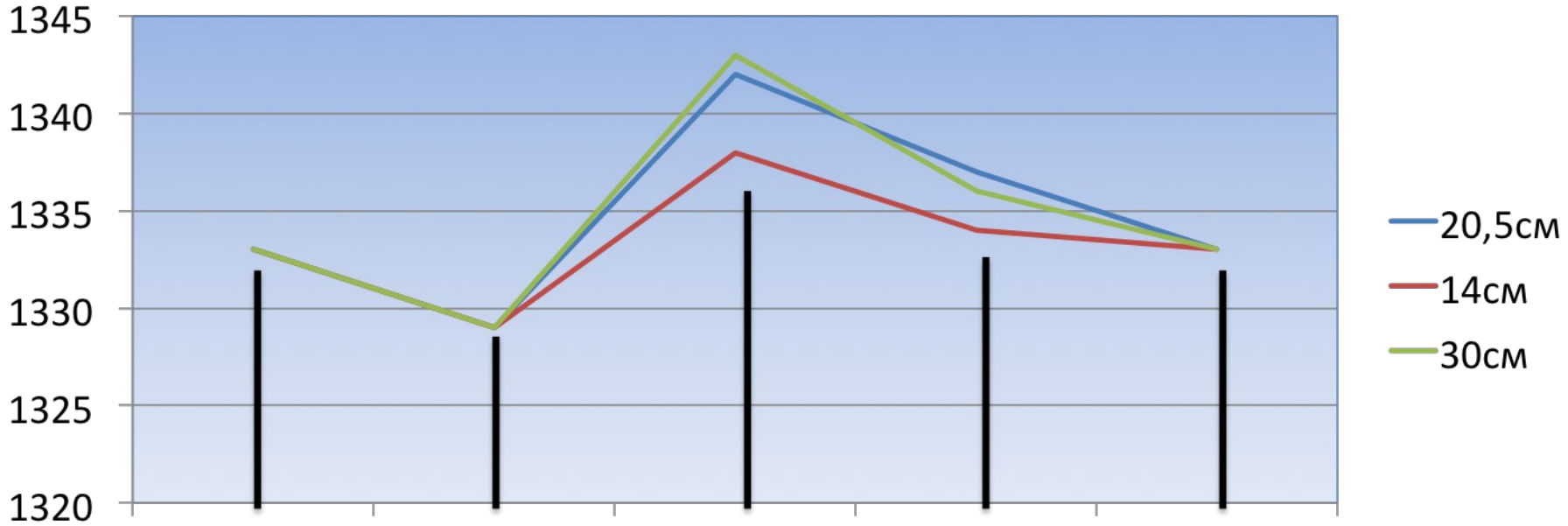
Ball in flight

Ball blow about a liquid

Ball movement in a liquid

Final weight

Falling of the ball into water with an oil film on a surface



Initial weight

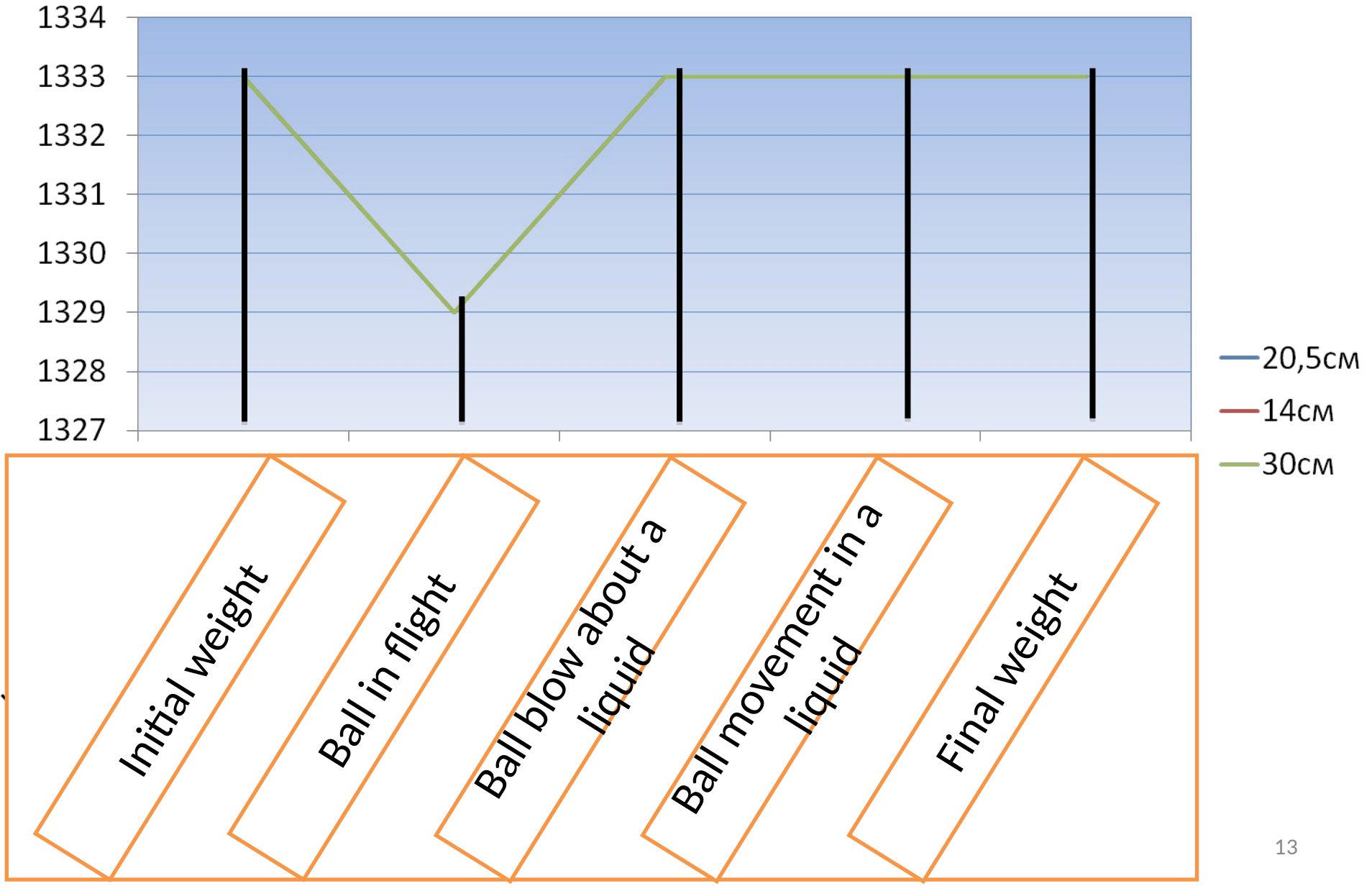
Ball in flight

Ball blow about a liquid

Ball movement in a liquid

Final weight

Falling of the ball into water with a washing-up liquid on a surface



Conclusion :

1) The higher ball entering speed into the fluid, the greater the value of the impact force on the surface of the receiving liquid.

2) Changes of the scales' data is dependent on the type of using fluid, i.e., depend on the value of surface tension and the presence of impurities on its surface.