



# Additional experimental problem

Republic of Moldova



# Theoretical explanation

- This experiment is just a problem from physics, mechanics capitol.
- For theoretical solving of the problem we just need to make the draw and analyse all the forces
- We are going to analyse two conditions, when is equilibrium, no acceleration, and another case when acceleration persist.
- Here is the theoretical notes
- We also are going to use some Newton's laws, they are:
  - 1)  $F=ma$
  - 2) Action force equal to reaction force!

# Theoretical notes:

Equilibrium moment

$$\begin{cases} N_1 = F_{fr} \sin d \\ F_{fr} \cos d = F_{fr} \\ N_1 = J_1 N_2 \sin d \\ J_1 N_2 \cos d = J_1 N_1 \end{cases} \Rightarrow \begin{cases} J_2 mg \cos d = J_1 J_2 mg \sin d \\ \Rightarrow J_1 = \frac{\cos d}{\sin d} \end{cases}$$

Accelerate moment

$$\begin{aligned} m a_x &= F_{fr} \cos d - F_{fr} \\ m a_y &= F_{fr} \sin d - N_1 \end{aligned}$$

$\vec{N}_2 = \vec{m}g$

$\vec{N}_2 = \vec{m}g$

# Experimental data

- Every time we move the ruler to the same distance, and every time we vary the angle, and we also change the part of the match box, because logically we have two sides, with two different friction forces.
- Every time we try to keep the same force of pushing the ruler, which is very important
- The only things we measure are, angle and distance travelled by the box along the ruler

# Here we present the Data

Angle	Distance
85	No distance passed
75	5 cm passed
60	9 cm passed
45	12 cm passed
30	15cm passed
10	19 cm passed

# Theoretical explanations:

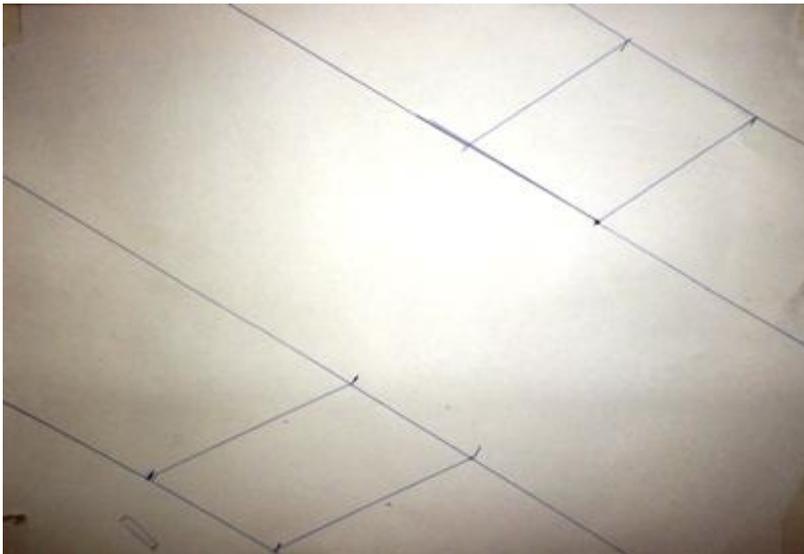
- We observe that the box is moving because of the friction force, and we are going to evaluate friction force projection
- Lets explain why no distance was passed at the angle of 85 degrees. Because the projected friction force is very small, because it is multiplied by cosinus, and as angle is bigger, cosinus is less, logically that projected force became smaller, and it cant move
- But when we decrease the angle the Projection force increases, and logically it start moving
- While the angle became smaller, the cosinus become bigger, and the distance increase
- And that`s why every time we change the angle, also the distance change
- Also we can observe that the velocity of the match box is different, increasing with angle decrease.
- When angle is 85 degrees , we can observe a very small motion, however when angle is 10 degrees we CAN observe a bigger velocity

**Now we are going to show you a little experiment, in which we will prove our theoretical notes!**

**At different angles, we observe different distances**



Here we change the angle .



# Experiment

If it was possible to measure the force we were pushing with, we could measure the friction coefficient. So we needed just a Dynamometer!

To make this experiment bigger, we can also change the types of surfaces, and it will be possible to measure also the friction force between the ruler and the friction coefficient between ruler and match

Also, while changing the parts of the box, we can find different friction coefficients of the box

# Errors determination

- There are 2 types of errors:

1. Apparatus error ( $\epsilon_a$ ) (Every apparatus has his specific error).

2. Measuring errors. ( $\epsilon_m$ ) While measuring the data, we commit some errors, this error may be calculated by the formulas:

Total error ( $\epsilon_t$ ) is calculated by the formula:

$$\epsilon_t = \epsilon_a + \epsilon_m$$

In our case we have three source of errors, because we can't exactly measure the distance, we can measure it with exactity with 0.5 cm

Also different times, we action different force, and also by this we can change the result.

Also the surface isn't the same, logically we get different Friction coefficient

# Conclusion

While realising this experiment we have solved a problem of physics, we tried to show the influence of angle on the movement of the match box

Realising this experiment we have just proved some newtone laws.

Also this experiment can be useful in industry for finding the best kind of tire for wheels, to prevent accident.