DYNAMICS LAB *

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Performed by Kayla V., Armaan P., and Ethan Z.

Question:
Does the frictional relationship between the force and mass of a liquid in a Modified Atwood's machine obey Newton's second law?

Hypothesis:
There exists a constant ratio between mass added and mass used to overcome static friction in the Modified Atwood's Machine.

Strategy:
The strategy used to identify the constant nature of this ratio is the use of a Modified Atwood's Machine. This configuration visually conveys the breaking of the barrier of static friction preventing the horizontal mass from moving. The decision to use water as a hanging mass is due to curiosity of whether this constant ratio remains despite the use of a different medium. Two standard trials were conducted and two additional trials, one with an additional 50g on the horizontal mass and the second with an addition of 100g were conducted. Water was gradually measured while added to the 3.4g cup by pipette.

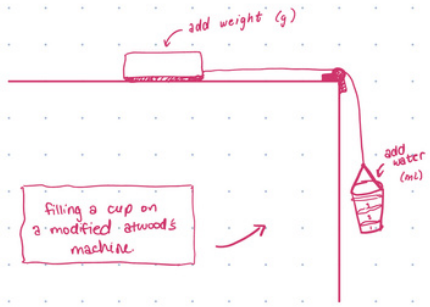

Figure 1: Modified Atwood's Machine set-up

Data:

Trial #	Addition of Water to Achieve Movement (mL)	Mass Added to Felt Eraser (g)
1	56	0
2	52	0
3	62	50
4	66	100

Figure 2: Raw data from performing the lab.

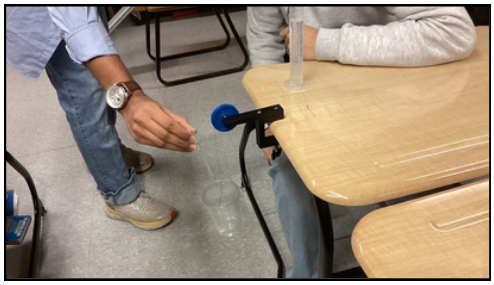

Figure 3: Photograph of the lab.

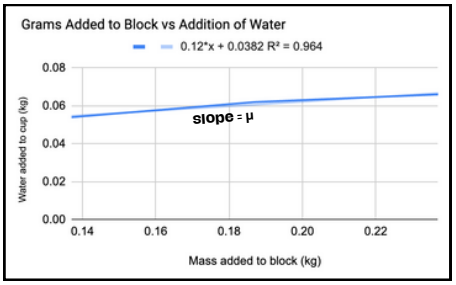

Figure 4: Graphed lab data.

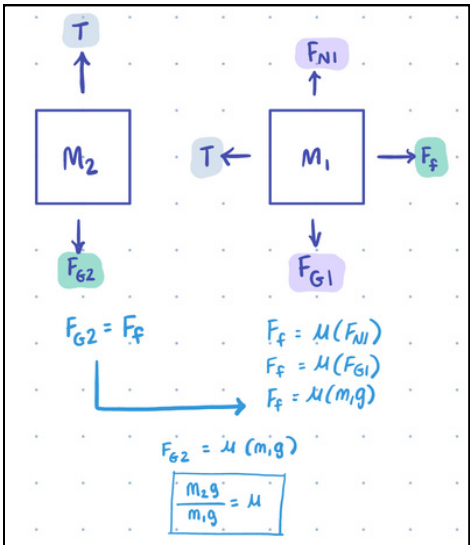

Figure 5: Free-body diagrams and visual calculations.

Analysis:
From the data presented in Figure 2, it can be determined that the provided hypothesis was correct. If linear, the graphical representation of the collected data would prove that the relationship between the horizontal mass and the vertical mass is not affected by increasing addition of mass, as there exists a constant frictional force that prevents the horizontal mass from moving unless unbalanced by the horizontal (applied) force. In Figure 5, this logic can be proven through the use of Newton's second law, which states that the sum of all forces acting on an object is equivalent to its mass multiplied by its acceleration. By manipulating this equation, it can be proven that the hanging mass divided by the horizontal mass will provide a constant coefficient of friction. Since the slope in this graph is the coefficient of friction preventing the horizontal mass from moving, and the line is near-linear, it can be determined that the coefficient of friction is constant despite mass additions in the horizontal mass. Despite initial concerns over possible errors in water spillage/measurement or movement of the standard configuration, the results are deemed as valid and correlative with the proposed hypothesis.