Armaan Priyadarshan B Group

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

Hypothesis: The masses of liquid needed to make different masses break static friction vary directly and linearly.

Strategy

- A Modified Atwood's Machine was set up using a cup of water as the hanging mass and a block as the mass being pulled across the flat surface of the table.
- The mass of the block was varied across trials by placing washers on top.
- Across four trials, water was added with a pipette to the cup in small increments until the block started moving.
- The amount of water needed to make the block start moving and the amounts of mass added across trials were noted.

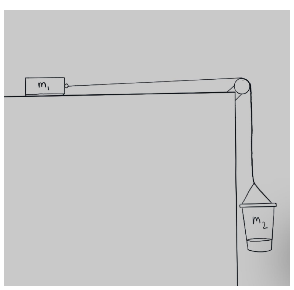

Figure 1: Modified Atwood's Machine

Data

Trial	Hanging Mass (mL = g)	Mass Added to Block (g)
1	56	0
2	52	0
3	62	50
4	66	100

Each mL of water is 1g

Analysis

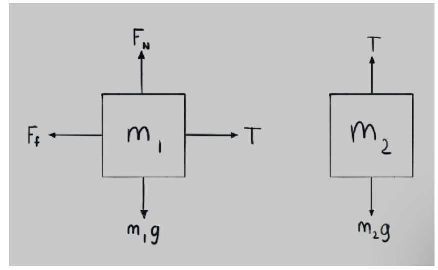

Figure 2: Free Body Diagrams

The following equations are based on the free body diagram, with positive motion for the block and cup of water being right and down, respectively.

- $F_f = \mu m_1 g$
- $m_1 a = T - \mu m_1 g$
- $m_2 a = m_2 g - T$

Solving the system of equations, $m_1 a + \mu m_1 g = m_2 g - m_2 a$, and since the acceleration is 0 when the block breaks static friction, $m_2 = \mu m_1$.

- The constant coefficient of friction shows that m_1 and m_2 vary linearly and directly, with μ as the slope of the linear function relating them.

The relationship between the dragged and hanging mass was graphed and shown to be linear.

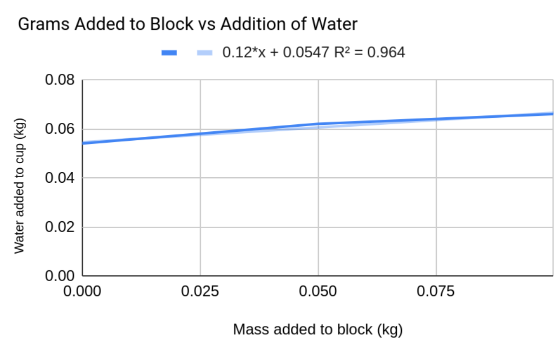

Figure 3: Graph of the Relationship Between Masses and the Volume of Water Needed to Make Them Move

The graph is not a completely straight line, which could be explained by the limited number of trials and imprecision in measuring and adding exact quantities of water.