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Dynamics Lab Report

Question: How does the acceleration and coefficient of friction of a wooden block on a metal track change when the weight on one side of a pulley increases?

Hypothesis: The acceleration of the block will decrease as more mass is added to the opposite side of the pulley, while the coefficient of friction between the block and track will remain constant.

Strategy:

- The mass of the block (mass 1) did not change.
- Mass 2 in the modified Atwood's machine was varied by hanging an increasing amount of washers tied to a string.
- The velocity of the block was measured using a Vernier motion detector.
- The acceleration was calculated using the velocity and distance traveled.
- Friction was solved for using the equation $F_{net} = ma$.

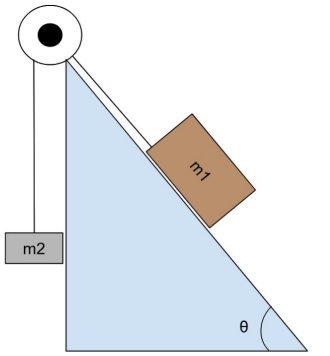

Figure 1: Modified Atwood's Machine

Data:

Figure 2: Data collected from Modified Atwood's Machine

Note. The velocity is the average of two trials. The weight of the washer #1 is not a washer, but a holder for the successive washers.

# of Washers	m2 (g)	Δ x (cm)	Velocity	Acceleration	μ
0	0	25.25	-1.449	4.158	0.483
1	50.1	25.25	-0.405	0.325	0.430
2	51.7	25.25	-0.379	0.284	0.418
3	53.7	25.25	-0.343	0.233	0.404
4	56.1	25.25	-0.2285	0.103	0.403
5	58.8	25.25	-0.122	0.029	0.386
6	61.4	25.25	-0.0365	0.003	0.360

Analysis:

The free body diagrams in Figure 3 show the forces on the masses in the modified Atwood's machine.

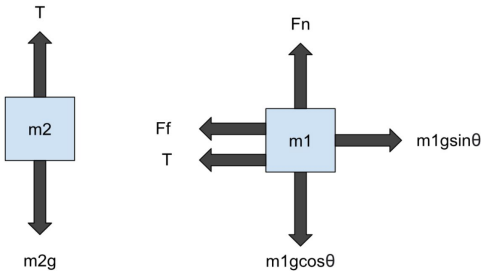

Figure 3: Free Body Diagrams

The weight of the string is negligible due to its low mass. Positive motion is defined as to the right for the wooden block, and up for the hanging mass. The following equations are based on the diagrams:

$m_1gsinθ - T - Ff = m_1a$

$T = m_2a + m_2g$

Combining these equations results in:

$m2g = (m1+m2)a + m1sin(θ) - Ff$

This equation represents a linear equation between m2g and acceleration. This equation is theoretical because m2 varies, while it should be a constant.

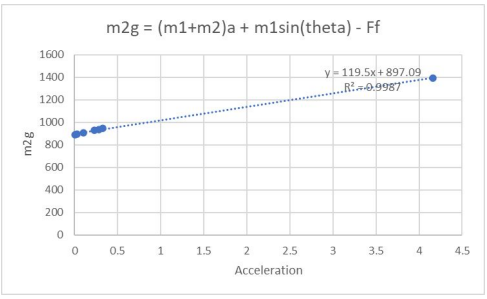

Figure 4: Graph of Equation

It is important to note a pattern of the coefficient of friction decreasing as m_2g increases in the data. This should not be the case, and may be attributed to the Vernier motion detector shifting downwards after each trial, therefore skewing Δ x and resulting in an incorrect acceleration which may have resulted in slightly incorrect values for μ.