Question: If the hanging object slides down an incline with friction at different angles, will the coefficient of kinetic friction change?
Hypothesis: Mu, the coefficient of kinetic friction, will stay constant even if the angle of the board changes.
Strategy:

- The hanging mass (mass 2) in the modified Atwood's machine slid down a wooden board at an angle, as seen in Figure 1. The hanging mass was a wooden block, and was connected to a Vernier motion detector (mass 1) using a piece of thread. The masses of both the block and the Vernier motion detector were taken.
- The angle was measured with a protractor, and using the Vernier motion detector, the acceleration was also measured.
- This process was repeated six times with the angle of the board varying by moving the board.

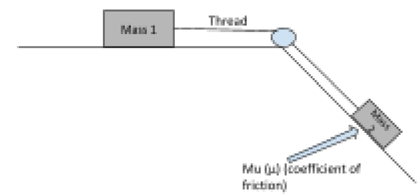

Figure 1. Diagram of Modified Atwood's Machine with Hanging Mass on an Incline

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Data:

Test	Theta (°)	Acceleration (m/s^2)
1	47°	1.365
2	50°	1.516
3	55°	1.712
4	33°	0.6688
5	40°	1.03
6	28°	0.4381

Table 1. *Angle of Board and Acceleration of Machine*

Object	Mass (kg)
Vernier motion detector (mass 1)	0.2998
Wooden block (mass 2)	0.133

Table 2. *Masses of Objects*

Analysis:

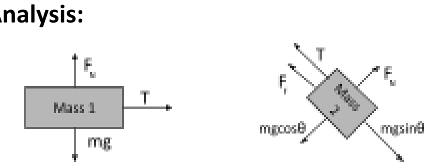

Figure 2. Free Body Diagrams of Mass 1 and Mass 2

Based on the diagram in Figure 1, two free body diagrams can be derived, one with mass 1, and one with mass 2. These free body diagrams can be seen in figure 2. The free body diagram involving only mass 1 can be used to create an equation solving for tension, which is $T = m_1 a$; mass 1 experienced negligible friction. Using the free body diagram involving only mass 2, the equation for mu can be found from the equation $m_2 g sin\theta - T - \mu m_2 g cos\theta = m_2 a$, which becomes $\mu = \frac{m_2 a + T - m_2 g sin\theta}{-m_2 g cos\theta}$. Using the T value calculated from the $T = m_1 a$ equation, as T is the same for both masses, the values of the measured masses, the measured acceleration, and the measured degree θ, μ can be solved for. After solving for all of the μ values of all the tests and putting them in ascending order of degree, as can be seen in table 3, the μ values become bigger as the angles become bigger. This is different from the hypothesis, which said that μ would stay consistent even if the angles changed. μ is supposed to be the constant of kinetic friction between two surfaces, but the data suggests that as the angle of the board increases, so does the value of mu. This suggests that further testing is needed, and some ways that this could be further tested would be taking more measurements at the same angle values, finding the value of kinetic friction at a 0° angle, to compare other data points against, and using more angle measurements, to see if the trend continues. The wooden board may also not have a consistent value of mu, which may have also led to the differences in mu values. To try and avoid unknowingly experiencing multiple mu values, the test could be run at specifically the same area of the board.

Test	Theta (°)	Tension (N)	Mu
6	28°	0.131	0.367
4	33°	0.201	0.385
5	40°	0.309	0.393
1	47°	0.409	0.408
2	50°	0.454	0.409
3	55°	0.513	0.437

Table 3. *Calculated Tension and Mu With Degrees in Ascending Order*