

Friction Lab with Inclined Planes: Testing Friction dependence on Normal Force

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1 Introduction

Recall that the static friction force is given by

$$f \leq \mu_s N \quad (1)$$

N represents the normal force. On a flat solid surface, $N = mg$. On an inclined surface with angle θ , the normal force balances the component of the weight vector perpendicular to the surface: $N = w_{\perp} = mg \cos \theta$. The component of the weight vector parallel to the incline is $w_{\parallel} = mg \sin \theta$. The component w_{\parallel} can be balanced by friction if an object is on an inclined plane but not sliding. Prove the following, by equating the static friction force with w_{\parallel} :

$$\mu_s = \tan \theta \quad (2)$$

2 Setup

You will need the following objects: an index card, a small circular weight, and a protractor. Place the weight on the index card and tilt the card upwards. The weight should remain in place. Use the protractor to measure the angle *at which* the weight just begins to slide.

3 Data Collection

Using three different masses m_1 , m_2 , and m_3 , fill in Tab. 1 with measurements of θ in degrees. Take three measurements for each mass and list them in trials 1, 2, and 3. Convert your angles in Tab. 1 to μ_s -values. Produce an average and standard deviation below:

$$\mu_s = \text{---} \pm \text{---}$$

Mass (grams)	Angle (degrees)	Trial
		1
		2
		3
		1
		2
		3
		1
		2
		3

Table 1: List the mass in grams in the first column, and keep the same mass for three trials. Record the angle in degrees.