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

Prof. Jordan C. Hanson

October 11, 2021

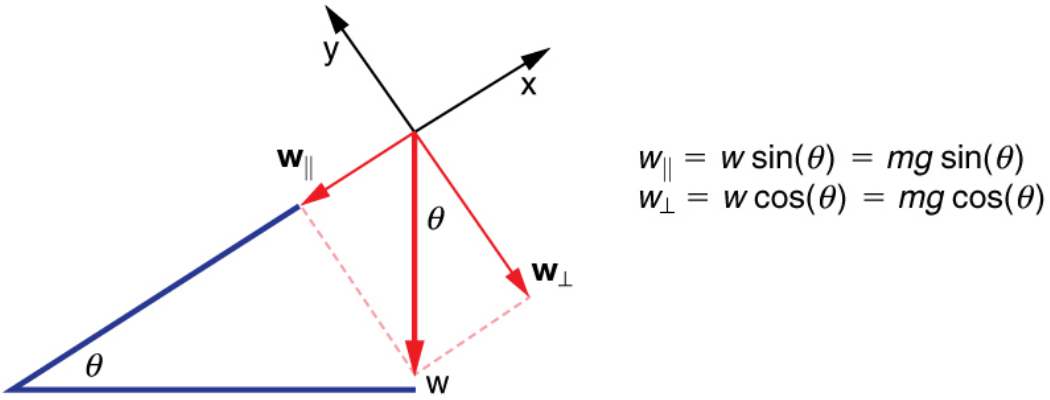

Figure 1: The weight vector may be broken into two components: parallel and perpendicular.

1 Introduction

Recall that the static friction force is given by

$$f \leq \mu_s N \tag{1}$$

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 $w_{||} = mg\sin\theta$. The component $w_{||}$ can be balanced by friction if an object is on an inclined plane but not sliding.

Equate the static friction force $\mu_s N = mg\sin\theta$ with $w_{||}$ to show that

$$\mu_s = \tan\theta \tag{2}$$

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 on the next page with measurements of θ in degrees. Take three measurements for each mass and list them in trials 1, 2, and 3.

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.

Convert your angles in Tab. 1 to μ_s-values. Produce an average and standard deviation below:

$\mu_s =$ ___ $\pm$ ___

Share your result with the instructor to build the class-wide table of results.