

Inclined Plane Simulator

Classroom worksheet · Interactive simulation: <https://lkforge.com/tools/physics/inclined-plane/>

Name: _____ Date: _____

Learning objectives

- Resolve gravity into components along and perpendicular to an incline.
- Relate the normal force to the slope angle.
- Determine when an object slides using friction.

Variables to change

- Incline angle
- Mass
- Coefficient of friction

Procedure

1. Set a low angle with friction and observe whether the block stays or slides.
2. Slowly increase the angle until the block begins to slide.
3. Compare the along-slope and perpendicular force components as the angle changes.

Observations

Record the angle at which sliding begins and how the normal force changes with angle.

Questions

1. Write the component of gravity along the incline and perpendicular to it.
2. How does the normal force change as the incline gets steeper?
3. What condition makes a block start to slide?

4. Does the sliding-start angle depend on the mass?
5. On a frictionless incline, what is the acceleration down the slope?

Answer key (instructors)

- **1.** Along: $mg \cdot \sin\theta$. Perpendicular: $mg \cdot \cos\theta$.
- **2.** It decreases, because $N = mg \cdot \cos\theta$ and $\cos\theta$ shrinks with angle.
- **3.** When $mg \cdot \sin\theta$ exceeds the maximum static friction $\mu \cdot mg \cdot \cos\theta$, i.e. $\tan\theta > \mu$.
- **4.** No — mass cancels; the critical angle depends only on the coefficient of friction ($\tan\theta = \mu$).
- **5.** $a = g \cdot \sin\theta$.

On an incline, gravity splits into $mg \cdot \sin\theta$ down the slope and $mg \cdot \cos\theta$ into it. The normal force equals $mg \cdot \cos\theta$, so it drops as the slope steepens. Sliding begins when the down-slope pull beats static friction, at $\tan\theta = \mu$, independent of mass.