

The Ramp (and Friction) PhET Simulation Lab

**Introduction:**

When an object is dragged across a horizontal surface, the force of friction that must be overcome depends on the normal force as  $F_f = \mu F_n$  and the normal

force is given by  $F_n = F_g$ . When the surface becomes an inclined plane, the normal force changes and when the normal force changes, so does the friction.

In this lab, you will change the angle of an inclined plane and observe how weight is resolved into its components ( $F_n$  and  $F_f$ ) using the basic trig functions.



The Ramp

**Procedure:** *Play with the Sims* → *Physics* → *Motion* → *The Ramp* Run Now!

• Be sure to stay in the Introduction part of the simulation. *More features* will be used later when we investigate energy. Start by playing with the cabinet some. Have fun, really... Now...back to work.

• Move the cabinet up and down the ramp by dragging it with your mouse.  
 • Move the ramp to an angle of zero (horizontal) and draw a free body diagram of the cabinet here:

1. On a horizontal plane, the normal force is perpendicular to the weight.
2. The cabinet has a mass of 100kg. It therefore has a normal force of 980 N and a friction force (on the horizontal plane) of 294 N  $\mu = 0.30$

• **Reset** the ramp and draw a free body diagram of the cabinet in the box here:

3. The force down the plane and normal force are components of weight.
4. Before we add an applied force on the ramp, there is a force of friction that acts against the force down the plane( Force parallel).

5. When we apply a force to get the cabinet moving, the friction force acts in the opposite direction as movement of the cabinet.

6. **Slowly** increase angle (0.1 degrees at a time) of the ramp until the cabinet starts to move on its own. What angle is this? 16.8° =  $\theta$

7. In the simulation, the coefficient of friction is 0.30. What is the normal force?
8. How much weight is acting on the cabinet? 980 N. How much weight is acting parallel to the ramp?
9. In the simulation, the cabinet has a mass of 100 kg. How much weight is acting perpendicular to the ramp?
10. In the simulation, the cabinet has a mass of 100 kg. How much weight is acting parallel to the ramp?
11. How much weight is acting perpendicular to the ramp?
12. How much weight is acting parallel to the ramp?
13. How much weight is acting perpendicular to the ramp?
14. How much weight is acting parallel to the ramp?

Angle	Normal force	Weight	Weight parallel to ramp	Weight perpendicular to ramp
0°	980 N	980 N	0 N	980 N
10°	966 N	980 N	169 N	963 N
20°	921 N	980 N	338 N	947 N
30°	850 N	980 N	507 N	913 N



# Phet The Ramp Lab Answer Key

**K Payea**



**Phet The Ramp Lab Answer Key:**

## Unveiling the Magic of Words: A Report on "**Phet The Ramp Lab Answer Key**"

In a world defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their capability to kindle emotions, provoke contemplation, and ignite transformative change is really awe-inspiring. Enter the realm of "**Phet The Ramp Lab Answer Key**," a mesmerizing literary masterpiece penned with a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve to the book is central themes, examine its distinctive writing style, and assess its profound impact on the souls of its readers.

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