Virtual Learning

Physics

Newton's Laws of Motion Sim Part III

April 23, 2020

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Newton's Laws of Motion Sim Part III: April 23, 2020

Objective/Learning Target:

Students will use a computer simulation to examine Newton's Laws of Motion and Friction.

Quick Review #1

Why can’t the strong man pull hard enough to make the chain perfectly straight?

Quick Review #1 Answer

The vertical components of tension in the two sides of the chain must add up to the weight of the load. As the chain is straightened and the angle approaches zero, the tension in the chain must approach infinity. Most difficult!

Quick Review #2

Suppose that a sled is accelerating at a rate of 2 m/s². If the net force is tripled and the mass is halved, then what is the new acceleration of the sled.

Quick Review #2 Answer

Answer: **12 m/s²**

The original value of 2 m/s² must be multiplied by 3 (since a and F are directly proportional) and divided by 1/2 (since a and m are inversely proportional)

$$a = \frac{F}{m}$$

Newton's Laws of Motion

Introduction

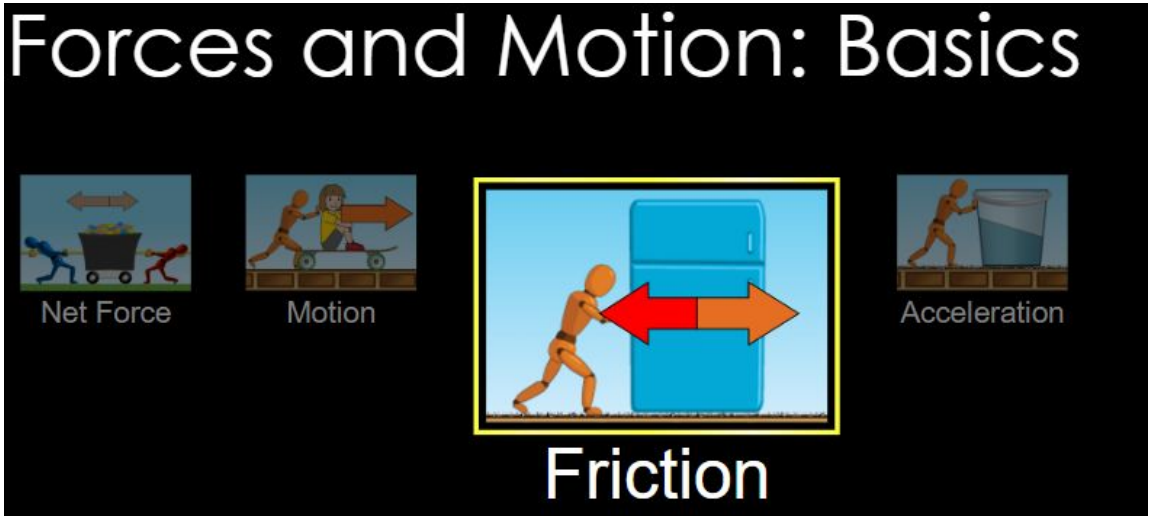
You will use a computer simulation today to reinforce your ideas of Newton's Laws of Motion. Since this is "inquiry based", you're not supposed to know everything going in, but learn as we walk through the lesson. **You must read the following slides carefully.** Let's get started!

Newton's Laws of Motion with Friction

Website:[Force and Motion Computer Simulation]

Make sure to use the HTML5 version.

Select the Friction icon and double click to start.



Newton's Laws of Motion with Friction

Remember to press Pause before setting your parameters!

Newton's Laws of Motion with Friction

The behavior of the skateboard in Part I and part II were not very realistic because friction was not present. So let's take a look with friction.

1. **Set friction to "none". Notice how the screen changed.**

   Why do you think the app designers did that?

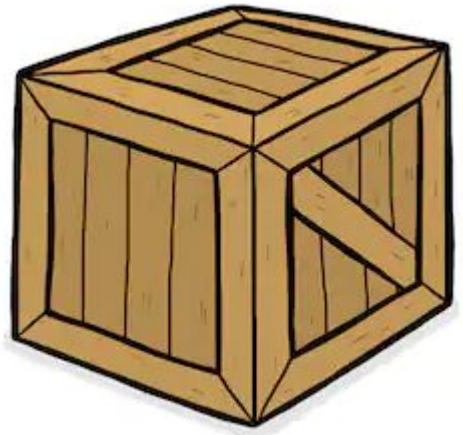
Newton's Laws of Motion with Friction

2. **Make sure that only the speed box is checked.**

   Apply a force to get the box to about half of its maximum speed, then remove the force.

   While the box is moving, move the friction slider to 1/2 way.

What happened to the box?



Newton's Laws of Motion with Friction

Reset the Friction app. Make sure Forces and Speed are checked.

3. **Apply a force of 50 N. Describe the movement of the box.**

4. **Apply a force of 100 N.**
   Describe the movement of the box.

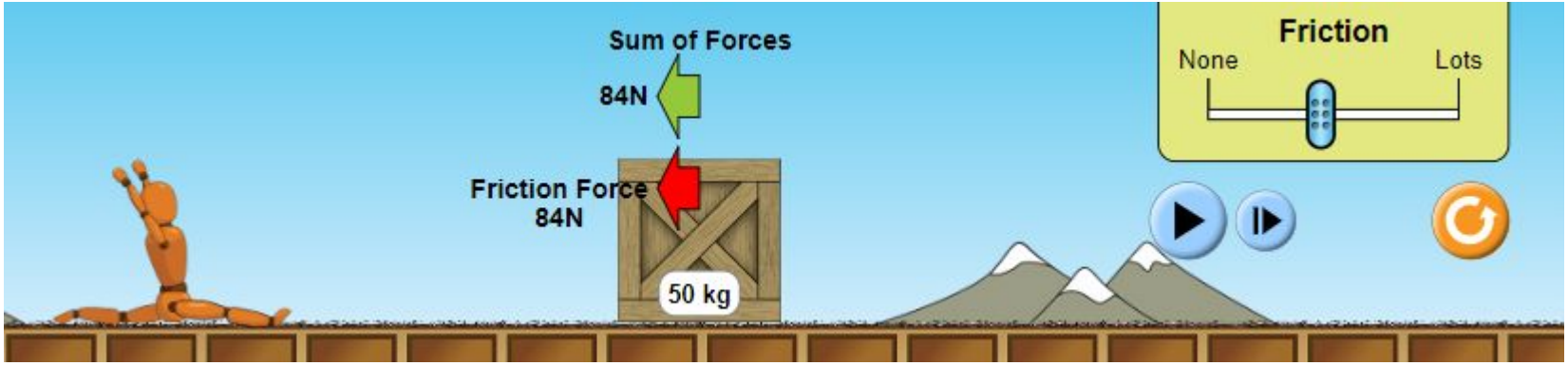
5. **Apply a force of 150 N. Describe the movement of the box.**

6. **Check the box that says "Sum of Forces". Repeat procedures 3, 4, and 5. What was different about 5?**

Newton's Laws of Motion with Friction

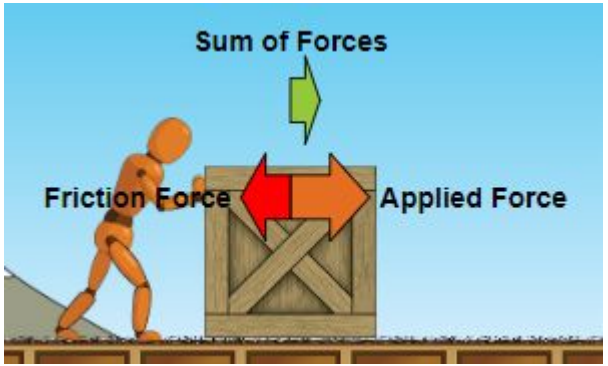
7. **Is friction a force? What evidence do you have?**

8. **Newton's Second Law states "<u>The acceleration of an object as produced by a net force is</u> directly proportional to the magnitude of the net force, <u>in the same direction as the net force</u>, and inversely proportional to the mass of the object." Explain how your observations relate to the underlined portion of this Law**



Newton's Laws of Motion with Friction Answers

1. The ground changed to ice, since ice is as close to "frictionless" as you get get in the everyday world.
2. When the friction was applied the box began slowing down and eventually came to rest.
3. Nothing. The box remained stationary.
4. Nothing. The box remained stationary.
5. The box slowly accelerated.
6. 3 and 4 had a sum of forces equal to zero while part 5 had a net sum to the right which caused the box to accelerate.

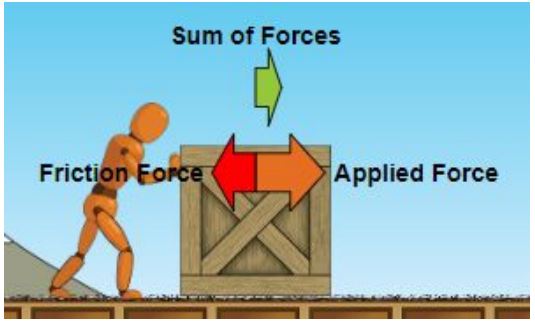


Newton's Laws of Motion with Friction Answers

7. Friction is a force. Friction when added to the applied forces created an overall net force. If that net force was zero the crate was stationary. When there was a net force the box accelerated in the direction of that net force.

   When the bax was sliding and friction was applied the crate was slowed. This could only be the case if a force was present to slow the crate. That force was friction.

8. Newton's Law is clearly evident even with friction. Friction affect the overall net force, but objects still accelerate in the direction of the net force as was evident in part 6 and pictured here.



Additional Practice

Follow the link below for additional interactive opportunities to further your experiences.

[Force Interactives]