Static and Kinetic Friction

Find the breakaway threshold and explain sliding

Name _____ Period _____ Date _____

Observe how friction adjusts before motion, changes at breakaway, and affects a block that is already sliding.

About 25 to 30 minutes | buildphysics.com/?experiment=static-kinetic-friction

Predict when the block will move

Keep the prepared 4.0 kg block on the level track. Set Static friction to 0.50 and Kinetic friction to 0.30. The block starts from rest. Use g = 9.8 m/s².

$$0 \le f_s \le \mu_s N \quad f_k = \mu_k N \quad \Sigma F_x = ma_x$$

1. Calculate the normal force and maximum possible static friction. For a 10 N rightward push, predict the actual friction force and the acceleration.

Test horizontal applied forces of 10, 18, and 22 N. Reset before each trial and auto-pause at 0.50 s. Read acceleration in Properties → Friction block → Live values. Read friction from its labeled arrow. For 22 N, read the values after sliding begins.

Applied F_x (N)	Rest or sliding	Friction F_x (N)	a_x (m/s²)
10			
18			
22			

2. Explain why the friction in the 10 N trial is not equal to $\mu_s N$. What changes when the block begins sliding?

Locate the transition

Choose additional forces between 18 and 22 N. Begin each trial from rest. Narrow the interval between the largest force that leaves the block at rest and the smallest force that makes it slide.

Largest tested force with rest (N)	Smallest tested force with sliding (N)

3. Compare this interval with your calculated maximum static friction. Why is an interval a useful way to report the transition?

Use the same force in two different states

Calculate $\mu_k N$. Set the applied force to that value. First test from rest. Next Reset and set the block's initial horizontal velocity to +3.0 m/s in Properties → Initial conditions. Use the same force and run to 0.50 s.

Initial state	Initial v_x (m/s)	Final v_x (m/s)	Friction F_x (N)
At rest	0		
Already sliding	+3.0		

4. Explain how the same applied force can leave one block at rest and keep the other moving at constant velocity. Which friction model applies in each trial?

5. Predict the effect of increasing only μ_s on breakaway force and on friction after sliding begins. Test one new μ_s value and explain the result.