Newtons First Law with Two Sleds

Compare coasting and motion with friction

Name _____ Period _____ Date _____

Explain why two moving sleds respond differently, then find the force that makes their motions match.

About 15 to 20 minutes | buildphysics.com/?experiment=newton-first-law

Watch the unforced sleds

Both sleds have mass 2.0 kg and begin at +8.0 m/s. One track is rough and the other is frictionless. Set Forward force · friction sled to 0 N.

1. Predict whether each sled will speed up, slow down, or keep the same velocity. Which horizontal forces act on each sled?

Run for 3.0 s. Select each sled in Properties and read horizontal Velocity and Acceleration in Live values. Open graph to compare their horizontal velocity traces.

Sled	Initial v_x (m/s)	v_x at 3.0 s (m/s)	a_x while moving (m/s²)
Friction sled	+8.0		
Frictionless sled	+8.0		

2. Sketch a horizontal force diagram for each sled. Explain why continued forward motion does not require a forward net force.

3. Use the two velocity traces to distinguish zero velocity from zero acceleration.

Make the motions match

Keep both initial velocities at +8.0 m/s. Adjust only the forward force on the friction sled. Find a value that keeps its velocity close to the frictionless sled's velocity throughout 3.0 s. Reset between attempts.

Attempt	Forward force (N)	Friction sled v_x at 3 s (m/s)	Frictionless sled v_x at 3 s (m/s)
1			
2			
3			

4. Report your successful force. Explain the net force on each sled when their velocities remain constant. Are the individual horizontal forces the same on both sleds?

5. Use the friction sled's mass and the matched force to calculate the kinetic friction coefficient. Show your force balance and compare with the sled and rough-track settings in Properties.

6. Predict whether your matched force will still produce zero acceleration at an initial speed of +4.0 m/s. Test it and explain the result.