Work and Kinetic Energy Lab

Constant force and changing speed

Name _____ Period _____ Date _____

Compare positive and negative work. Then vary mass at fixed force and displacement, linearize final-speed data, and determine net work from the graph.

Time 50 minutes • Open buildphysics.com/?experiment=work-kinetic-energy-example

Model and measurements

Right is positive. The track is frictionless and horizontal. The applied horizontal force is the net force.

$$W_{net} = \Delta K \quad W_{net} = F_x \Delta x \quad K = \frac{1}{2}mv^2$$

The block starts at x_o = 4.00 m. Measure final velocity near x = 7.00 m, so displacement Δx is about +3.00 m.

Predict before running

If a force opposes a block moving right, can its kinetic energy decrease while remaining positive? Predict and explain.

Part A Compare signed work

1. In Explore this setup, set Block mass to 3.0 kg and Initial horizontal velocity to +4.0 m/s. Test the forces below. Reset between trials.
2. Open Properties → 3 kg block → Live values. Read x and v_x from the first Position and Velocity values.
3. Pause just before x = 7.00 m, then use Step to get close. Record actual x and v_x. Calculate work from your measured displacement.

Force F_x (N)	Final x (m)	Final v_x (m/s)	Net work W (J)
-4.0			
0			
+8.0			

A1. Use two trials to compare the signs of net work and the changes in kinetic energy.

A2. Why does negative net work decrease kinetic energy without making kinetic energy negative in this trial?

Part B Design and collect

Suggested time 16 minutes

Investigation question How does final speed depend on mass for the same force, displacement, and initial velocity?

Choose at least five masses from 1.0 to 6.0 kg, spread across the range. Keep Horizontal applied force at +8.0 N, initial velocity at +4.0 m/s, and final position near 7.00 m.

B1. Identify the independent and dependent variables.

B2. What will you keep constant? How will you do this?

B3. List your masses. Why is this set useful?

B4. How will you measure final velocity at approximately the same displacement in every trial?

B5. Write a procedure another group could follow.

Record your measurements

F_x = +8.0 N Initial v_o = +4.0 m/s Initial x_o = 4.00 m

Trial	Mass m (kg)	Final x (m)	Final v_x (m/s)
1			
2			
3			
4			
5			
Extra			

Part C Build and analyze a linear graph

Suggested time 14 minutes

C1. The relationship is $v_f{}^2 = v_0{}^2 + \frac{2F_x\Delta x}{m}$. Describe how final speed depends on mass when F_x, Δx, and v_0 are fixed.

C2. Choose quantities for a straight-line graph. Label the table with your choices and units, and calculate the transformed values.

Trial	_____ Units _____	_____ Units _____
1		
2		
3		
4		
5		
Extra		

C3. Plot your transformed data and draw a best-fit line. Label both axes with quantities and units.



C4. Find slope and units using two separated points on your fitted line. Use the slope to determine net work. Interpret the intercept.

Part D Explain and predict

Suggested time 8 minutes

D1. A student says, “Negative work means negative kinetic energy.” Evaluate this claim using your opposing-force trial.

D2. Compare your graph-based net work with $F_x\Delta x$. Does changing mass change the work over the same displacement? Explain.

D3. Choose an unused mass within your measured range. Predict final velocity from your fit before running. Measure near x = 7.00 m and compare.

New mass (kg)	Predicted v_x (m/s)	Measured v_x (m/s)

Comparison