

ENERGY DAY 8: CONSERVATION OF ENERGY

🕒 Warm-Up (3 min)

Fill in from memory (no peeking!):

Energy Type	Symbol	Formula
Kinetic		
Gravitational PE		
Elastic PE		

PROBLEM-SOLVING STRATEGY

For every conservation problem:

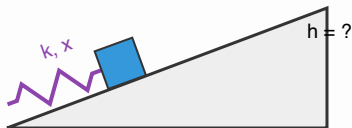
1. **Identify initial and final states.** What's moving? What's stretched? How high?
2. **List energy accounts.** Which types are non-zero at each state?
3. **Write the equation:** $K_i + U_{g,i} + U_{s,i} = K_f + U_{g,f} + U_{s,f}$
4. **Cross out zeros.** (At rest? $K = 0$. On ground? $U_g = 0$. Relaxed spring? $U_s = 0$.)
5. **Solve for the unknown.**

Numbers: use $g = 9.8 \text{ m/s}^2$ throughout.

TYPE 1: SPRING → HEIGHT (FRICTIONLESS)

WE DO Spring Launcher

A spring ($k = 800 \text{ N/m}$) is compressed 0.15 m . A 0.50 kg block is placed against it and released. The block slides up a frictionless ramp. How high does it rise?



Given: $k = 800 \text{ N/m}$, $x = 0.15 \text{ m}$, $m = 0.50 \text{ kg}$

Step 3: Substitute and solve for h

Answer: $h = \underline{\hspace{2cm}} \text{ m}$

Step 1: States

Initial: spring compressed, block at rest, $y = 0$

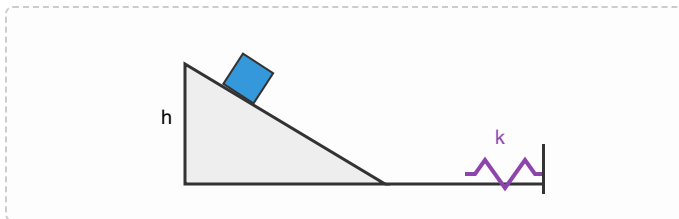
Final: spring relaxed, block at rest, $y = h$

Step 2: Equation

PRACTICE: ENERGY CONVERSIONS (FRICTIONLESS)

WE DO Block Compresses Spring

A 2.0 kg block slides down a frictionless ramp from height $h = 0.80$ m. At the bottom, it collides with a spring ($k = 500$ N/m). How far does the spring compress?



Identify states:

Initial: _____

Final: _____

Write equation:

Given: $m = 2.0$ kg, $h = 0.80$ m, $k = 500$ N/m

Solve for x :

Answer: $x =$ _____ m

YOU DO Practice: Kinetic $\rightarrow$ Height

A ball is thrown straight up with an initial speed of 8.0 m/s. How high does it rise above the release point? (Ignore air resistance.)

Equation:

Calculation:

Answer: $h =$ _____ m

YOU DO Practice: Height + Speed $\rightarrow$ Speed

A 2.0 kg block starts at $h = 1.8$ m with an initial speed of 1.0 m/s down a frictionless ramp. What is its speed at the bottom?

Equation:

Calculation:

Answer: $v =$ _____ m/s

TYPE 3: MULTI-STEP PROBLEMS (FRICTIONLESS)

WE DO The Full Journey

A spring ($k = 600 \text{ N/m}$) is compressed 0.20 m . It launches a 0.40 kg block up a frictionless ramp.

- What is the block's speed just after leaving the spring (before climbing)?
- How high up the ramp does it travel before stopping?

(a) Spring $\rightarrow$ Kinetic

Initial: compressed, at rest. Final: relaxed, moving.

$v = \underline{\hspace{2cm}} \text{ m/s}$

(b) Kinetic $\rightarrow$ Height

Initial: moving at v . Final: at rest, height h .

$h = \underline{\hspace{2cm}} \text{ m}$

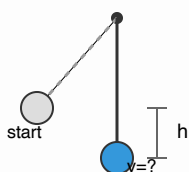
Shortcut: You can skip the middle step! Go directly from U_s to U_g :

$$\frac{1}{2} kx^2 = mgh$$

Try it—you should get the same h .

YOU DO Pendulum Speed

A pendulum bob (mass 0.25 kg) is released from rest when the string makes an angle with vertical such that the bob is 0.40 m above its lowest point. Find the speed at the bottom of the swing.



Solve:

$v = \underline{\hspace{2cm}} \text{ m/s}$

Common Mistake: Students sometimes use the string length instead of the vertical height drop. Only the *vertical* change in position matters for U_g .

HOMEWORK

1 Conservation Check

A 0.20 kg ball is launched by a spring ($k = 500 \text{ N/m}$) compressed 0.08 m up a frictionless ramp.

(a) Speed just after leaving the spring? (b) How high does it rise?

(a) $v =$ _____ m/s (b) $h =$ _____ m

4 Moving Block Hits Spring

A 1.2 kg block sliding at 4.0 m/s on a frictionless floor hits a spring ($k = 600 \text{ N/m}$). How far does it compress?

Answer: $x =$ _____ m

5 Challenge: Multiple Energy Types

A 0.60 kg block at $h = 0.80 \text{ m}$ with initial speed 3.0 m/s slides down a frictionless ramp and compresses a spring ($k = 500 \text{ N/m}$). Find the maximum compression.

Answer: $x =$ _____ m