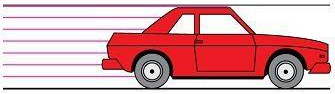
Science 10 Energy Unit Name:_____ Block: ____

CONSERVATION OF ENERGY PROBLEMS

The **law of conservation of energy** is a law of science that states that energy cannot be _____ or _____, but only changed from one _____ into _____ or transferred from one _____ to another.

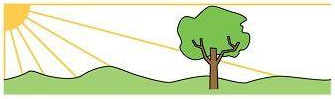
This means that the total energy in a _____ *system* must remain _____, or the total energy ($\mathbf{E_t}$) at any time, must _____ the total energy at any other point in time ($\mathbf{E_t'}$).

$$\mathbf{E_t = E_t'}$$

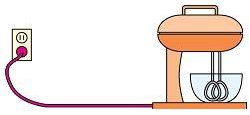


An automobile engine changes chemical energy to mechanical and heat energy.

A thermonuclear reaction changes nuclear energy to radiant and heat energy.

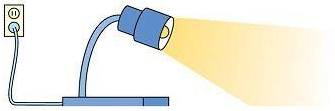


A tree changes radiant energy to chemical energy.



An electric mixer changes electrical energy to mechanical and heat energy.

Hammering a nail changes mechanical energy to deformation and heat energy.



A lamp changes electrical energy to radiant and heat energy.

Note that in a nuclear reaction, mass may be lost and converted to energy according to Einstein's formula $E = mc^2$ where E is energy in joules, m is the mass in kilograms, and c is the speed of light in m/s.

Example Problem:

A ball is thrown upward and reaches a height of 21.0 m above the point of release. What was the velocity of the ball just after being released?

Known Values:

m = ? (sometimes this is not needed, stay tuned…)

h = _____ m

g = _____ N/kg (on Earth)

Unknown Value: _____

Formula:	$E_t = E_t'$	(total energy before = total energy after)
	$\_\_\_\_ = \_\_\_\_'$	(only kinetic E at bottom, only potential E at the top)
	$\frac{1}{2}mv^2 = mgh$	(notice there is an "m" on either side, so divide both sides by m!)
	$\_\_\_\_\_ = \_\_\_\_\_$	(now multiply both sides by 2)
		(now take the square root of both sides)
	=	
	=	(substitute in the data values)
	=	(calculate)
	=	(round off and add the units)

Practice Questions: (Your solutions should be organized similar to the example problem. Show all your steps please. Round to 3 digits)

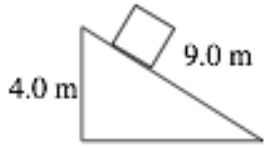
1. A student is dropped. If they reach the floor at a speed of 3.20 m/s, from what height did they fall? (no students were harmed in the making of this problem.)

2. A heavy object is dropped from a vertical height of 8.00 m. What is its speed when it hits the ground?

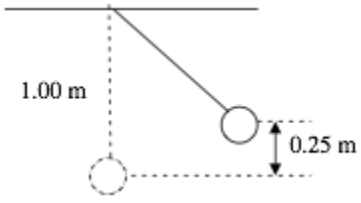
3. A bowling ball is dropped from the top of a building. If it hits the ground with a speed of 37.0 m/s, how tall was the building?

4. A safe is hurled down from the top of a 135 m tall building at a speed of 11.0 m/s. What is its velocity as it hits the ground?

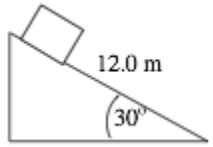
5. A box slides down a frictionless ramp. If it starts at rest, what is its speed at the bottom? (assume the box started at the very top of the ramp)



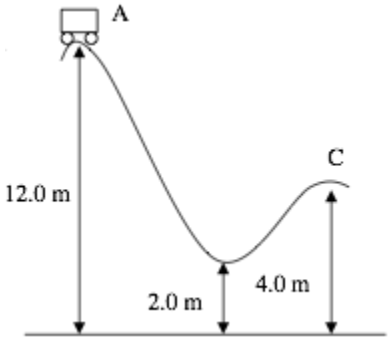
6. A pendulum is dropped from the position shown, 0.250 m above its equilibrium position. What is the speed of the pendulum bob as it passes through its equilibrium position?



7. A box slides down a frictionless incline as shown. If the box starts from rest, what is its speed at the bottom? (assume the box started at the very top of the ramp)



8. A roller coaster car starts from rest at point A. What is its speed at point C if the track is frictionless?



9. The roller coaster shown above has a mass of 525 kg and is travelling at 2.10 m/s at point A, and is later travelling at 12.7 m/s at the lowest point. How much energy was lost to heat on the trip down?

10. An 80.0 kg student running at 3.50 m/s grabs a rope that is hanging vertically. How high will the student swing?