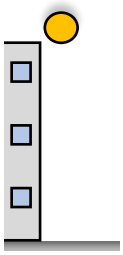
CONCEPT: CONSERVATION OF MECHANICAL ENERGY

● Mechanical Energy (**ME**) of a system is simply the _____ of Kinetic (**K**) & Potential (**U**) energy: $ME = K + U$

EXAMPLE: You drop a 2kg ball from the top of a 100m building. Calculate the ball's total Mechanical Energy **a)** at the top of the building and then **b)** at the moment right before it hits the ground.



Energy
$K = \frac{1}{2}mv^2$
$U_g = mgy$

UAM Equations
(1) $v = v_0 + at$
(2) $v^2 = {v_0}^2 + 2a\Delta x$
(3) $\Delta x = v_0 t + \frac{1}{2}at^2$
(4) $\Delta x = \left(\frac{v+v_0}{2}\right)t$

● When a system's **M.E.** is transferred between potential & kinetic energy *without loss*, we say it is _____:

…which we will always write as:

_____ = _____

_____ = _____

(Conservation of Mechanical Energy)

EXAMPLE: You drop a ball of unknown mass from the top of a 50m building. Use **Conservation of Energy** to determine the speed of the ball right before it hits the ground.

CONSERVATION OF ENERGY
1) Draw Diagram
2) Write Cons. of Energy EQ
3) Eliminate & expand terms
4) Solve

PROBLEM: You launch a 4kg object directly up from the ground with an initial 40m/s. Use Energy Conservation to find the maximum height the object reaches. Ignore air resistance.

CONSERVATION OF ENERGY

1) Draw Diagram
2) Write Cons. of Energy EQ
3) Eliminate & expand terms
4) Solve

PROBLEM: You throw a 6kg object down from a height of 20m. If the object reaches the ground with 30m/s, calculate the initial speed you threw it with.

CONSERVATION OF ENERGY

1) Draw Diagram
2) Write Cons. of Energy EQ
3) Eliminate & expand terms
4) Solve

UAM Equations

(1) $\boldsymbol{v = v_0 + at}$
(2) $\boldsymbol{v^2 = {v_0}^2 + 2a\Delta x}$
(3) $\boldsymbol{\Delta x = v_0 t + \frac{1}{2}at^2}$
(4) $\boldsymbol{\Delta x = \left(\frac{v+v_0}{2}\right)t}$

PROBLEM: You launch a ball directly upward from the ground. The ball is going up with 20m/s at 30m from the ground. **a)** Calculate the launch speed. **b)** Calculate its maximum height.

CONSERVATION OF ENERGY
1) Draw Diagram **2)** Write Cons. of Energy EQ **3)** Eliminate & expand terms **4)** Solve

● Some problems give more than TWO points. The 2 points you pick should be the **GIVEN** & **TARGET** (known & unknown)

CONCEPT: CONSERVATION OF TOTAL ENERGY AND ISOLATED SYSTEMS

TOTAL ENERGY			
Mechanical Energy			Non-Mech. Energy
Kinetic	Potential		Thermal (friction) + all other types
	Elastic	Grav.	

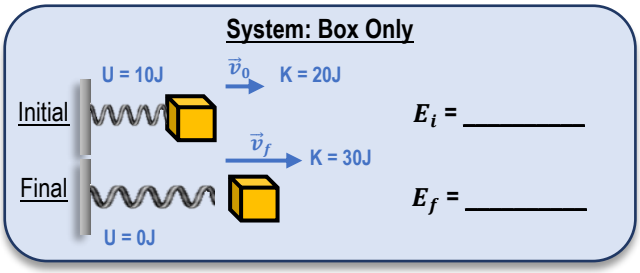
- There are 2 conceptual rules explaining when Energy is conserved:

1) The **TOTAL** Energy of a system is **conserved** if the system is _____

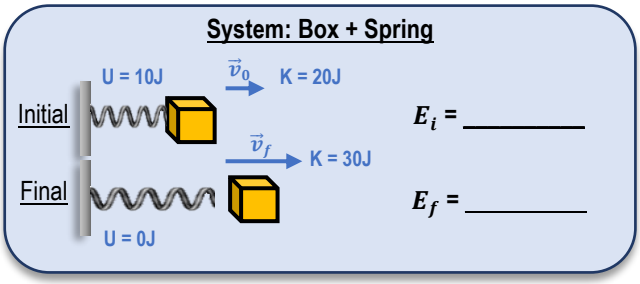
- A *system* is a _____ of objects that is CHOSEN (by you or the problem).
- A system is **ISOLATED** if NO External forces do work and ONLY Internal forces do work.
- *External* Forces are **[inside | outside]** of system. If ANY Net Force is external, system is **[isolated | not isolated]**
- *Internal* Forces are **[inside | outside]** of system. If ALL Forces are internal, system is **[isolated | not isolated]**

EXAMPLE: A spring pushes a box, and it accelerates. Determine whether the **(i)** forces are internal, **(ii)** system is isolated, and **(iii)** Total Energy of the system is conserved if the system is defined as **a)** only the box; **b)** the box AND the spring.

a)



b)

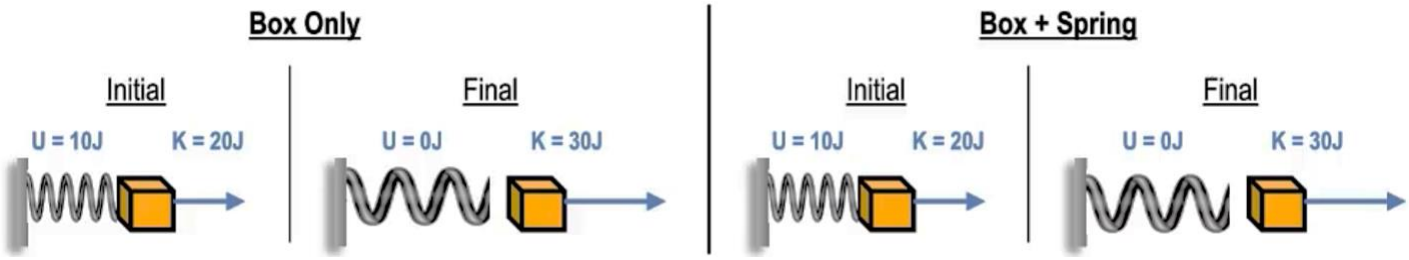


All Forces internal?	System Isolated?	Total Energy Conserved?
		E_i ____ E_f
		E_i ____ E_f

CONCEPT: SYSTEMS AND CONSERVATIVE VS. NON-CONSERVATIVE FORCES

● Conservation of Energy often refers to a _____ of objects that is CHOSEN.

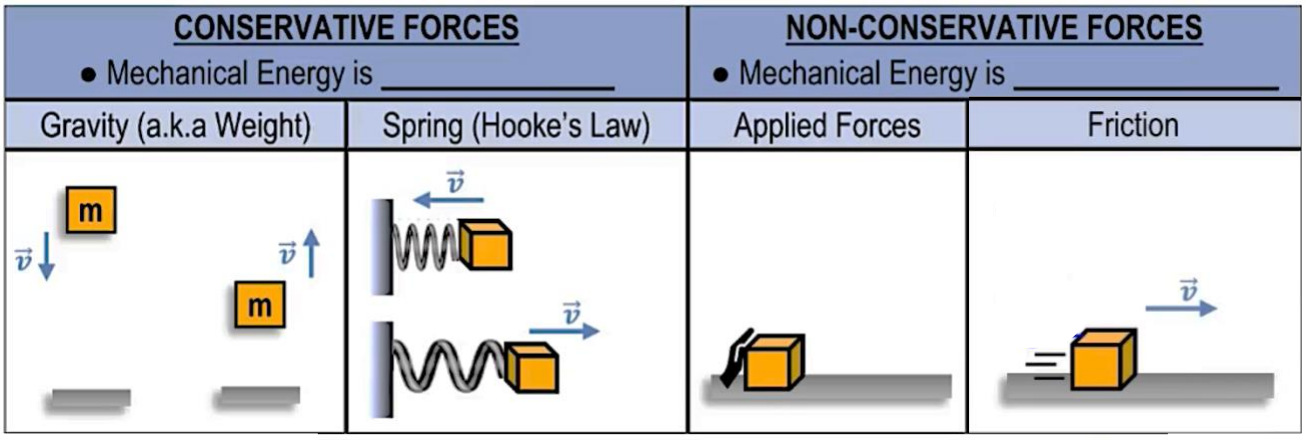
EXAMPLE: Consider spring pushing a box. Determine whether the Mechanical Energy of the system is conserved if the system is defined as **a)** only the box; **b)** the box AND the spring.



● **Mech. Energy** in a system is **CONSERVED** if the *ONLY* forces doing work are _____ Forces. (_____ **= 0**)

EXAMPLE: For each of the situations below: **(i)** Is the mechanical energy conserved? **(ii)** Describe the energy transfers.

SITUATION	Energy Conserved?	Energy Transfers
(a) A block falls without air resistance		
(b) A moving block hits a spring, deforms it, and rebounds		
(c) You push a block at rest, and it accelerates to the right		
(d) A moving block slows due to friction		



● Conservative Forces are "_____", meaning you can "undo" the action and get any lost energy back.