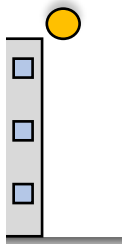


CONCEPT: CONSERVATION OF MECHANICAL ENERGY

- 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 _____:

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

...which we will always write as:

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

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

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

- | |
|--|
| <ol style="list-style-type: none">1) Draw Diagram2) Write Cons. of Energy EQ3) Eliminate & expand terms4) 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

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

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

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) **System: Box Only**

Initial: $U = 10\text{J}$, $K = 0\text{J}$, $\vec{v}_0 = 0$

Final: $U = 0\text{J}$, $K = 30\text{J}$, $\vec{v}_f$

$E_i = \underline{\hspace{2cm}}$

$E_f = \underline{\hspace{2cm}}$

b) **System: Box + Spring**

Initial: $U = 10\text{J}$, $K = 0\text{J}$, $\vec{v}_0 = 0$

Final: $U = 0\text{J}$, $K = 30\text{J}$, $\vec{v}_f$

$E_i = \underline{\hspace{2cm}}$

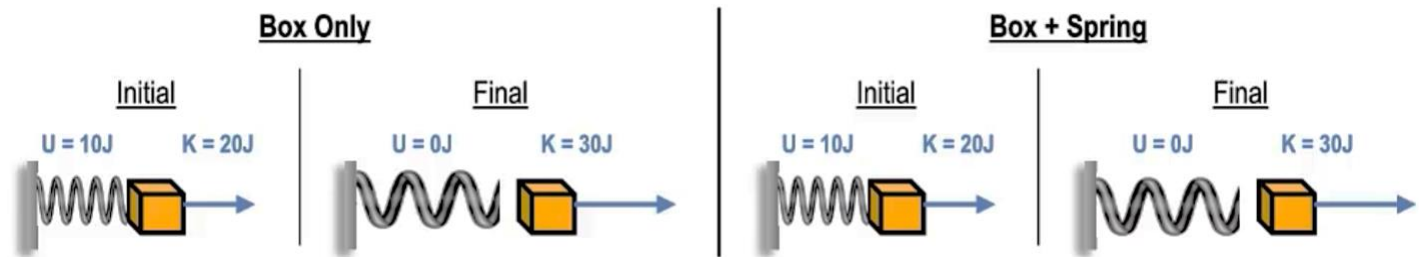
$E_f = \underline{\hspace{2cm}}$

All Forces internal?	System Isolated?	Total Energy Conserved?
		$E_i \underline{\hspace{1cm}} E_f$
		$E_i \underline{\hspace{1cm}} E_f$

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		NON-CONSERVATIVE FORCES	
• Mechanical Energy is _____		• Mechanical Energy is _____	
Gravity (a.k.a Weight)	Spring (Hooke's Law)	Applied Forces	Friction

- Conservative Forces are “_____”, meaning you can “undo” the action and get any lost energy back.