

Potential Energy 7.4 & 7.5

Madison Jayes & Kinsey Yow

7.4-

Definitions:

Conservative Force: a force for which work done by or against it depends only on the starting and ending points of a motion and not on the path taken. RESULTS IN POTENTIAL ENERGY!

Potential Energy (PE): Stored energy (recoverable), Any conservative force.



Deriving of Formula for Potential Energy of a Spring:

PE_s → Potential Energy in spring (Stretched/compressed)

Formula is derived from **Hooke's law**: states magnitude of force F on spring and resulting deformation ΔL are proportional. Resulting in the formula $F=k\Delta L$

BOARD WORK!

Final Equation → $PE=1/2kx^2$

x = Displacement from undeformed position

k = springs force constant



Deriving Formula of Conservation of Mechanical Energy

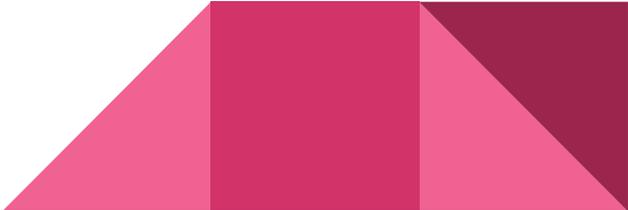
Mechanical Energy: total KE plus total PE ($\Delta KE + \Delta PE$)

Work Energy Theorem: net work done by all forces acting on a system is equal to change in kinetic energy.

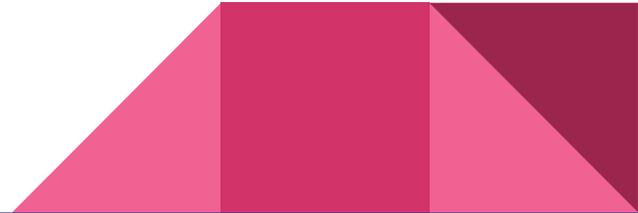
Formula $\rightarrow W_{\text{net}} = 1/2mv^2 - 1/2mv_0^2 = \Delta KE$

BOARD WORK!

Remember! Friction doesn't apply to this equation!

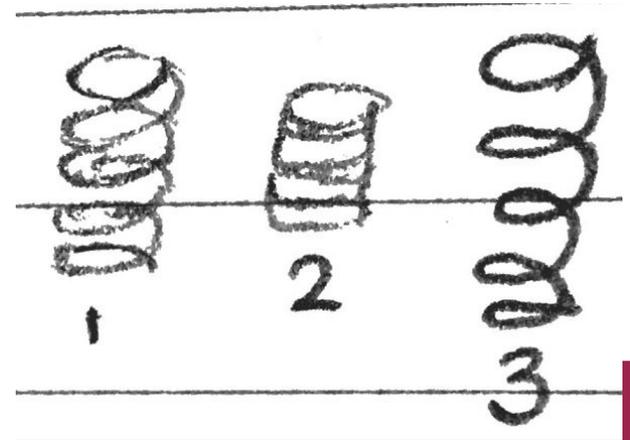
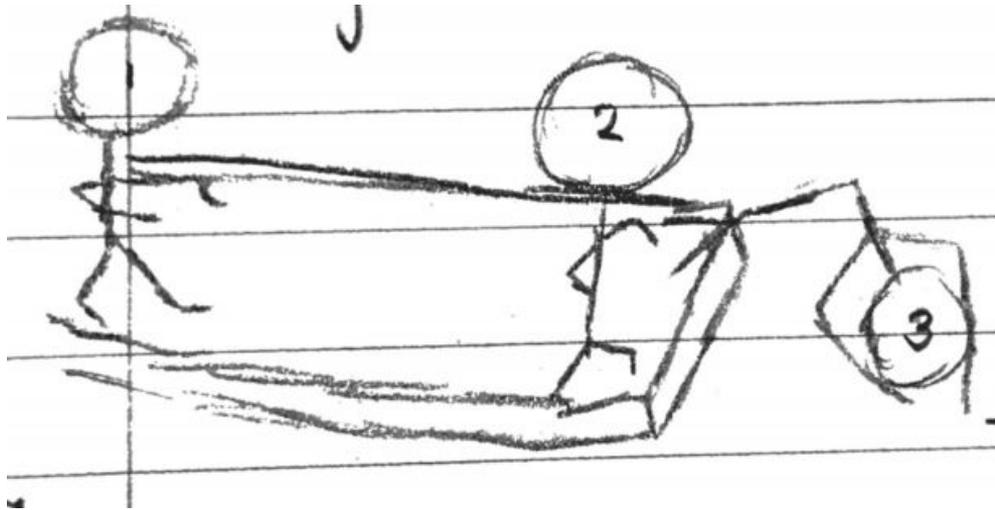


LAB



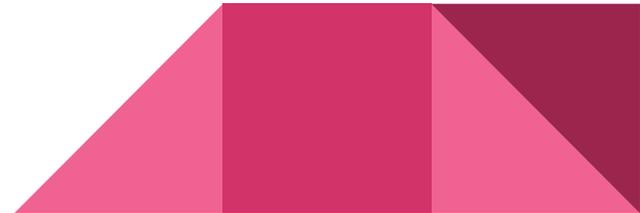
7.4 HOMEWORK

10.) The force exerted by a diving board is CONSERVATIVE. Assuming friction is negligible, describe changes in the potential energy of a diving board as a swimmer dives from it, starting just before the swimmer steps on the board until just after his feet leave it.



ANSWER

10.) At point 1, when the swimmer steps onto the board, the PE is incredibly small. The farther he walks out onto the diving board, the greater the PE of the spring becomes, because the displacement of the spring is increasing due to the weight of the diver. Therefore, at point 2, the PE of the spring is at its greatest, and as soon as the diver's feet leave the board, point 3, all the potential energy is transformed into kinetic energy, propelling the diver into the air.

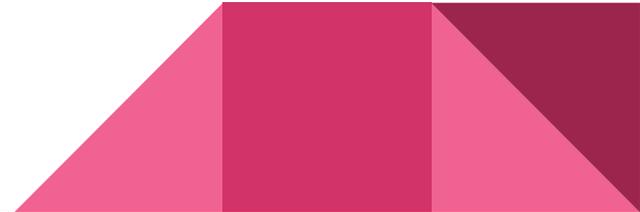


HOMEWORK

22.) A 5.00×10^5 kg subway train is brought to a stop from a speed of .500 m/s in .400 m by a large spring bumper at the end of its track. What is the force constant k of the spring?

BOARD WORK!

Answer: 7.812×10^5 N/m



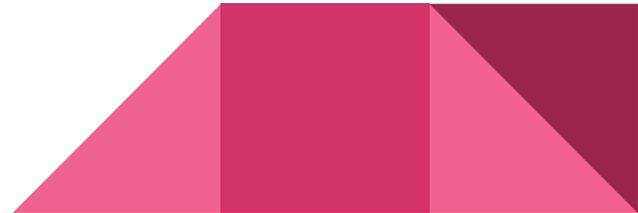


7.5

Nonconservative Forces

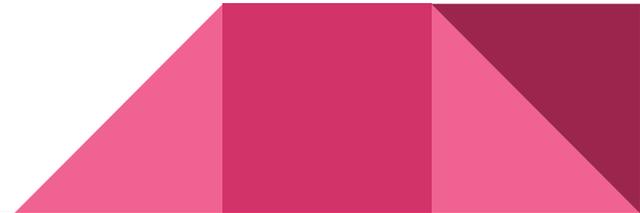
Nonconservative Forces or Friction

- **Force:** can be either conservative or nonconservative
- **Nonconservative force:** a force that depends on the path taken and does not store energy, there is no potential energy associated with a nonconservative force
 - $W_{nc} = \Delta KE + \Delta PE$
- **Friction:** depends on the length of the path between the starting and ending endpoints of a path



Nonconservative forces affect mechanical energy

- Mechanical energy may not be conserved when nonconservative forces act
 - When a Car is brought to a stop by friction on level ground, it loses kinetic energy, which is dissipated by thermal energy, reducing its mechanical energy
- Nonconservative force = Δ Mechanical Energy
- $W_{\text{net}} = \Delta$ KE
 - $W_{\text{net}} = W_{\text{nc}} + W_{\text{c}}$
 - $W_{\text{nc}} + W_{\text{c}} = \Delta$ KE



Conservation Of Mechanical Energy

The amount of work done by Nonconservative Energy adds up to Mechanical Energy so if...

W_{nc} increases ME increases

W_{nc} decreases ME decreases

W_{nc} equals 0 ME is conserved and Non Conservative Force is balanced



Applying Energy Conservation with Nonconsecutive Force

In order to conserve Mechanical Energy use:

$$KE_i + PE_i + W_{nc} = KE_f + PE_f \rightarrow$$

This means the amount of work done by NC forces adds up to ME of a system



7.5 Homework

25.

- a. How high a hill can a car coast up (engine disengaged) if work done by friction is negligible and its initial speed is 110 km/h?
- b. If, in actuality, a 750-kg car with an initial speed of 110 km/h is observed to coast up a hill to a height 22.0 m above its starting point, how much thermal energy was generated by friction?
- c. What is the average force of friction if the hill was a slope 2.5 degrees above the horizontal?

