Gravitational Potential Energy

POWER

- Potential Energy – possibility of doing work
  - Energy based on vertical height above the *ground

- *Work must be done (by you) to lift an object a height (h) into the air

Me

$W = F \cdot d \cdot \cos\theta$

$W = mg \cdot h \cdot \cos 0^\circ$

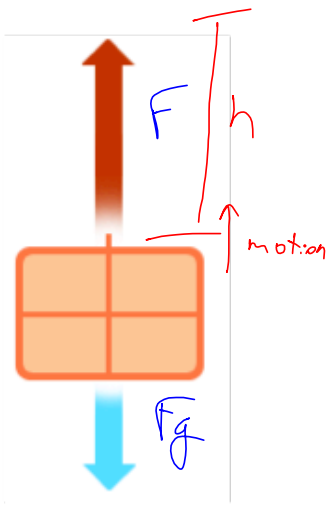
$W = m(9.8)h$

$W = mgh$

Work done by me = Energy gained by Object

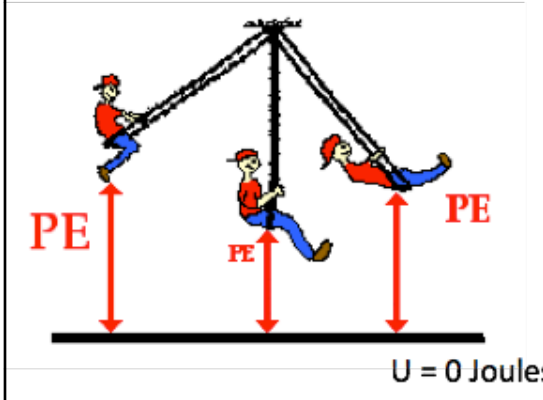
$U = mgh$ (9.8)

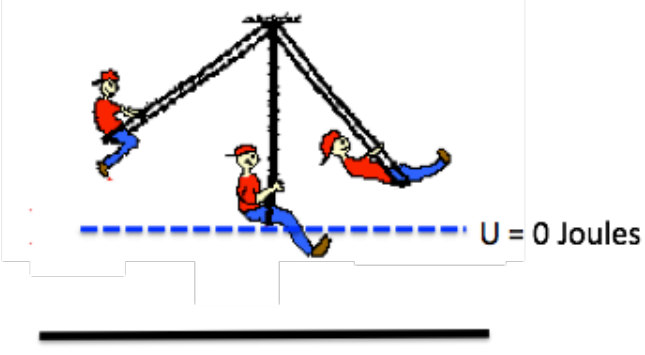
$KE = \frac{1}{2}mv^2$



Gravitational Potential Energy

- Where U = 0 J
  - Without specific guidelines, this can be where ever you want, but **be consistent**!





Conservative vs Non-Conservative Forces

- Does the path taken matter considering energy?

No	Yes
Gravitational	Friction
*Elastic & Electric	Air Resistance
	Tension
	Motor or rocket propulsion

*All conservative forces have a potential energy included

Conservation of Energy

- **If there is no loss of energy (no non-conservative forces)**
  - Mechanical Energy (KE + U) stays constant
  - $Energy_{end} = Energy_{beginning}$

    $KE_f + U_f = KE_o + U_o$
- **If energy is 'lost' (there are non-conservative forces)**
  - $Energy_{end} = Energy_{beginning} - W_{non\text{-}conservative\ forces}$
  - $KE_f + U_f = KE_o + U_o - W_{friction}$ $F \cdot d \cdot \cos\theta$
- **Law of Conservation of Energy:**
  - Energy is neither created nor destroyed, just transferred or transformed from one kind to another

Conservation of Energy

- Another Proof
  - $W_{NC} = \Delta KE + \Delta U$

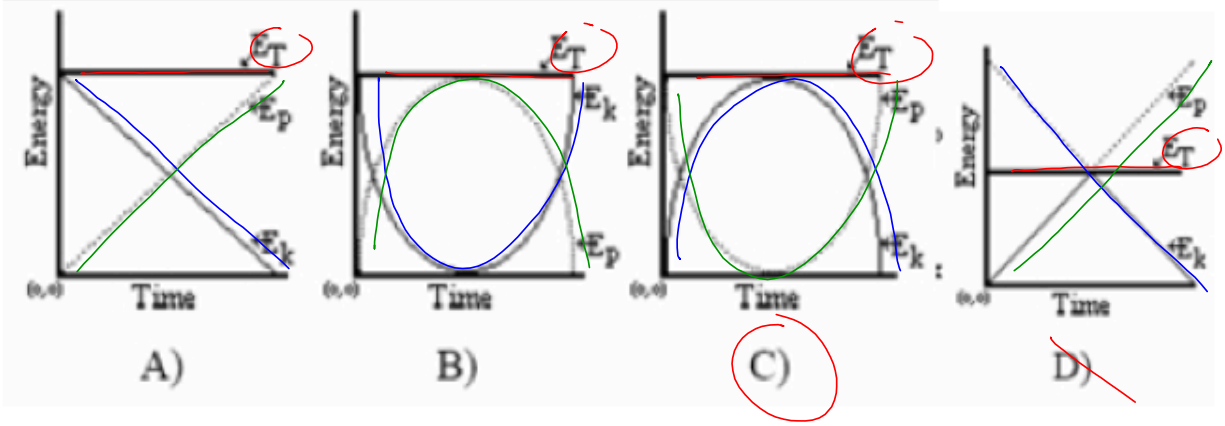
If $W_{NC} = 0$ J

If $W_{NC} \neq 0$ J

Example 10

POWER

A pendulum is pulled to one side and released. It swings freely to the opposite side and stops. Which of the following might best represent graphs of kinetic energy (E_k), potential energy (E_p) and total mechanical energy(E_T)



Example 11

[Multiple correct answers] A football is kicked off the ground a distance of 50 yards downfield. Neglecting air resistance, which of the following statements would be INCORRECT when the football reaches the highest point?

*FIND 2 incorrect

A. *All of the balls original kinetic energy has been changed into potential energy FALSE

B. The ball's horizontal velocity is the same as when it left the kickers foot true

C. The ball will have been in the air one-half of its total flight time true

D. The vertical component of the velocity is equal to zero true

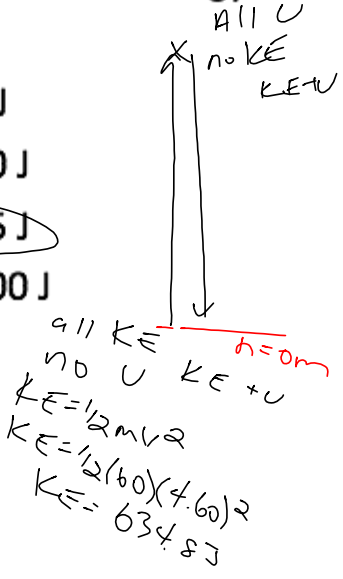
E. The acceleration of the ball is equal to 0 m/s^2 $a = -9.8\ m/s^2$

Example 12

POWER

A 60.0 kg clay ball is tossed vertically upward in the air with an initial velocity 4.6 m/s. Ignoring air resistance, what is the change in the ball's potential energy when it reaches the highest point?

A. 0 J
B. 45 J
C. 280 J
D. 635 J
E. 2700 J



$\Delta U = 634.8 - 0$

Example 13

POWER

A pendulum bob of mass m on a cord of length L is pulled sideways until the cord makes an angle θ with the vertical as shown in the figure to the right. The change in potential energy of the bob during the displacement is:

$\Delta U = U_f - 0$

$\Delta U = U_f$

$\Delta U = mgh$

$\Delta U = mgL(1-\cos\theta)$ $\cos\theta = \frac{x}{L}$

$x = L \cdot \cos\theta$

A. $mgL(1-\cos\theta)$

B. $mgL(1-\sin\theta)$

C. $mgL\sin\theta$

D. $mgL\cos\theta$

E. $2mgL(1-\sin\theta)$