Work & Energy

Energy = capacity to do "work"

What is "work" in physics? Very simple definition:

\[ W = F \cdot d \]

If you move a mass \( m \) a distance \( d \) with force \( F \) \( \Rightarrow \) work = \( F \cdot d \)

Units? \( \text{m} \cdot \text{N} = \text{Joule} (\text{J}) \)

English \( \text{lb} \cdot \text{ft} \)

cgs \( \text{dyne} \cdot \text{cm} = \text{erg} \)

Work can result in several outcomes:

1. acceleration \( \Rightarrow \) kinetic energy, energy of motion
2. storage \( \Rightarrow \) potential energy
3. heat \( \Rightarrow \) thermal energy

Examples of each?
Gravitational Potential Energy

Lift a mass a height $h$ at constant speed
$$\Rightarrow F = mg \Rightarrow W = mgh \text{ done by you}$$
$$\Rightarrow \text{potential energy change } \Delta U = mgh$$

Kinetic Energy

Now drop the mass from height $h$.
At bottom $h = \frac{1}{2} g t^2$ (started at rest)

But also $v = gt \Rightarrow t = \frac{v}{g}$

$$\Rightarrow h = \frac{1}{2} g \left( \frac{v}{g} \right)^2 = \frac{1}{2} \frac{v^2}{g}$$

Kinetic energy at bottom = Potential Energy at top
$$V = mgh = mg \frac{1}{2} \frac{v^2}{g} = \frac{1}{2} mv^2 = K$$

$K = \text{energy of motion} = \frac{1}{2} \text{mv}^2$

Energy cannot be created or destroyed, only transferred or transformed.

Q: What happens when mass hits bottom?