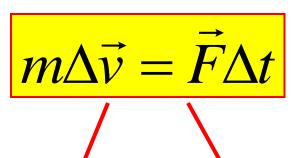
## **Conservation Laws**

2<sup>nd</sup> Newton's Law



Only conservative forces:

**Energy conservation** 

$$K + U = const$$

## Mo external forces: Momemtum conservation

$$\vec{p}_1 + \vec{p}_2 + \dots + \vec{p}_n = const$$

## **Examples of Potential Energy, U:**

Earth gravity, 
$$F = -mg$$
:  $U(x) =$ 

Hooke's spring, 
$$F = -kx$$
:  $U(x) = \frac{kx^2}{2}$ 

## Homework

A bullet of mass  $\mathbf{m}$  that moves horizontally with speed  $\mathbf{v}$ , hits boxer's punch bag that is hang up from the sealing. The punch bag has mass  $\mathbf{M}$ , and bullets gets stuck in it. As a result, the punch bag starts moving as a pendulum. Find the maximum height  $\Delta \mathbf{h}$  which it will reach, with respect to its initial position.

Hint: you need to split the problem onto two parts: momentum is conserved in one part, and energy in the other.

