

Conservation Laws

2nd Newton's Law

$$m\Delta\vec{v} = \vec{F}\Delta t$$

Only conservative forces:
Energy conservation

$$K + U = \text{const}$$

Mo external forces:
Momemtum conservation

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

Examples of Potential Energy, U:

$$\text{Earth gravity, } F = -mg : \quad U(x) = mgx$$

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

Homework

A bullet of mass m that moves horizontally with speed v , hits boxer's punch bag that is hang up from the ceiling. The punch bag has mass M , and bullet gets stuck in it. As a result, the punch bag starts moving as a pendulum. Find the maximum height Δh 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.

