

## CHAPTER 11

## Energy and Its Conservation

**BIG IDEA** Within a closed, isolated system, energy can change form, but the total energy is constant.

## SECTIONS

1 The Many Forms of Energy

2 Conservation of Energy

Forces that do not store energy are called **nonconservative** or dissipative forces.

**Conservative:** Gravitational Force, Elastic Force, Magnetic Force, Electrostatic Force.

**Nonconservative:** Friction Force, Applied or External Force, Tension, Normal

Theorem: Work and Kinetic Energy

$$W = F \cdot \Delta X$$

$$F = m \cdot a$$

$$W = m \cdot a \cdot \Delta X$$

$$V^2 = V_0^2 + 2a \Delta X$$

$$W = m \cdot a \cdot \frac{V^2 - V_0^2}{2a}$$

$$\frac{V^2 - V_0^2}{2a} = \Delta X$$

$$W = \frac{1}{2} m V^2 - \frac{1}{2} m V_0^2$$

$$\frac{1}{2} m V^2 = K \text{ (Kinetic Energy)}$$

$$W = K - K_0$$

$$W = \Delta K$$

Work done by  $\left\{ \begin{array}{l} \text{Conservative} \\ \text{None conservative} \\ \text{FORCES} \end{array} \right.$

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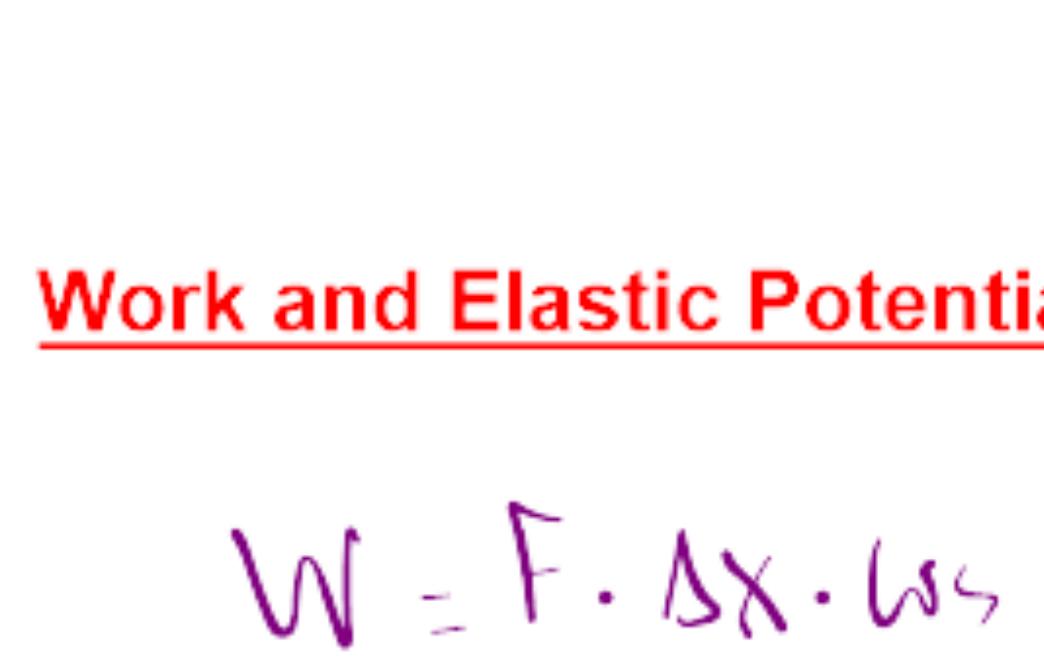
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## Work and Elastic Potential Energy

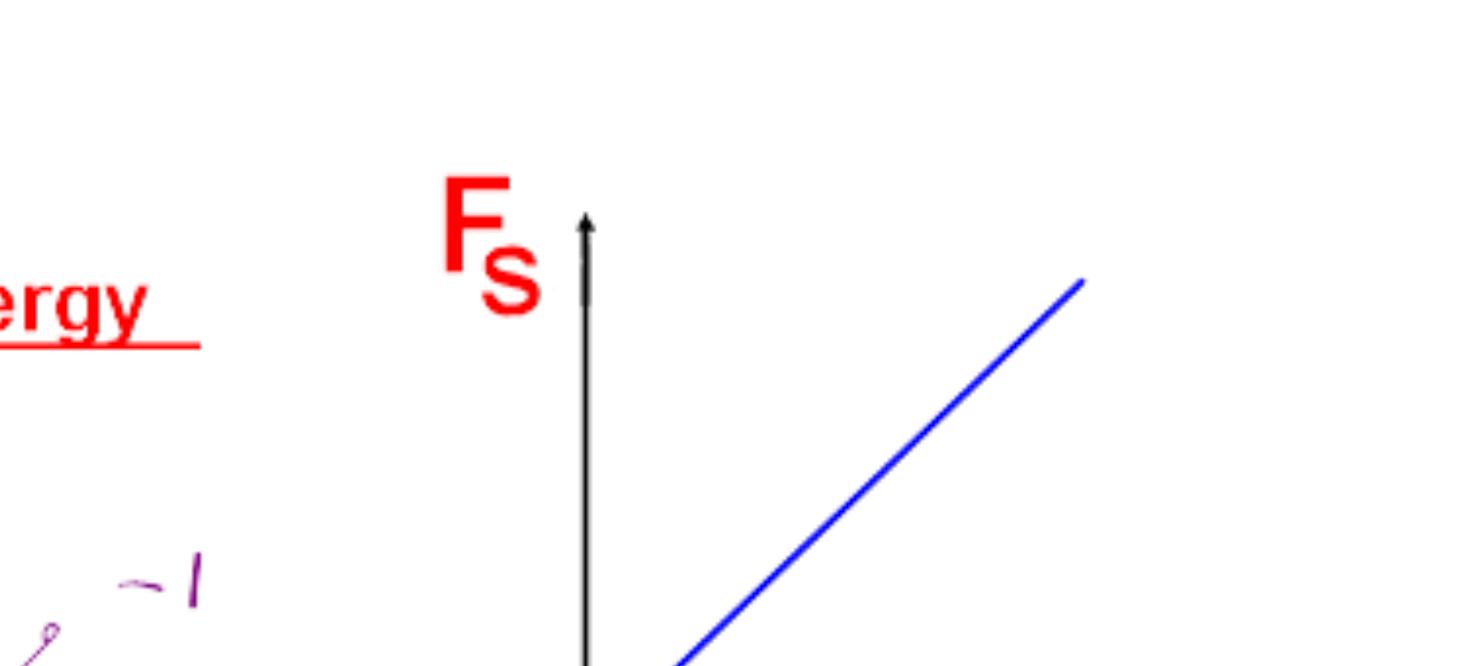


$$F_s = Kx$$

$$K = \frac{\Delta F}{\Delta X} = \frac{(7.8 - 0) \text{ N}}{(0.620 - 0.157) \text{ m}}$$

spring (or Elastic Force)  
Force

## Spring Constant From Graph



$$K = 16.8 \frac{\text{N}}{\text{m}}$$

spring  
constant

## Work and Elastic Potential Energy

$$W = F \cdot \Delta X \cdot \cos \theta$$

$$W_{F_s} = F_s \cdot \Delta X \cdot \cos(180^\circ)$$

$$W_{F_s} = -K \cdot \Delta X \cdot \Delta X$$

$$W_{F_s} = -\frac{1}{2} K \Delta X^2$$

$$W_{F_s} = -\Delta U_s$$

## Hooke's Law Lab

$$F_s = K \Delta X$$

$F_s$  elastic force

$$\text{The factor } \frac{1}{2} \Delta X^2 = U_s$$

Elastic  
Potential  
Energy !!



$$W_{\text{net}} = W_c + W_{\text{nc}} = K$$

$$W_{F_g} = -\Delta U_g$$

$$W_{F_s} = -\Delta U_s$$

$$-\Delta U + W_{\text{nc}} = \Delta K$$

$$W_{\text{nc}} = \Delta K + \Delta U$$

$$E = K + U$$

$$W_{\text{nc}} = \Delta E$$