11.1 Potential Energy and the Work Done by Conservative Forces

**Announcements**

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**Potential Energy and the Work Done by Conservative Forces**

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<th>Learning Target</th>
<th>Description</th>
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<td>11.1</td>
<td>I can define, analyze, and solve problems involving potential energy and the work done by conservative forces.</td>
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**Conservative vs. Nonconservative Forces**

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<th>NONCONSERVATIVE FORCES</th>
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<td>• Work is stored in the form of energy that can be released at later time.</td>
<td>• Work cannot be recovered later as kinetic energy. Instead, it is converted to other forms of energy.</td>
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**Examples**

- Gravity & Springs
- Friction, Tension, Muscles

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**Energy**

The ability to do work.

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**Energy and Ice Cream**
11.1 Potential Energy and the Work Done by Conservative Forces

**Kinetic Energy**

\[ KE = \frac{1}{2} m v^2 \]

**Potential Energy**

Potential Energy \( U \) is a storage system for energy.

\[ \Delta U_g = mgh \]

**Gravitational Potential Energy**

Gravitational Potential Energy depends on weight and height, \( h \), but it is independent of horizontal position.
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Springs and Bungees

Because springs, and bungee cords, exert conservative forces, they can serve as energy storage devices.

Work Done By a Spring

Hooke’s Law

\[ F = kx \]

Work Done by a Spring

\[ W = \frac{1}{2} kx^2 \]

Potential Energy for a Spring

\[ U_s = \frac{1}{2} kx^2 \]

POTENTIAL IN-CLASS PROBLEMS

1. An 82.0 kg mountain climber is in the final stage of the ascent of 4301-m-high Pikes Peak. What is the change in gravitational potential energy as the climber gains the last 100.0 m of altitude?

\[ \Delta U_g = mgh = (82 \text{ kg})(9.8 \text{ m/s}^2)(100 \text{ m}) \]
\[ \Delta U_g = 80,400 \text{ J} \]

Pike’s Peak or Bust

An 82.0 kg mountain climber is in the final stage of the ascent of 4301-m-high Pikes Peak. What is the change in gravitational potential energy as the climber gains the last 100.0 m of altitude?

\[ \Delta U_g = mgh \]
\[ \Delta U_g = (82 \text{ kg})(9.8 \text{ m/s}^2)(100 \text{ m}) \]
\[ \Delta U_g = 80,400 \text{ J} \]
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PHYSICS 1

February 25, 2019

POTENTIAL IN-CLASS PROBLEMS

2. Find the potential energy of a spring with force constant \( k = 680 \text{ N/m} \) if it is (a) stretched by 5.00 cm or (b) compressed by 10.00 cm.

   a) \( \Delta U_s = \frac{1}{2} k x^2 \)
      \( \Delta U_s = \frac{1}{2} (680 \text{ N/m})(0.05 \text{ m})^2 \)
      \( \Delta U_s = 0.85 \text{ J} \)

   b) \( \Delta U_s = \frac{1}{2} k x^2 \)
      \( \Delta U_s = \frac{1}{2} (680 \text{ N/m})(0.10 \text{ m})^2 \)
      \( \Delta U_s = 3.4 \text{ J} \)

3. When a force of 120.0 N is applied to a certain spring, it causes a stretch of 2.25 cm. What is the potential energy of this spring when it is compressed by 3.50 cm?

   \( F = k x \)
   \( F / x = k \)
   \( 5330 \text{ N/m} = k \)
   \( \Delta U_s = \frac{1}{2} k x^2 \)
   \( \Delta U_s = \frac{1}{2} (5330 \text{ N/m})(0.035 \text{ m})^2 \)
   \( \Delta U_s = 3.26 \text{ J} \)

Application

PROBLEMS (1-5)