Edgenuity

Warm-Up | Potential Energy

Lesson Question

What is the relationship between potential energy and the position of an object?

Lesson Goals

Explore the concept of potential energy.

Describe gravitational and [elastic] forms of potential energy.

Identify the relationships among potential energy, mass, and displacement.

Calculate gravitational and elastic [potential] energy.

Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

elastic potential energy	the energy stored in a [compressed] or stretched object
gravitational potential energy	the energy stored in an object due to its position in a [gravitational] field
potential energy	the stored energy an object or particle has due to its [position]
spring constant	the measure of a spring's [resistance] to being compressed or stretched

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Work

- Work is the use of [force] to move an object.
  - Work is equal to force times displacement.
    - $W =$ [Fd]
  - Work is equal to the change in kinetic energy.
    - $W = \Delta KE = \frac{1}{2}mv^2$

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Potential Energy

- The stored energy an object has due to its [position] is known as **potential energy**.
  - [Stored] energy has the potential to do work.

Gravitational Potential Energy

- **Gravitational potential energy** is the stored energy of a mass due to its [height] above a reference position.

$PE_g = mgh$

- An object's gravitational potential energy is equal to the work required to [lift] the object.

Now, changing the height of an object always changes its gravitational potential energy.

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Rearrangements of Gravitational Potential Energy Formula

To find…	…use the formula…	… you must already know…
potential energy	$PE_g =$ [mgh]	mass and height
mass	$m =$ [$\frac{PE_g}{gh}$]	height and potential energy
height	$h = \frac{PE_g}{mg}$	[mass] and potential energy

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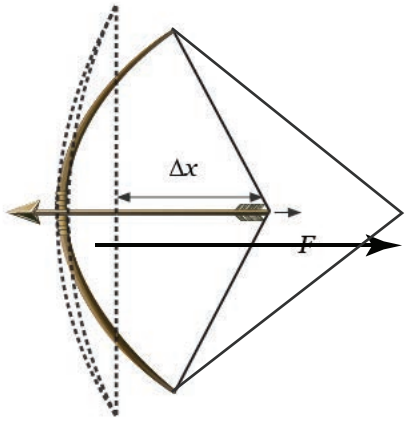
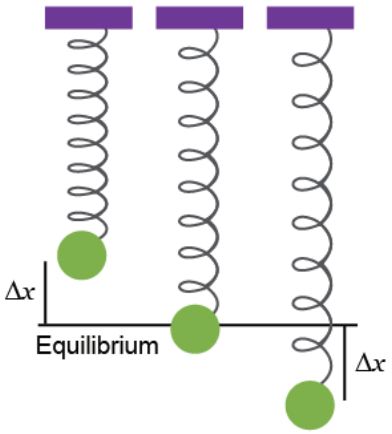
Elastic Potential Energy

- The potential energy stored in a [compressed] or stretched object is known as **elastic potential energy**.
  - Pulling the string back requires work.
  - The greater the distance the archer pulls back, the [more] work is done.
  - This work is now stored in the form of elastic potential energy.



Springs

- Every spring has an equilibrium position where the net force acting on the spring is [zero].
- Every spring has its own **spring constant**.
  - The spring constant, *k*, is a measure of a spring's resistance to being compressed or [stretched].



Elastic Potential Energy

- The elastic potential energy of a spring is affected by:
  - the spring constant.
    - The higher the spring constant, the [higher] the elastic potential energy.
  - the displacement.
    - The [greater] the displacement, the higher the elastic potential energy.

$$PE_e = \frac{1}{2}kx^2$$

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To find…	…use the formula…	… you must already know…
potential energy	$PE_e = \frac{1}{2}kx^2$	spring constant and displacement
spring constant	$k =$ $\frac{2PE_e}{x^2}$	potential energy and displacement
displacement	$x =$ $\sqrt{\frac{2PE_e}{k}}$	potential energy and spring constant

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How to Determine Height

EXAMPLE

A spring with a spring constant of 12,000 N/m is compressed 10 cm. A 2-kg ball is placed on top of the spring, then the spring is released. How high will the ball rise?

- Given:
  - $k = 12{,}000\ \frac{\text{N}}{\text{m}}$
  - $x = 10\ \text{cm} = 0.1\ \text{m}$
  - $m = 2\ \text{kg}$
- Unknown: h
  - Formula: $mgh = \frac{1}{2}kx^2$

$$h = \frac{kx^2}{2\,mg}$$

$$h = \frac{12{,}000\ \text{N/m} \times (0.1\ \text{m})^2}{2 \times 2\text{kg} \times 9.8\ \text{m/s}^2}$$

$$h = \frac{120\ \text{Nm}}{39.2\ \text{N}}$$

$$h = 3.1\ \text{m}$$

Summary | Potential Energy

Lesson Question

What is the relationship between potential energy and the position of an object?

Answer

(Sample answer) The potential energy of an object increases with the increase of its displacement from a specified point of origin. For example, the higher a ball is from the ground, the larger the potential energy it possesses.

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Review: Key Concepts

Potential energy is the stored energy an object or particle has due to its [position].

Term	Definition	Formula	Unit
[gravitational] potential energy	the energy stored in an object due to its position in a gravitational field	$PE_g = mgh$	[joule] (J)
[elastic] potential energy	the energy stored in a compressed or stretched object	$PE_e = \frac{1}{2}kx^2$	joule (J)

Summary | Potential Energy

Use this space to write any questions or thoughts about this lesson.