Potential Energy

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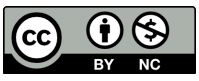

CHAPTER 1 Potential Energy

This diver has just jumped up from the end of the diving board. After she dives down and is falling toward the water, she'll have kinetic energy, or the energy of moving matter. But even as she is momentarily stopped high above the water, she has energy. Do you know why?

Stored Energy

The diver has energy because of her position high above the pool. The type of energy she has is called potential energy. **Potential energy** is energy that is stored in a person or object. Often, the person or object has potential energy because of its position or shape.

Q: What is it about the diver's position that gives her potential energy?

A: Because the diver is high above the water, she has the potential to fall toward Earth because of gravity. This gives her potential energy.

Gravitational Potential Energy

Potential energy due to the position of an object above Earth's surface is called gravitational potential energy. Like the diver on the diving board, anything that is raised up above Earth's surface has the potential to fall because of gravity. You can see another example of people with gravitational potential energy in the **Figure** 1.1.

Gravitational potential energy depends on an object's weight and its height above the ground. It can be calculated with the equation:

Gravitational potential energy (GPE) = weight $\times$ height

Consider the little girl on the sled, pictured in the **Figure** 1.1. She weighs 140 Newtons, and the top of the hill is 4 meters higher than the bottom of the hill. As she sits at the top of the hill, the child's gravitational potential energy is:

FIGURE 1.1

GPE = 140 N $\times$ 4 m = 560 N • m

Notice that the answer is given in Newton • meters (N • m), which is the SI unit for energy. A Newton • meter is the energy needed to move a weight of 1 Newton over a distance of 1 meter. A Newton • meter is also called a joule (J).

Q: The gymnast on the balance beam pictured in the **Figure** 1.1 weighs 360 Newtons. If the balance beam is 1.2 meters above the ground, what is the gymnast's gravitational potential energy?

A: Her gravitational potential energy is:

GPE = 360 N $\times$ 1.2 m = 432 N • m, or 432 J

Elastic Potential Energy

Potential energy due to an object's shape is called elastic potential energy. This energy results when an elastic object is stretched or compressed. The farther the object is stretched or compressed, the greater its potential energy is. A point will be reached when the object can't be stretched or compressed any more. Then it will forcefully return to its original shape.

Look at the pogo stick in the **Figure** 1.2. Its spring has elastic potential energy when it is pressed down by the boy's weight. When it can't be compressed any more, it will spring back to its original shape. The energy it releases will push the pogo stick—and the boy—off the ground.

FIGURE 1.2

Q: The girl in the **Figure** 1.3 is giving the elastic band of her slingshot potential energy by stretching it. She's holding a small stone against the stretched band. What will happen when she releases the band?

A: The elastic band will spring back to its original shape. When that happens, watch out! Some of the band's elastic potential energy will be transferred to the stone, which will go flying through the air.

FIGURE 1.3

Other Forms of Potential Energy

All of the examples of potential energy described above involve movement or the potential to move. The form of energy that involves movement is called mechanical energy. Other forms of energy also involve potential energy, including chemical energy and nuclear energy. Chemical energy is stored in the bonds between the atoms of compounds. For example, food and batteries both contain chemical energy. Nuclear energy is stored in the nuclei of atoms because of the strong forces that hold the nucleus together. Nuclei of radioactive elements such as uranium are unstable, so they break apart and release the stored energy.

Summary

- Potential energy is energy that is stored in a person or object.
- Gravitational potential energy is due to the position of an object above Earth's surface. The object has the potential to fall due to gravity. Gravitational potential energy depends on an object's weight and its height above the ground (GPE = weight x height).
- Elastic potential energy is due to an object's shape. It results when an elastic object is stretched or compressed. The more it is stretched or compressed, the greater its elastic potential energy is.
- Chemical energy and nuclear energy are other forms of potential energy.

Review

1. What is potential energy?
2. Compare and contrast gravitational and elastic potential energy, and give an example of each.
3. The diver on the diving board in the opening picture weighs 500 Newtons. The diving board is 5 meters above the ground. What is the diver's gravitational potential energy?
4. Why does food have potential energy?

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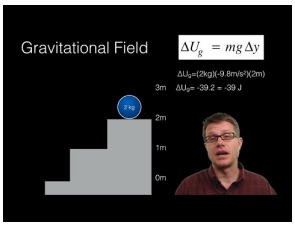

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