Inquiry Approaches

Initial Inquiry

What are the two types of mechanical energy?

Mechanical energy is described as kinetic energy (energy of motion) or potential energy (energy of position). The total mechanical energy of a system is the sum of the system's kinetic energy and the potential energy.

What is the difference between endothermic and exothermic reactions?

The difference between endothermic and exothermic reactions is which direction the energy flows. An exothermic reaction releases energy from the system into the environment. An endothermic reaction absorbs energy into the system from the environment.

Experimental Procedure Inquiry

What part of a nuclear reaction are the set mousetraps analogous to?

The set mousetraps are analogous to the bonds in the atom. Just as setting off the mousetrap releases energy and transfers it into the golf balls, breaking an atomic bond releases energy, which is transferred into neutrons and gamma rays (electromagnetic radiation).

What subatomic particles do the golf balls represent?

The golf balls represent neutrons. A golf ball is fired to start the mouse-trap chain reaction, just as a neutron is fired to start a nuclear chain reaction. The first golf ball sets two more golf balls in motion, which each set two more golf balls in motion and so on, just as each neutron in a fission reaction collides with an atom resulting in the release of two or more neutrons.

What kind of energy does the system of the mousetraps and golf balls start with? What kind of energy does it end with?

At the beginning of the reaction, the system has kinetic energy (in the form of the first rolling golf ball), and potential energy (in the form of the set mousetraps). At the end of the reaction, the system has more kinetic energy than it started with, but no stored potential energy.

In-Depth Inquiry

Is a fission reaction exothermic or endothermic?

A nuclear fission reaction is exothermic because it releases energy in the form of heat, electromagnetic radiation and the kinetic energy of fragments.

In the first step of the chain reaction, two golf balls are released. In the second step, each of the two golf balls released in the first step hit a mousetrap, so that in this step four golf balls are released. How many golf balls are released in the third step? If the mouse-trap setup were to be spread out over hundreds of play-mats in an infinitely large classroom, how many golf balls would be released in the 100th step? What about the millionth step?

In the first step, two golf balls are released, which can also be expressed as 2^1 golf balls. In the second step, 2×2, or 2^2, golf balls are released. In the 3rd step, each of these four golf balls hits another mousetrap, releasing two more golf balls: $4 \times 2 = 2 \times 2 \times 2 = 2^3$. The number of golf balls released in step n is 2^n. So the number of golf balls released in the 100th and millionth step are, respectively, 2^{100} and $2^{1,000,000}$.