SECTION 2

Energy

SECTION OBJECTIVES

- Identify several forms of energy.
- Calculate kinetic energy for an object.
- Apply the work–kinetic energy theorem to solve problems.
- Distinguish between kinetic and potential energy.
- Classify different types of potential energy.
- Calculate the potential energy associated with an object's position.

KINETIC ENERGY

Kinetic energy is energy associated with an object in motion. **Figure 4** shows a cart of mass m moving to the right on a frictionless air track under the action of a constant net force, **F**, acting to the right. Because the force is constant, we know from Newton's second law that the cart moves with a constant acceleration, **a.** While the force is applied, the cart accelerates from an initial velocity v_i to a final velocity v_f. If the cart is displaced a distance of Δx, the work done by **F** during this displacement is

$$W_{net} = F\Delta x = ma\Delta x$$

When you studied one-dimensional motion, you learned that the following relationship holds when an object undergoes constant acceleration:

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$a\Delta x = \frac{v_f^2 - v_i^2}{2}$$

Substituting this result into the equation $W_{net} = ma\Delta x$ gives

$$W_{net} = m\left(\frac{v_f^2 - v_i^2}{2}\right)$$

$$W_{net} = \tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_i^2$$

kinetic energy

the energy of an object that is due to the object's motion

Kinetic energy depends on speed and mass

The quantity $\frac{1}{2}mv^2$ has a special name in physics: **kinetic energy.** The kinetic energy of an object with mass m and speed v, when treated as a particle, is given by the expression shown on the next page.

extension

Integrating Health

Visit go.hrw.com for the activity "Energy Costs of Walking and Running."

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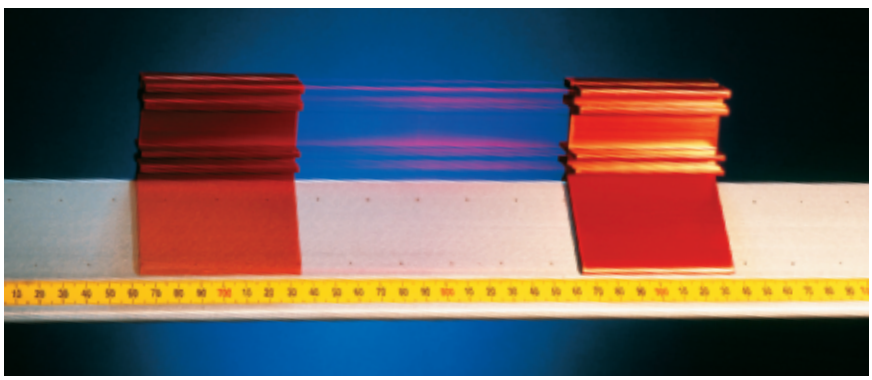

Figure 4

The work done on an object by a constant force equals the object's mass times its acceleration times its displacement.