

Practice Problems

11.1 The Many Forms of Energy pages 285–292

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1. A skater with a mass of 52.0 kg moving at 2.5 m/s glides to a stop over a distance of 24.0 m. How much work did the friction of the ice do to bring the skater to a stop? How much work would the skater have to do to speed up to 2.5 m/s again?

To bring the skater to a stop:

$$\begin{aligned} W &= KE_f - KE_i \\ &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ &= \frac{1}{2}(52.0 \text{ kg})(0.00 \text{ m/s})^2 - \\ &\quad \frac{1}{2}(52.0 \text{ kg})(2.5 \text{ m/s})^2 \\ &= -160 \text{ J} \end{aligned}$$

To speed up again:

This is the reverse of the first question.

$$\begin{aligned} W &= KE_f - KE_i \\ &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ &= \frac{1}{2}(52.0 \text{ kg})(2.5 \text{ m/s})^2 - \\ &\quad \frac{1}{2}(52.0 \text{ kg})(0.00 \text{ m/s})^2 \\ &= +160 \text{ J} \end{aligned}$$

2. An 875.0-kg compact car speeds up from 22.0 m/s to 44.0 m/s while passing another car. What are its initial and final energies, and how much work is done on the car to increase its speed?

The initial kinetic energy of the car is

$$\begin{aligned} KE_i &= \frac{1}{2}mv^2 = \frac{1}{2}(875.0 \text{ kg})(22.0 \text{ m/s})^2 \\ &= 2.12 \times 10^5 \text{ J} \end{aligned}$$

The final kinetic energy is

$$\begin{aligned} KE_f &= \frac{1}{2}mv^2 = \frac{1}{2}(875.0 \text{ kg})(44.0 \text{ m/s})^2 \\ &= 8.47 \times 10^5 \text{ J} \end{aligned}$$

The work done is

$$\begin{aligned} KE_f - KE_i &= 8.47 \times 10^5 \text{ J} - 2.12 \times 10^5 \text{ J} \\ &= 6.35 \times 10^5 \text{ J} \end{aligned}$$

3. A comet with a mass of 7.85×10^{11} kg strikes Earth at a speed of 25.0 km/s. Find the kinetic energy of the comet in joules, and compare the work that is done by Earth in stopping the comet to the 4.2×10^{15} J of energy that was released by the largest nuclear weapon ever built.

$$\begin{aligned} KE &= \frac{1}{2}mv^2 \\ &= \frac{1}{2}(7.85 \times 10^{11} \text{ kg})(2.50 \times 10^4 \text{ m/s})^2 \\ &= 2.45 \times 10^{20} \text{ J} \end{aligned}$$

$$\frac{KE_{\text{comet}}}{KE_{\text{bomb}}} = \frac{2.45 \times 10^{20} \text{ J}}{4.2 \times 10^{15} \text{ J}} = 5.8 \times 10^4$$

5.8×10^4 bombs would be required to produce the same amount of energy used by Earth in stopping the comet.

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4. In Example Problem 1, what is the potential energy of the bowling ball relative to the rack when it is on the floor?

$$\begin{aligned} PE &= mgh \\ &= (7.30 \text{ kg})(9.80 \text{ m/s}^2)(-0.610 \text{ m}) \\ &= -43.6 \text{ J} \end{aligned}$$

5. If you slowly lower a 20.0-kg bag of sand 1.20 m from the trunk of a car to the driveway, how much work do you do?

$$\begin{aligned} W &= Fd \\ &= mg(h_i - h_f) \\ &= (20.0 \text{ kg})(9.80 \text{ m/s}^2)(0.00 \text{ m} - 1.20 \text{ m}) \\ &= -2.35 \times 10^2 \text{ J} \end{aligned}$$

Chapter 11 Study Guide Conservation Of Energy Answers

Patrick Vollmar



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