CHAPTER 7

Conservation of Energy and Momentum

CHAPTER CONTENTS

With a "whump," the fireworks shell is lofted upward into the darkness. As the shell rises, it slows; kinetic energy transforms into gravitational potential energy. Then, the shell explodes and chemical potential energy rapidly converts into heat, light, and sound. The darkness gives way to brilliant colour and loud bangs startle the crowd below.

There is a balance in all of these transformations and effects. Energy gained in one form comes at the expense of another. This is the law of conservation of energy.

In this chapter, you will examine these energy transformations and the laws that govern these transformations.

MULTI LAB

Energy Transformations in Springs

TARGET SKILLS

- Performing and recording
- Analyzing and interpreting
- Communicating results

A Spring Pendulum

Hang a spring (at least 50 cm long) from a rigid support and attach a mass to the lower end of the spring. Ensure that the mass is heavy enough to extend the spring noticeably without overstretching it. The hanging mass should not come close to the desktop. Pull the mass to the side and release it, allowing the spring to swing from side to side. Observe the motion of the mass and the spring.

Analyze and Conclude

1. What types of periodic (repeating) motion did you observe?
2. When the amplitude of one type of vibration was at a maximum, what happened to the amplitude of the other type of vibration?
3. When the spring was stretched to a greater length than it was when the mass was at rest, was the mass moving rapidly or slowly?
4. What was being transferred between **(a)** the different types of vibration, and **(b)** the mass and the spring?
5. The law of conservation of energy states that the total energy of an isolated system remains constant. How was that law illustrated by the action of the spring and the mass in this case?
6. What eventually happened to the motion of the spring and the mass? Suggest why this occurred.
7. If the system regularly switched back and forth between the two patterns of motion, was the time taken for the change consistent?

Slinky Motion

Place a Slinky™ toy several steps up from the bottom of a set of stairs, with the axis of the spring vertical. Take the top coil and arc it over and down to touch the next lower step. Release the Slinky™ and observe its motion.

Analyze and Conclude

1. What is the condition of the coils of the spring when energy is stored in the spring?
2. At what stage or stages in the action of the spring is kinetic energy being converted into elastic potential energy in the spring?
3. At what stage or stages in the action of the spring is elastic potential energy in the spring being converted into kinetic energy?
4. Is there any instant during the motion of the spring when both the kinetic energy and the elastic potential energy are at a maximum? Would you expect this to be possible? Give a reason for your answer.
5. Any system loses energy due to friction, which converts mechanical energy into thermal energy. Why then does the spring continue going down the stairs? From where is it getting its energy?