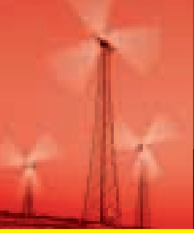
CHAPTER 13

Simple Harmonic Motion

CHAPTER CONTENTS

Stringed instruments are beautiful in both appearance and the music they produce. They are also beautiful examples of periodic motion because you can vividly see the strings vibrating. Although you can rarely see them, vibrations of many objects are impacting your life continuously. Every sound you hear is a result of the vibrations of air molecules that are causing your ear drums to vibrate. In a microwave oven, the electromagnetic waves cause water molecules in the food to vibrate and heat the food. Sometimes the wind causes windows and other structures to vibrate, producing eerie sounds at night. The low pitched sounds in loud music can even make the floor vibrate so much that you feel it over your whole body. A mass oscillating on the end of a spring makes an excellent model of all types of vibrational motion. In this chapter, you will analyze the properties of a mass and spring system as well as the properties of a swinging pendulum.



INVESTIGATION 13-A

A Projectile Spring

TARGET SKILLS
- Predicting
- Performing and recording
- Analyzing and interpreting

In this investigation, you will combine your newly acquired knowledge of projectiles with your previous knowledge of elastic potential energy and then make predictions about the motion of a small spring.

Problem

How far will the elastic potential energy stored in the spring carry the spring?

Equipment

- balance
- retort stand
- ramp or small, smooth board
- set of masses with a mass holder
- protractor
- metre stick or metric tape measure
- utility clamp
- small spring
- small cardboard box
- masking tape

CAUTION Safety goggles must be worn during this activity.

Procedure

Work in small groups for the investigation.

1. Measure the mass of the spring.
2. Using the equipment, determine the spring constant for the spring. (If you cannot remember how to determine a spring constant, see Investigation 6-A on page 255.)
3. Set up the ramp on a desk, or make a ramp by resting one end of the board on a stack of books. Measure the angle that the ramp makes with the desktop. Make sure that there is a long area of clear space in front of the ramp.
4. Decide on the amount of extension that you intend to use with the spring and then determine the corresponding elastic potential energy stored in the spring at that extension. (The equation for elastic potential energy is on page 259.)
5. Use the law of conservation of energy to determine the velocity with which the spring will leave the ramp.
6. Use the velocity, the angle of the ramp, and the height of the end of the ramp to determine the point at which the spring will hit the floor (or the wall).
7. Place the cardboard box at that predicted point.
8. Set up the spring by hooking one end over the upper edge of the ramp. Then, pull it backward to extend it the selected distance and release it.

Analyze and Conclude

1. Provide a summary of your force-extension measurements for the spring.
2. Show your calculation of the spring constant.
3. What extension did the group choose? Show your calculation of the elastic potential energy stored in the spring.
4. Show your calculation of the
   (a) velocity of the spring as it leaves the ramp
   (b) range of the projectile (the spring)
5. How close did the spring come to its predicted landing point?
6. Describe the energy changes that occurred during the launch and flight of the spring.
7. Does this investigation further confirm the law of conservation of energy?