Name Period Date

106 You're on Your Own

Many of the labs in this manual are intended to help you better understand a physics principle or concept or to give you experience in performing some specific task. As such, they often contain very specific directions. Sometimes you may know the "answer" to a lab before you do it. That's okay—because the answer is secondary to the important practice you gain in gathering, organizing and interpreting data.

The following labs are open-ended and do not entail specified steps for you to follow. The purpose of these open-ended investigations is to give you experience at attempting to find the solutions to problems for which the answer is not known. In these cases, you must devise your own method. A list of such labs is shown below.

Choose one of the investigations from the list or come up with one of your own. It is important that you define exactly what your investigation will and will not accomplish. Formulate a hypothesis. As a safety precaution, be sure to have your teacher approve your experimental procedure and/or apparatus before you begin experimenting. Acquire and organize your data—graphically, if appropriate. Specify as many factors as you can that influenced your experimental outcome. Does your experiment affirm or refute your hypothesis? Remember, some of the most famous experiments in physics had null results—e.g., the Michelson–Morley experiment—so do not despair if your experimental results refute your hypothesis. Do and *enjoy*!

- Find a relationship between the area covered by jigsaw pieces that are unconnected and the same pieces when connected. Predict the area needed to lay out pieces for a puzzle that when put together is known to have a certain area.
- Determine the factors that influence the toppling speed of dominoes. What is the maximum speed for a chain of dominoes at least one meter long?
- Devise and build an accelerometer. Calibrate the accelerometer so that it measures acceleration in m/s^2. Explain its operation.
- Devise an experiment that shows how the applied force (or *net* force) and mass of a system are related to its acceleration.
- Devise a method to measure free-fall acceleration.
- Devise a method to measure the speed of an object, such as a whiffle ball, tennis ball, baseball, etc., as it strikes the ground when dropped.
- Find quantitative relationships among the height, speed, mass, kinetic energy, and potential energy of a projectile ejected by a physical pendulum apparatus (such as in Releasing Your Potential available from Arbor Scientific) or a child jumping from a swing while swinging.
- Devise a simulation using *Interactive Physics* software.
- Devise an experiment that demonstrates: (a) constant speed, (b) constant velocity, (c) constant acceleration, and (d) variable acceleration (jerks).

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- Devise an experimental procedure that measures the important variables for a damped harmonic oscillator, such as a loaded spring.
- Devise an experimental procedure to measure the vertical temperature gradient over a 24-hour period in your physics classroom during: (a) a school day and (b) on the weekend. Compare the temperature gradients between days during both warm and cold seasons. How thermally efficient is the classroom? A computer with multiple temperature probes may be very helpful.
- Estimate the average force you exert on a baseball with your hand when pitched. Express your estimate in terms of the distance the ball is thrown and the time of flight—both quantities you can measure.
- Devise a method by measure the coefficient of rolling friction for a toy car.
- Use the CASTLE Kit (available from PASCO) to devise an experiment that investigates the effect different numbers of bulbs have on the charging/discharging times of a capacitor.
- Calculate the uphill incline of a hill, θ, which you can cycle on at constant speed as a function of the gear radii. Test your predictions by cycling on a nearby incline.
- Segments of a short span bridge are observed to deflect downwards as vehicles cross it. Likewise, rails on a railroad track are deflected as a train rolls by. Devise a technique that will enable you to safely measure the deflection of the roadbed or the train track.
- Use LabQuest from Vernier Software to devise an experiment.
- Use one or more of the physics principles you have learned to explain and test the operation of an instrument used in a biology, chemistry, or biotechnology classroom, such as a spectrophotometer, gel electrophoresis box, power supply, centrifuge, −20°C freezer, orbital shaker, or a pH meter.

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