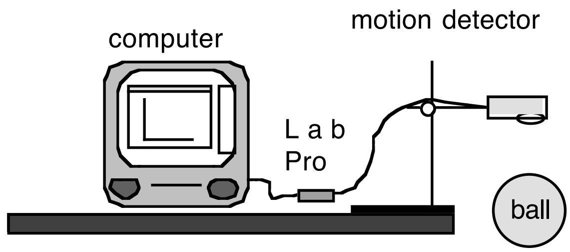
Lab 2-6: **Free Fall**

Purpose:
1. To make and interpret the motion graphs for a freely falling ball using the Motion Detectors.
2. To determine if an object falls with constant velocity or constant acceleration.
3. To determine how the placement of the motion detector affects the acceleration.

Diagram:



Procedure:
1. Set up the motion detector on a stand as shown. Make sure that the detector is pointing to the ground and at least several inches over the edge of the lab table.
2. Start Logger Pro and open up the file "*02 Ball*."
3. Hold the ball several inches below the motion detector.
4. Start timing. When you hear the detector clicking (a couple seconds after clicking on the green "collect" button.), let go of the ball. Be careful to not give the ball any initial velocity, and be careful to get your hands out of the way of the detector.
5. The resulting graphs will be pretty messy because they will show a lot more than just the ball falling. Ignoring all the extra clutter of the graphs, sketch the shape of the graphs while the ball was falling in the data section below. Label the axes as well.
6. Make an appropriate best fit line for the velocity graph for the portion of the graph that shows the ball falling. Record the slope, including units, next to the graph.
7. Repeat the above, except this time place the motion detector on the floor. Hold the ball chest high over the detector, start recording, drop the ball, and catch it before it lands on the detector. (Your teacher may have a screen to place over the motion detector as an added safety – if not, place some books around it so that the ball cannot actually land on the detector.)

Data:

Motion Detector Looking Down:

slope = _________

Motion Detector Looking Up:

slope = _________

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Conclusion:

1. While it was falling, was the *velocity* of the ball constant? Explain.

2. While it was falling, was the *acceleration* of the ball constant? Explain.

3. What were the equations that give the velocity as a function of time for both trials? (Remember to use "v" and "t" instead of "y" and "x" and remember the units.)
   a. Motion Detector Looking Down:

   b. Motion Detector Looking Up:

4. a. What was true about the *magnitudes* of the accelerations you found? What does that mean?

   b. What about the *signs* of the accelerations? What does that mean?

5. What was the class average for the acceleration due to gravity?

6. The class probably found that the acceleration was less than 9.8 m/s^2. Why do you think that happened?

7. Why do we tend to round the acceleration due to gravity to be 10 m/s^2?

8. In what direction does gravity ALWAYS point?

Follow Up Questions:

Use $g = 10\ m/s^2$ for the following problems.

7. When you drop something on the earth, how much faster does it move for every second that it falls?

8. If you drop a rock, how fast is it going after 5 seconds?

9. If you drop a rock, how fast is it going after 3.2 seconds?

10. If a falling rock has a speed of 15 m/s, what is its speed 1 second later?

11. If a falling rock has a speed of 5 m/s, what is its speed 1.5 seconds later?