Group 5
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Experiment I – 1-D Kinematics

The data collection for this and many other labs use Logger*Pro* software operating a variety of sensors connected to a LabPro interface. This week's sensor is a Vernier Motion Detector 2. It measures position by emitting pulses of sound and measuring the time until the reflected sound returns (like radar but with sound waves).

- You will hear a clicking sound when data collection begins.
- The detection zone extends about 15-20° to either side of the axis of the beam's centerline. If some other object or body part gets inside this "cone" it will be detected instead of the target. A sharp change in the position data may be due to this.
- The position detector can measure an object only within the range 15 cm - 6 m.
- The detector folds open so that the detector can be aimed. Opening the detector reveals a sensitivity switch with cart and normal (person/ball) settings. Selecting the appropriate setting will give better data.
- The default is for the position detector to be the origin or the zero point of an axis with the positive direction away from the detector.
- The only thing that is directly ***measured*** is position with respect to the detector as a function of time; the Logger*Pro* software calculates the velocity and acceleration from the position data. This increases the noise in derived values like acceleration.

Activity 1 Put the detector into the first setup: measuring the cart on the track. Open the file "1-D Kinematics #1"; this file will initialize some parameters and prepare graphs. Level the track so that the cart remains motionless or nearly motionless on the track.

Try understanding the graphs for some sample motions. In particular, make sure you can explain the features of the $v(t)$ graph and how it relates to the $x(t)$ and $a(t)$ graphs.

The following are examples of situations you can try:

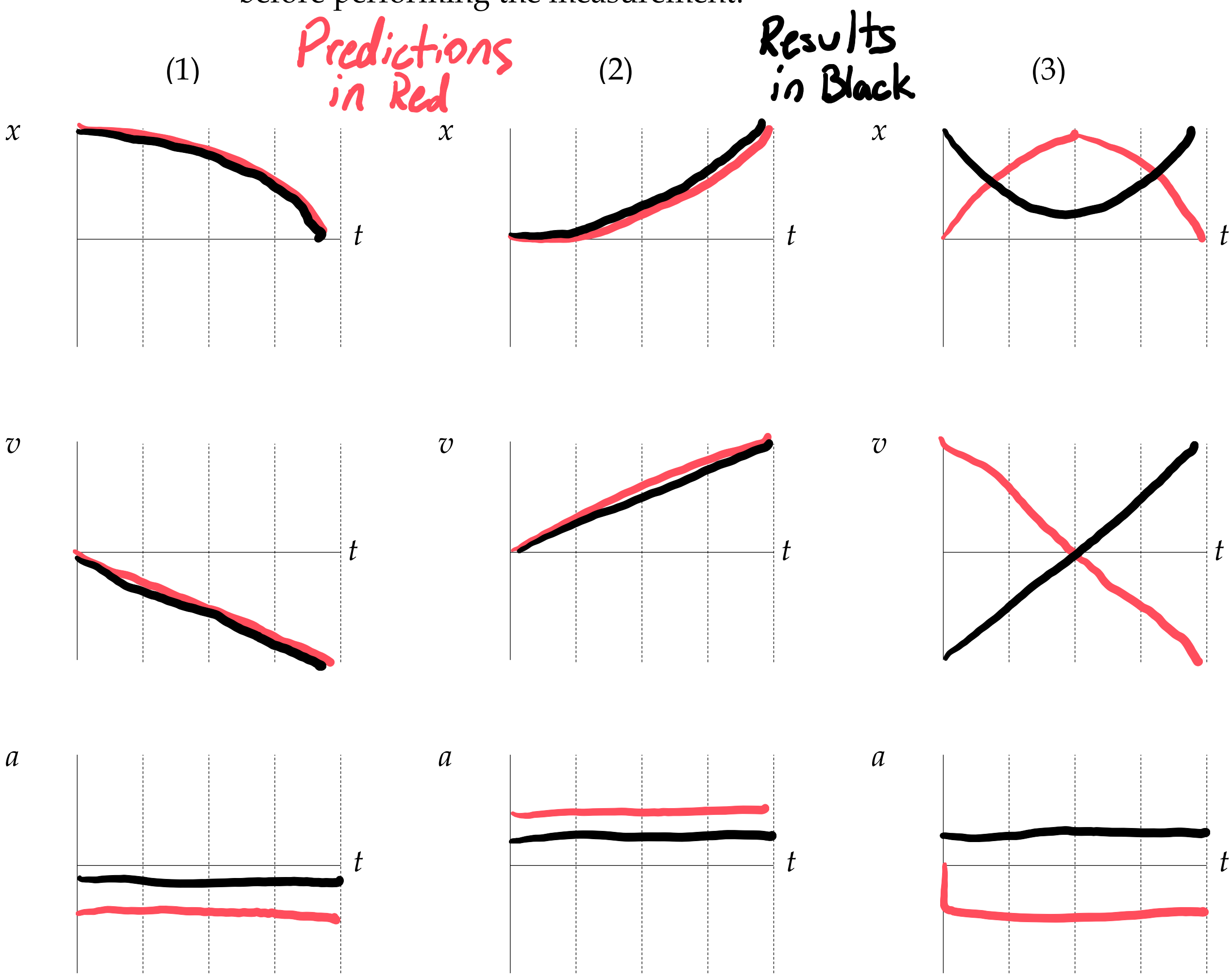
- The cart rests motionless at some distance from the detector.
- After data collection starts, tap the cart so that it moves slowly away from the detector. Can you identify when the tap started and when it ended?
- Push the cart steadily to get roughly constant acceleration (difficult).
- Push the cart back and forth to get oscillatory motion. Can you identify the sign of the acceleration as it changes simply by looking at $x(t)$? At $v(t)$?

Activity 2 For each case below, (1) sketch your best guess for the cart's motion on the graphs, then (2) perform the experiment, ideally recording the experimental results in a different color and (3) reconcile any differences.

1. Raise one end of the track to be about 6 cm above the other. Place the detector at the lower end and the cart near the higher end and release the cart.

2. Put the detector at the higher end, with the cart also near the higher end, and release the cart.

3. With the detector at the higher end, start with the cart near the lower end and tap it so that it rolls towards the detector, stops before hitting the detector and then rolls back. You may need to practice a few times before performing the measurement.

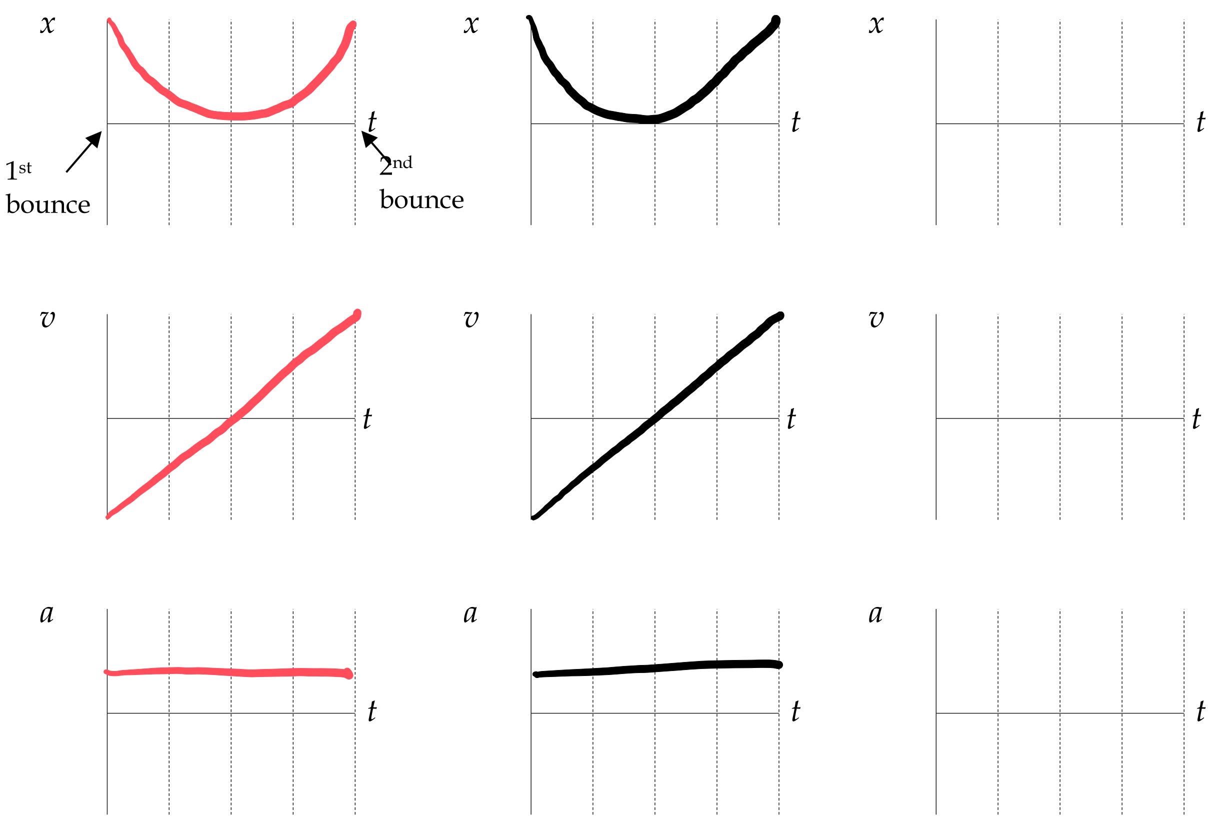


Activity 3 Predict the motion of the dropped basketball. The position detector will measure the ball's motion after you drop the ball. The ball will fall and bounce a first time and then bounce a second time while still under the detector. Your job is to predict the motion starting immediately after the first bounce and continuing until just before the second.

Open the file "1-D Kinematics #2". Hold the detector over the floor, pointing downward. Which way is the positive direction? Positive direction is down

Make your prediction on the leftmost graphs. Once you are ready to do the experiment, wait for your instructor. Do not drop the basketball with the computer taking data until you have your instructor's attention. Sketch the results using the middle graphs below. Sketch only the portion of the motion between the first and second bounces.

Prediction | **Measured** | **Use these graphs for scratch work.**



Instructor Initials: ______________	Date: 8/31/22