Bowling Ball Laboratory –Guided LT

PSI Physics – Kinematics

Name_____ Date_____ Period_____

Description: The goal of this experiment is to determine the velocity of a bowling ball based on measurements of displacement and time. We will use both an algebraic and a graphical approach to solve this problem.

Materials:

- Bowling ball
- Ramp (bowling ball launcher, car ramp, a board leaned on a chair, etc)
- 5 stop watches
- Meter sticks
- (optional) Masking tape to mark the floor every 3 meters

Procedure:

1. Place the ball and ramp in the hallway outside the laboratory and aim it down the center of the hallway..
2. Position 5 people with stopwatches along the hallway so that they are 3 m apart The first person should be located 3 m beyond the base of the launcher. Use pieces of tape to mark the locations of the timers and the base of the ramp.
3. Designate a sixth person to be in charge of releasing the ball.
4. Locate a seventh person beyond the last timer to stop the ball.
5. Designate an eighth person to collect data from all timers.
6. Three trials should be made from a single height on the ramp. The height should be noted and tape used to mark the launcher in order to get reproducible launches. (You may wish to have a few practice runs before collecting data).
7. When the ball reaches the floor all the timers should be started. As the ball passes each person with a stopwatch, they should stop their watch. The data should then be recorded in the below chart.
8. Repeat for three trials.

Safety Warning: Be aware of other people in the halls! Allow them to pass.

Data Collection:

t \ Δx	3m	6m	9m	12m	15m
trial 1					
trial 2					
trial 3					

Analysis:

Algebraic Approach

The position of an object traveling at constant velocity (v) is given by:

$x = x_0 + vt$ defining the initial position as zero ($x_0 = 0$) this becomes

$x - x_0 = vt$ or $\Delta x = vt$ then solving for v yields

$$v = \frac{\Delta x}{t}$$

To determine if the ball is traveling at a constant velocity, v, we will first assume that it is and then test that hypothesis.

1. Calculate the average time, $t_{average}$, it took the bowling ball to travel the given distance by adding the results from your three trials and dividing by three. Record that result below.

2. Calculate the average velocity, v with which the ball traveled that distance by dividing the distance, Δx, by the average time, $t_{average}$. Record that result below.

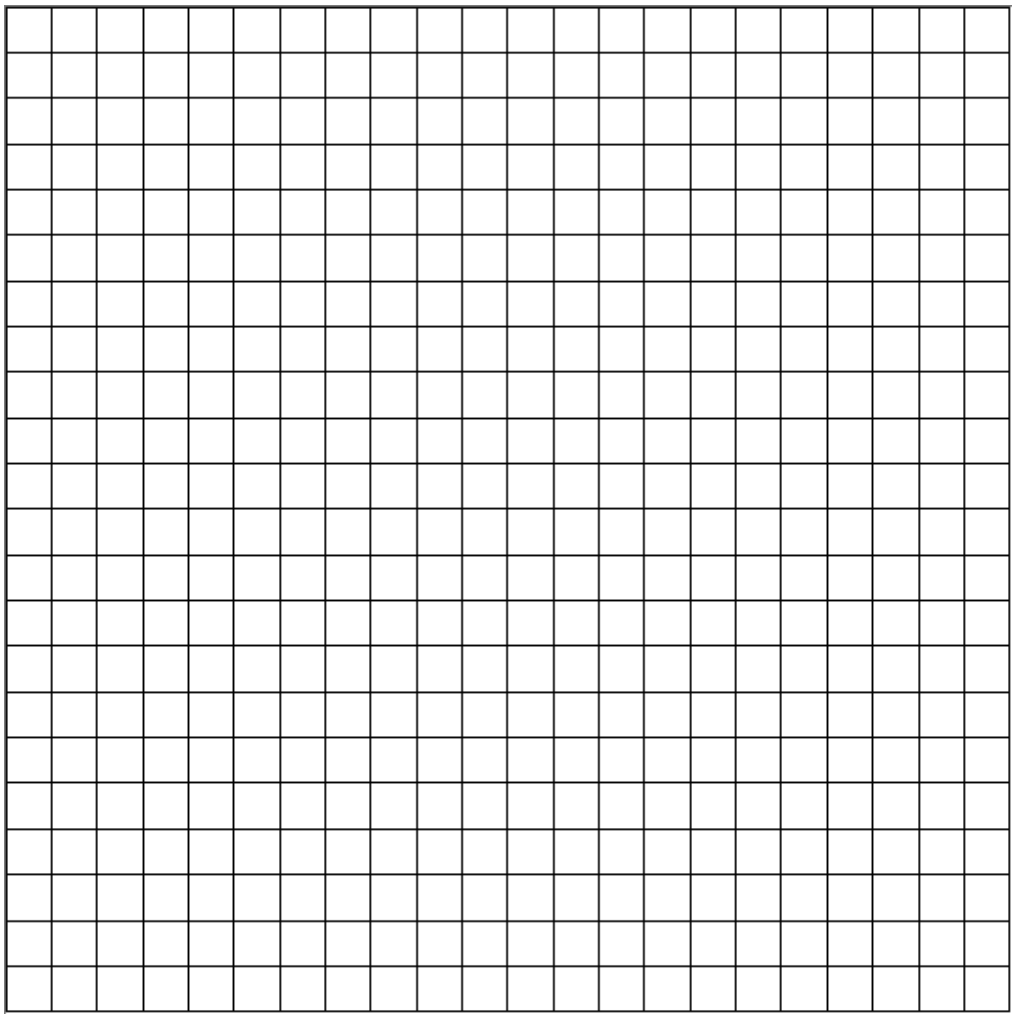
Δx	3m	6m	9m	12m	15m
$t_{average}$					
v					

Graphical Approach

1. Plot the your data from the last table: distance Δx (on the y-axis) versus time, $t_{average}$ (on the x-axis). Label your axes so that your graph takes up most of the grid and includes (0,0) as one of your points.

2. Draw a "best fit" line. A best fit line is a straight line that passes as close as possible to all the points. It does not need to pass through any of the points.

3. Determine the slope of the "best fit" line. **Show all work determining the slope on the graph below.**



Slope = Rise ÷ Run = _____

Conclusions:

1. Look at the values of v you determined in your *Algebraic Approach*. If the velocity is constant, then your values of v should be the approximately the same at all distances. Do your results for v indicate constant or changing velocity?

2. In your *Graphical Approach* you were asked to find the slope of the distance versus time graph. How does this slope compare to your results for v from your algebraic approach?

3. What would a steeper slope of the position versus time graph indicate?

4. Did the values of v you calculated in the algebraic approach vary a lot?
    a. Yes or No?
    b. If Yes, why do you think your values of v had variations?

Application:

5. How could you use or change this lab to check the speed of cars on your street? Just list the steps you would take.

6. The marker posts on a highway are 0.1 miles apart. If a truck is timed taking 5 seconds between posts, how fast is the truck going (in MPH; there are 3600 seconds in an hour)?