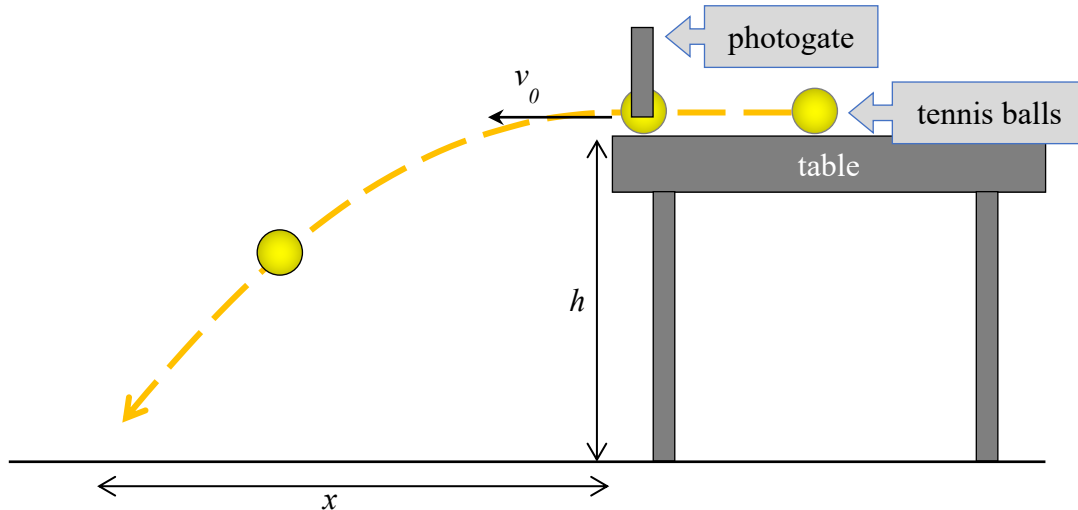


Projectile MiniLab – Photogate

Purpose: The goals are to measure the initial speed and range for a projectile launched horizontally, and to produce a graph to assess the expected properties of this motion.

Equipment: LabQuest Mini, two tennis balls, two meter sticks, masking tape, section of track, photogate, ring stand, clamp



Procedure: Use the photogate to measure the initial speed of a tennis ball moving horizontally off the edge of a table. Observe and measure the horizontal distance (range) the ball travels before hitting the floor. Record height h of the table, initial speed v_0 , and range x for multiple trials.

1. Use masking tape to attach a short length of track right at the edge of a table to create a “launching ramp”.
2. Attach a photogate to a ring stand and arrange to measure the tennis ball as it leaves the ramp and flies off the table.
3. Connect LabQuest Mini to laptop and the photogate to a digital input: DIG1. Run Graphical Analysis. Change the photogate timing mode to Speed through Gate – enter the diameter of the tennis ball (which is very close to 6.5 cm).
4. Place meter sticks on the floor to measure range.
5. Click the Collect button one time in Graphical Analysis to start. Then do as many trials as necessary. You do not need to start and stop after each trial. All data is shown in one table.
6. Hold a second ball and use it to hit the first ball and launch it horizontally through the gate. Record speed and range. The “hit” should be a sudden “strike” that sets the first ball into motion. ONLY ONE ball should pass through the gate!
7. Repeat at least 5 trials with various values that will show a relationship when graphed. This means you need a wide range of values for v_0 and x . Record height of table.

Analysis: Do not use a computer! Create an appropriate high-quality graph illustrating the relationship between range and initial speed. Draw the line or curve of best fit and determine the corresponding equation. Show all work on the graph itself.

Data

Height of table:		Tennis ball diameter:	
Trial Number	Gate Time (s)	Initial Speed (m/s)	Range (m)
1			
2			
3			
4			
5			

Questions: Write out responses on separate paper – show all work.

1. Show work calculating the initial speed in trial 1 by using the gate time and the diameter of the ball. (This is to verify that the computer determined the initial speeds correctly.)
2. Derive an expression that gives the range x in terms of the initial velocity v_0 , height of the table h , and the freefall acceleration rate g .
3. Describe whether or not the graph and best fit support and agree with the expression you derived. Explain and support your answer.
4. Use a coefficient of your best fit equation and the height of the table to determine an experimental value for the acceleration of gravity and determine the percent error.
5. Discuss error – both the evidence in the results that it occurred and the probable sources during the experiment.

Complete report (40 pts):

- Data Table (20)
- Graph with best fit (10)
- Responses to questions (10)