#3 Ballistic Pendulum - Projectile Motion

Pre-Lab Report

Lab section:

Name & Surname:

Table # :

Before the Lab complete this page YOURSELF! Hand it in in the first 5 min. of the session PERSONALLY!

You MUST justify your answers and show all steps. NO COPYCAT answers, or NO credits!

Please read the relevant presentation on PHYS LAB Website.

Q1. What would the expression for uncertainty in the velocity that is Δv? Write an expression in terms of height and range values and their uncertainties. Consult page 28-29 in your book.

Q2. What are the possible sources of error in this experiment? Answer this question in terms of the classification given in your book. **Justify your answer or no credits!**

(3rd and 4th Questions are on the next page!)

Q3. In this experiment we are ignoring the effect of air friction. Assuming that the experiment is done in a very viscous liquid, discuss the effect of the friction due to the liquid on the motion of the ball. **Justify your answer or no credits!**

Q4. Assume that the ballistic pendulum is moving upward with a speed of v_b in the first part. Derive the equations for the range and the final velocity with which the ball strikes the floor. **Show your calculations below explicitly or no credits!**

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Lab Report

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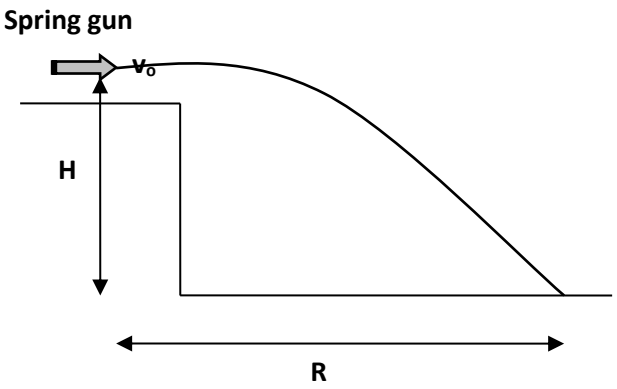
Complete this report YOURSELF except DATA taking parts! Use a pencil for plots only and a pen for the rest! **Show your work clearly, NO COPYCAT analysis allowed, or NO credits!**

OBJECTIVE : To study the fundamentals of projectile motion.

THEORY : When the ball is shot with an initial speed v in the horizontal direction, its range will be

$$R = vt$$



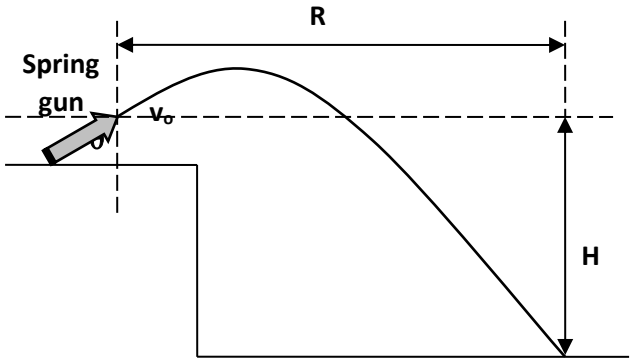
where t is the time of flight and it will be free falling. The height it falls down will determine the flight time:

$$H = \frac{1}{2} g t^2$$

By combining these two equations, we can determine the initial speed in terms of the range and the height:

$$v_o = R\sqrt{\frac{g}{2H}}$$

On the other hand, when the ball is shot at an angle θ, it will follow a parabolic trajectory:



It can be shown that the trajectory equation is

$$\frac{gR^2}{2v_o^2}\tan^2\theta - R\tan\theta + \left(\frac{gR^2}{2v_o^2} - H\right) = 0$$

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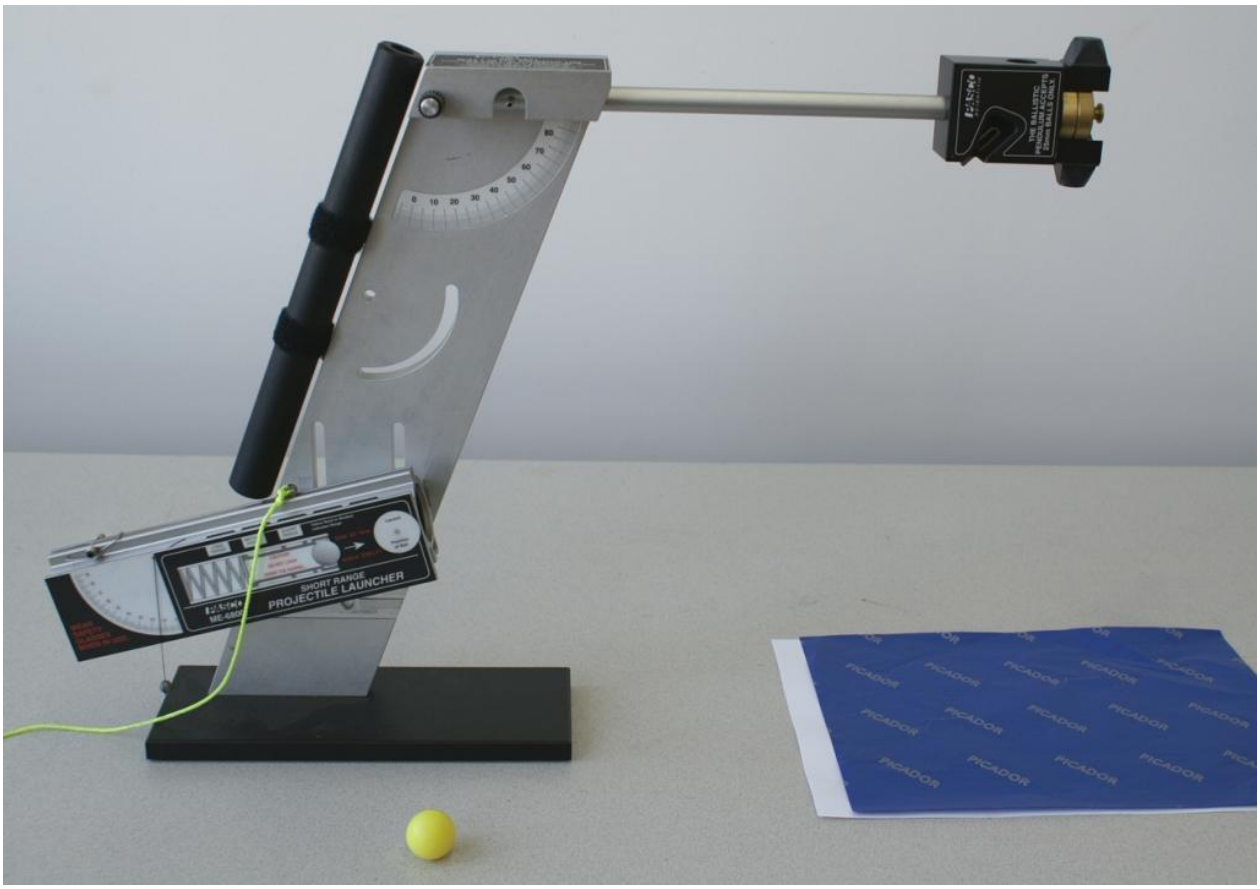
APPARATUS : Ballistic pendulum with plastic ball, meter stick, balance, carbon paper.

PROCEDURE :

Part 1: The spring gun is leveled on the table and the plastic ball is projected horizontally. The initial velocity of the ball can be determined by measuring the range, R, and the initial height, H, of the ball.



Part 2: The spring gun is inclined at an angle θ with the horizontal and the ball is shot freely. Range, height and the initial velocity of the ball are used to calculate θ.

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DATA & CALCULATIONS & RESULTS

PART 1 – HORIZONTAL MOTION

Description / Symbol			Value & Unit
Height	H	=	.....
Range (1st trial)	R_1	=	.....
Range (2nd trial)	R_2	=	.....
Average Range	R_{ave}	=	.....
Initial velocity of the ball	v_o	=	.....

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PART 2 – PROJECTILE MOTION

Description and Symbol			Value & Unit
Height	H	=	.....
Range (1st trial)	R_1	=	.....
Range (2nd trial)	R_2	=	.....
Average Range	R_{ave}	=	.....
Measured Angle	θ_{MV}	=	.....

CALCULATIONS and RESULT:

Equation for θ : $$\frac{gR^2}{2v_o^2}\tan^2\theta - R\tan\theta + \left(\frac{gR^2}{2v_o^2} - H\right) = 0$$

Solve for $\tan\theta$:

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Description	Calculations (show each step)	Result & Unit

$Arctan\,\theta_{EV1}$ = ...

. . . . . .

$Arctan\,\theta_{EV2}$ = ...

. . . . . .

Chose the physically meaningful θ above as the experimental value and ignore the other one!

% Difference in θ experimental and measured values:

. . . . . .

Consult to the resources for this experiment from PHYS LAB Website:

PHYL101 Intro

Presentation #3

PHYL101 Lab Book