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Using a Ballistic Pendulum to Determine Muzzle Velocity of a Marble Launcher

Steve Whitman

The College at Brockport, stevewhitman27@gmail.com

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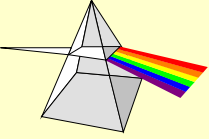
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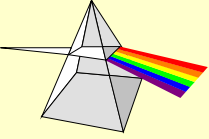
LAB #12

- **BALLISTIC
PENDULUM**



GOALS

- **TO USE A BALLISTIC PENDULUM TO DETERMINE MUZZLE VELOCITY OF A MARBLE LAUNCHER**
- **TO DETERMINE THE KE LOST IN THE COLLISION**
- **TO SIMULATE A BALLISTIC PENDULUM AND COMPARE RESULTS.**



PROCEDURE

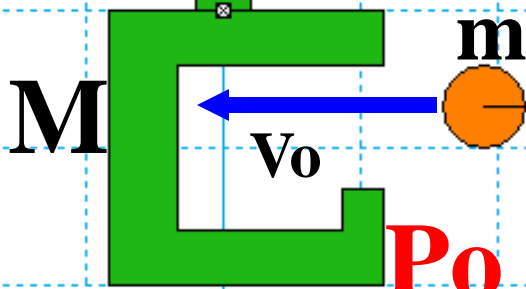
- **SHOOT THE PROJECTILE INTO THE BALLISTIC PENDULUM WITH PHOTOGATE TIMER IN PLACE**
- **MEASURE THE MAXIMUM ANGLE OF DEFLECTION OF THE PENDULUM**
- **RECORD PHOTOGATE TIME TO DETERMINE v PHOTO**
- **REPEAT FOR ALL FIVE NOTCHES OF THE LAUNCHER**
- **BUILD AN I.P. BALLISTIC PENDULUM**
- **REPEAT THE EXPERIMENT WITH THE VIRTUAL PENDULUM**
- **COMPARE RESULTS FOR EACH**

Ballistic Pendulum

Before Impact

ANGLE
rot 0.000°

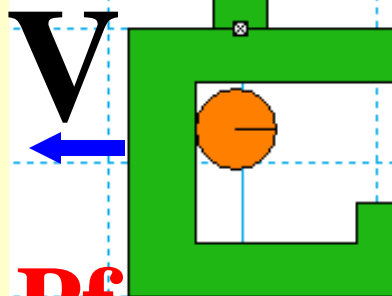
$V_0 = ?$



$P_0 = P_f$

At Impact

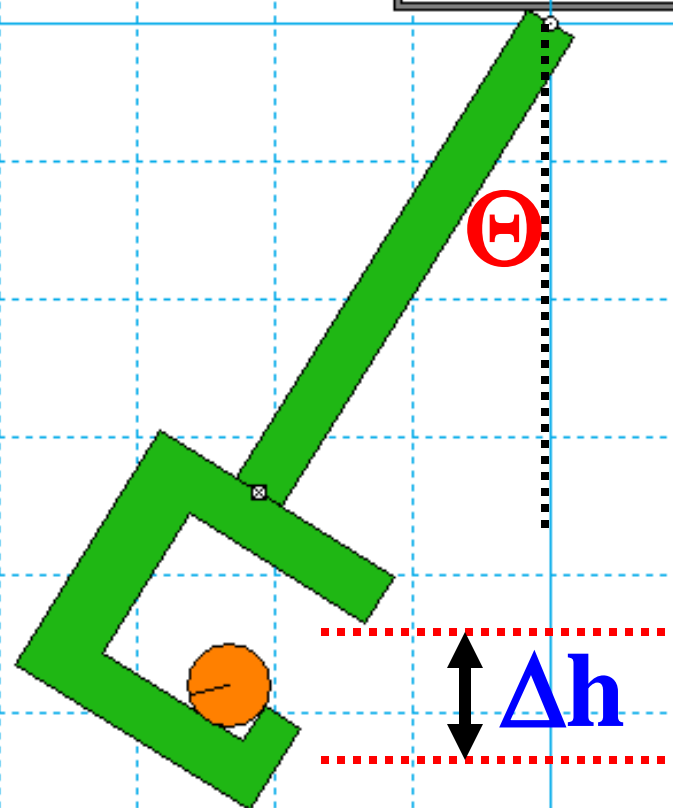
ANGLE
rot -0.137°



$$m v_0 = (M + m) V$$

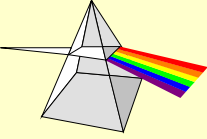
At Highest Swing

ANGLE
rot -31.957°



$KE_{\text{lost}} = PE_{\text{gain}}$

~~$$\frac{1}{2}(M + m) V^2 = (M + m) g \Delta h$$~~



Ballistic Pendulum Equation

$$mv_0 = (M+m) V$$

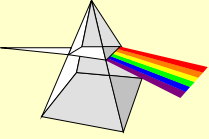
$$\cancel{\frac{1}{2}(M+m) V^2} = \cancel{(M+m) g\Delta h}$$

$$V^2 = 2g\Delta h$$

$$v_0 = \frac{(M+m) V}{m}$$

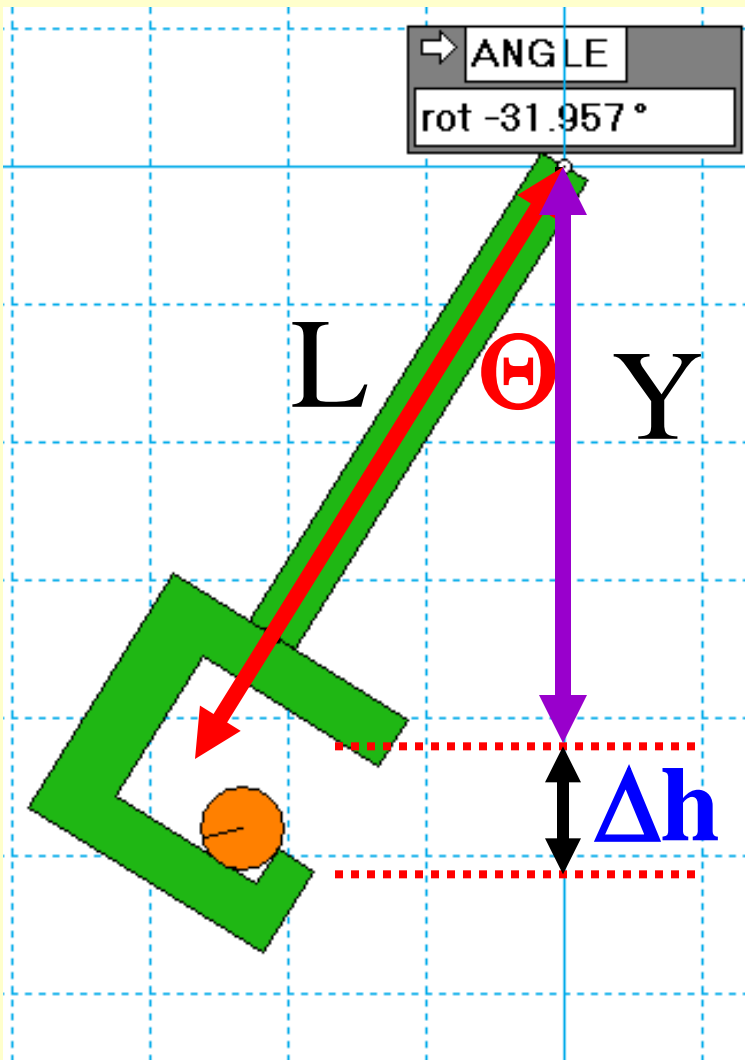
$$V = \sqrt{2g\Delta h}$$

$$v_0 = \frac{(M+m)}{m} \sqrt{2g\Delta h}$$



Determine Δh from Θ

At Highest Swing



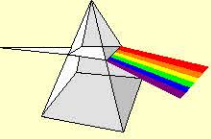
$L =$ length of pend

(pivot to center of bob)

$$\Delta h = L - Y$$

$$Y = L \cos \Theta$$

$$\Delta h = L - L \cos \Theta$$



K.E. ANALYSIS

SAMPLE DATA TABLE: (REAL BALLISTIC PENDULUM)

CONSTANTS:

M (kg) =

m (kg) =

<u>TRIAL</u>	<u>KE MARBLE (J)</u>	<u>KE CATCHER (J)</u>	<u>KE LOST (J)</u>	<u>%KE LOST</u>
1				
2				
3				
4				
5				

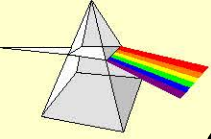
SAMPLE DATA TABLE: (I.P. BALLISTIC PENDULUM)

CONSTANTS:

M (kg) =

m (kg) =

<u>TRIAL</u>	<u>KE MARBLE (J)</u>	<u>KE CATCHER (J)</u>	<u>KE LOST (J)</u>	<u>%KE LOST</u>
1				
2				
3				
4				
5				



GRAPH #1: REAL PENDULUM

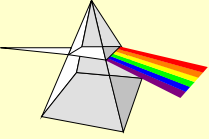
Marble V_0

$$V = \sqrt{2g\Delta h}$$

GRAPH #2: I.P. PENDULUM

Marble V_0

$$V = \sqrt{2g\Delta h}$$

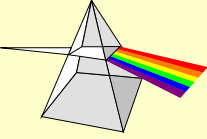


WRITE-UP

- SCREEN DUMP OF IP PEND
 - SHOW BALLISTIC PEND EQ PROOF
- DATA TABLES
- GRAPHS
 - TRENDLINES
 - GRAPH ANALYSIS
- CONCLUSION

LAB #12

DATA
ANALYSIS



GRAPH #1: REAL PENDULUM

