Projectile motion

Monday, February 22, 2021 1:00 PM

Projectile Motion Lab - Data Tables - Give to Students

PHY20 **Lab 4**

Initial Data Tables

Note: For the online course, use the Data Set Number provided to you to complete the Initial Data Table and complete the lab.

Data Set Number = 15

Angle 1 (Θ = 0°)

Angle: Θ = 0°
Distance between photo-gates: Δ*d* = 0.100 m
Height: *h* = 0.301 m

Run	Time between Gates - Δ*t* (s)	Horizontal Displacement - $\vec{d}_x$ (m)
1	0.0214	1.20 m
2	0.0234	1.17 m
3	0.0239	1.05 m

Angle 2 (Θ ≠ 0°)

Angle: Θ = 57°
Distance between photo-gates: Δ*d* = 0.100 m
Height: *h* = 0.385 m

Run	Time between Gates - Δ*t* (s)	Horizontal Displacement - $\vec{d}_x$ (m)
1	0.0285	1.28
2	0.0308	1.10
3	0.0298	1.51

Angle 3 (Θ ≠ 0°)

Angle: Θ = ____
Distance between photo-gates: Δ*d* = _____
Height: *h* = _____

Run	Time between Gates - Δ*t* (s)	Horizontal Displacement - $\vec{d}_x$ (m)
1		
2		
3		

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Final Results Tables

Trial 1 (Θ = 0.0°)

Angle: Θ = 0° ____
Constant vertical acceleration: $\vec{a}_y$ = -9.8 m/s
Distance between photo-gates: Δd = 0.100 m; Average time between gates: Δt = 0.0229 s
Initial velocity: $\vec{v}_i$= 4.3668 m/s (state using polar notation)
Constant velocity in horizontal direction: $\vec{v}_x$= 4.3668 m/s
Initial velocity in vertical direction: $\vec{v}_{yi}$= 0 m/s
Time of flight: t = 0.2477 s
Horizontal range: d_x = 1.08 m (Calculated value)
Average horizontal range: d_x = 1.14 (Experimental value)
% error for d_x: % error = 5.56 %

Trial 2 (Θ ≠ 0.0°)

Angle: Θ = 57°
Constant vertical acceleration: $\vec{a}_y$ = 9.8 m/s
Distance between photo-gates: Δd = 0.100 m; Average time between gates: Δt = 0.0297
Initial velocity: $\vec{v}_i$= 3.767 m/s (state using polar notation)
Constant velocity in horizontal direction: $\vec{v}_x$= 1.8338 m/s
Initial velocity in vertical direction: $\vec{v}_{yi}$= 2.9238 m/s
Final velocity in vertical direction: $\vec{v}_{yf}$= -3.050 m/s
Time of flight: t = 0.5987
Horizontal range: d_x = 1.10 (Calculated value)
Average horizontal range: d_x = 1.30 (Experimental value)
% error for d_x: % error = 18 %

Angle 3 (Θ ≠ 0.0°)

Angle: Θ = ____
Constant vertical acceleration: $\vec{a}_y$ = _____
Distance between photo-gates: Δd = _____ ; Average time between gates: Δt = _____
Initial velocity: $\vec{v}_i$= _____ (state using polar notation)
Constant velocity in horizontal direction: $\vec{v}_x$= _____
Initial velocity in vertical direction: $\vec{v}_{yi}$= _____
Final velocity in vertical direction: $\vec{v}_{yf}$= _____
Time of flight: t = _____
Horizontal range: d_x = _____ (Calculated value)
Average horizontal range: d_x = _____ (Experimental value)
% error for d_x: % error = _____

Calculations:

Trial 1.

(1) $\Delta t = \frac{(\Delta t_1 + \Delta t_2 + \Delta t_3)}{3} = \frac{0.0214 + 0.0239 + 0.0234}{3} = 0.0229$ s

(2) $v_i = \frac{0.100\ m}{\Delta t} = \frac{0.100\ m}{0.0229\ s} = 4.3668$ m/s

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(3) $\vec{v}_x = v_i \cdot cos0$ $V_x = 4.3668\ m/s \times Cos\ 0 = 4.3668\ m/s$

(4) $\vec{v}_{yi} = v_i \cdot sin0$ $V_{y_i} = 4.3668\ m/s \times Sin\ 0 = 0\ m/s$

(5) $t = \sqrt{\frac{2 \cdot \vec{d}_y}{\vec{a}_y}}$ $= \sqrt{\left(\frac{2 \times 0.301\ m}{9.81\ m/s^2}\right)} = 0.2477\ s$

(6) $d_{xcalc} = v_x \cdot t$ $= 4.3668\ m/s \times 0.2477\ s = 1.08\ m$

(7) $d_{xexp} = \frac{(d_{x1}+d_{x2}+d_{x3})}{3}$ $\frac{1.20s + 1.17s + 1.08s}{3} = 1.14\ m$

(8) $\%\ error = \frac{|d_{xexp} - d_{xcalc}|}{d_{xcalc}} x100\ \%$ $= \frac{|1.14\ m - 1.08\ m|}{1.08\ m} \times 100\%$

$= 5.56\ \%$

Tr. M #2

(1) $\Delta t = \frac{(\Delta t_1 + \Delta t_2 + \Delta t_3)}{3} = \frac{0.0285 + 0.0308 + 0.0298}{3} = 0.0297\ s$

(2) $v_i = \frac{0.100\ m}{\Delta t} = \frac{0.100\ m}{0.0297\ s} = 3.367\ m/s$

(3) $\vec{v}_x = v_i \cdot cos\theta$ $= 3.367\ m/s \times Cos\ 57^\circ = 1.8338\ m/s$

(4) $\vec{v}_{yi} = v_i \cdot sin\theta$ $= 3.367\ m/s \times Sin\ 57^\circ = 2.8238\ m/s$

(5) $\vec{v}_{yf} = -\sqrt{\vec{v}_{yi}^{\,2} + 2 \cdot \vec{a}_y \cdot \vec{d}_y}$ $= -\sqrt{\left((2.8238\ m/s)^2 + 2 \times 9.81\ m/s^2 \times 0.38\ m\right)}$

$= -3.050\ m/s$

(6) $t = \frac{(\vec{v}_{yf} - \vec{v}_{yi})}{\vec{a}_y}$ $= \frac{|-3.050\ m/s - 2.8238\ m/s|}{-9.81\ m/s^2} = 0.5987\ s$

(7) $d_{xcalc} = v_x \cdot t$ $= 1.8338\ m/s \times 0.5987\ s = 1.10\ m$

(8) $d_{xexp} = \frac{(d_{x1}+d_{x2}+d_{x3})}{3}$ $= \frac{1.28 + 1.51 + 1.10\ m}{3} = 1.30\ m$

(9) $\%\ error = \frac{|d_{xexp} - d_{xcalc}|}{d_{xcalc}} x100\ \%$ $= \frac{|1.30\ m - 1.10\ m|}{1.10\ m} \times 100\%$

$= 18\ \%$