Laboratory simulation: Projectile Motion

Go to link: <https://phet.colorado.edu/en/simulation/projectile-motion>

**PART A**

Procedure:

1. Set the cannon at angle *θ = 600* and set the speed of the projectile to 15 m/s . Launch the projectile and observe its trajectory.
2. Use the virtual tape to measure the range (maximum x ) and the height (maximum y ) of the projectile. Record the values in Data table 1

*DATA TABLE 1.*

|  |  |  |  |
| --- | --- | --- | --- |
| *Angle, θ (degrees)* | *Speed,* $v\_{o}$ *(m/s)* | *Range, x (m)* | *Height, y (m)* |
|  |  |  |  |

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 *Simulation PHET*

Procedure for Calculations:

1. Calculate $v\_{ox}$ and $v\_{oy} $

$v\_{ox}=v\_{o }$cos *θ*

$v\_{oy}=v\_{o }$sin *θ*

1. Calculate the time it takes for the projectile to reach the max height ( $g=9.8 m/s^{2}$ ) :

$$t\_{up}=\frac{v\_{oy}}{g}$$

1. Calculate the total time of the flight $t\_{total}=2 × t\_{up}$
2. Calculate ***x*** using equation



1. Calculate ***y*** using equation



*CALCULATION TABLE 1.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| $$v\_{ox}(m/s)$$ | $$v\_{oy} (m/s)$$ | $t\_{up}$*(s)* | $t\_{total} $*(s)*  | *Range x (m)* | *Height y (m)* |
|  |  |  |  |  |  |

1. Find the percentage error for Range **x**

$$\%err=\frac{\left|x\_{th}- x\_{exp}\right|}{x\_{th}}×100\%$$

1. Find the percentage error for Height **y**

$$\%err=\frac{\left|y\_{th}- y\_{exp}\right|}{y\_{th}}×100\%$$

**PART B**

Procedure:

1. Set the cannon at angle *θ = 750*, and set the speed of the projectile to 18 m/s. Launch the projectile. Measure the range and record the value in Data Table 2
2. Repeat the procedure in Step 1 for *θ = 650* and the angles in the table below:

*DATA TABLE 2.*

|  |  |
| --- | --- |
| *Angle, θ (degrees)* | *Range, x (m)* |
| *750* |  |
| *650* |  |
| *550* |  |
| *450* |  |
| *350* |  |
| *250* |  |

1. Based on your measurements, at what angle was the range the greatest?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. For the angle in part 5, calculate Range **x** using the PART A calculation procedure.

*CALCULATION TABLE 2.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| $$v\_{ox}(m/s)$$ | $$v\_{oy} (m/s)$$ | $t\_{up}$*(s)* | $t\_{total} $*(s)*  | *Range x (m)* |
|  |  |  |  |  |

1. Find the percentage error for Range **x**

$$\%err=\frac{\left|x\_{th}- x\_{exp}\right|}{x\_{th}}×100\%$$

**PART C**

*Challenge*: Turn on ‘Air Resistance’. Investigate how the presence of air affects the trajectory of the projectile. How does the range of the projectile change?

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