<u>Projectile Motion</u>

<u>Objective:-</u>

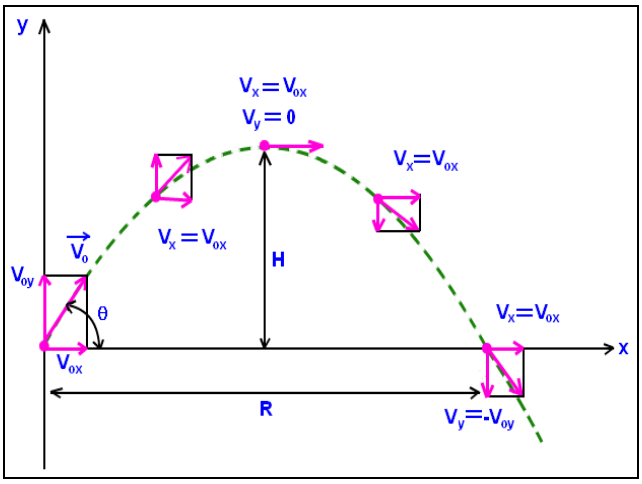
To calculate the initial velocity $\boldsymbol{v_0}$ of the projectile.

<u>Theory:-</u>

A particle moves in a vertical plane with some initial velocity $\boldsymbol{v_0}$ but its acceleration is always the freefall acceleration **g**, which is downward. Such a particle is called a **projectile** (meaning that it is projected or launched), and its motion is called **projectile motion.**

If neglecting frictional forces, such as air resistance, an object projected from a launcher undergoes a motion that is the simple vector combination of uniform velocity in the horizontal direction and uniform acceleration in the vertical direction (acceleration of gravity **g**) but the acceleration in x direction is **zero**. For a projectile launched with a speed $\boldsymbol{v_0}$ at an angle $\boldsymbol{\theta_0}$ with respect to the positive *x* axis, it can be shown that the trajectory caused by such a combination predicts a **parabolic shape**.

In projectile motion, the horizontal motion and the vertical motion are independent of each other; that is, neither motion affects the other.



The horizontal range R of the projectile is the horizontal distance the projectile has travelled when it returns to its initial height and is given by:

$$R = \frac{v_0^2}{g}\, sin2\theta_0$$

$$v_0 = \sqrt{g \times slope}$$

The horizontal range R is maximum for a launch angle of 45°.

Apparatus:

Projectile Launcher	Plastic ball	Table
Paper target	Meter stick	

Procedure:

1. Be sure the Projectile Launcher and paper target **at the same height**.
2. The launcher has three ranges: each range is determined by a click in the spring launcher and is also marked on the side of the launcher. Be sure to use the **first** click (**short** range setting).
3. Set up a projectile launcher at a 30^o angle.
4. Fire the launcher, plastic ball now would leave a mark on the paper target. Measure the horizontal distance (R) by using a meter stick from the launcher to the paper.
5. Record the ranges for different values of $\boldsymbol{\theta_0}$ and tabulate the result.
6. Graph the relation between the **sin 2**$\boldsymbol{\theta_0}$ on the **x-axis** and the **R** on the **y-axis** and **calculate the slope.**
7. Use the graph to calculate the **initial velocity** $\boldsymbol{v_0}$.