Assignment 4

Name : Ish Haresh Gavkhadkar
Github ID : ishgavkhadkar

MM22B026

PROJECTILE MOTION

Introdution:-

Projectile motion,refers to the motion of an object launched into the air that follows a curved path under the influence of gravity, with no other forces acting on it.
Q1) Department: an equation, a plot that describes the equation, a brief description of the equation and the symbols contained in it, a set of references that give more informatiom about the equation and finally, a paragraph on how you went about choosing the equation.

A. Vertical motion of a projectile under the influence of gravity.

Equation: $\mathbf{y} = \mathbf{u}\text{sint} - \frac{\mathbf{1}}{\mathbf{2}}\mathbf{gt^2} + \mathbf{u}\sin\theta\frac{\mathbf{t}_{\text{flight}}}{\mathbf{2}}$

- **y:** Vertical position of the projectile at a given time (m)
- **u**: Initial velocity of the projectile (m/s)
- **:** Launch angle of the projectile (deg)
- **t:** Time (s)
- **g:** Acceleration due to gravity (9.8 m/sˆ2)
- $\mathbf{t}_{\text{flight}}$**:** Time of flight of the projectile (s)
- **y** represents the vertical position of the projectile at a given time. It tells us how high or low the projectile is above the ground (measured in meters).
- **u** is the initial velocity of the projectile. It represents the magnitude of the velocity vector at the instant of launch. The velocity has both horizontal and vertical components.

- **sin** is the sine of the launch angle . The launch angle determines the direction of the projectile's initial velocity vector. It is measured in degrees.

- **t** is the time elapsed since the projectile was launched. It represents the independent variable of the equation and is measured in seconds.

- **g** is the acceleration due to gravity. On Earth, it is approximately 9.8 (m/sˆ2). It affects the vertical motion of the projectile, causing it to accelerate downward.

- $\mathbf{t}_{\text{flight}}$represents the total time of flight of the projectile. It is the time it takes for the projectile to reach the ground after being launched. It is calculated as 2 u sin / g.

1. **u**sint**:** This term represents the initial upward velocity component of the projectile. As the projectile is launched, this component contributes to the vertical displacement. It gradually decreases over time due to the effect of gravity.

2. $\frac{\mathbf{1}}{\mathbf{2}}\mathbf{gt^2}$:This term represents the vertical displacement due to the downward acceleration caused by gravity. As time increases, the effect of gravity becomes more pronounced, causing the projectile to fall faster.

3. $\mathbf{u}\sin\theta\frac{\mathbf{t}_{\text{flight}}}{\mathbf{2}}$**:** This term adjusts the equation to ensure the final position matches the initial position. It compensates for the fact that the projectile starts and ends at the same vertical position.

B. Horizonal motion of a projectile under the influence of gravity

Equation:- $\mathbf{x} = \mathbf{u}\text{cost}+\mathbf{u}\sin\theta\frac{\mathbf{t}_{\text{flight}}}{\mathbf{2}}$

- **x:** Horizontal position of the projectile at a given time (m)

- **u**: Initial velocity of the projectile (m/s)

- : Launch angle of the projectile (deg)

- **t:** Time (s)

- **g:** Acceleration due to gravity (9.8 m/sˆ2)

- $\mathbf{t}_{\text{flight}}$**:** Time of flight of the projectile (s), font=("Arial", 25)

- **x** represents the horizontal position of the projectile at a given time. It tells us how far the projectile has traveled horizontally from the starting point (measured in meters).

- **u** is the initial velocity of the projectile. It represents the magnitude of the velocity vector at the instant of launch. The velocity has both horizontal and vertical components.

- **cos :** is the cosine of the launch angle .The launch angle determines the direction of the projectile's initial velocity vector. It is measured in degrees.
- **t** is the time elapsed since the projectile was launched. It represents the independent variable of the equation and is measured in seconds.
- $\mathbf{t}_{\text{flight}}$**:**represents the total time of flight of the projectile. It is the time it takes for the projectile to reach the ground after being launched. It is calculated as 2 u sin() / g, where g is the acceleration due to gravity.

1. **u**cost This term represents the horizontal displacement of the projectile due to its initial velocity component in the x-direction. It describes the projectile's horizontal motion without considering the effect of gravity.
2. $\mathbf{u}\sin\theta\frac{\mathbf{t}_{\text{flight}}}{\mathbf{2}}$**:** This term adjusts the equation to ensure the final position matches the initial position. It compensates for the fact that the projectile starts and ends at the same horizontal position.

C. Time of Flight :-

Equation:- $\mathbf{t}_{\text{flight}}=\frac{\mathbf{2u}\sin\theta}{\mathbf{g}}$

- $\mathbf{t}_{\text{flight}}$**:** Time of flight of the projectile (s)
- **u**: Initial velocity of the projectile (m/s)
- **:** Launch angle of the projectile (deg)
- **g:** Acceleration due to gravity (9.8 m/sˆ2)
- $\mathbf{t}_{\text{flight}}$ represents the time of flight of the projectile, which is the total time it spends in the air from the moment of launch until it lands. It is measured in seconds.
- **u** is the initial velocity of the projectile. It represents the magnitude of the velocity vector at the instant of launch. The velocity has both horizontal and vertical components.
- **sin** is the sine of the launch angle . The launch angle determines the direction of the projectile's initial velocity vector. It is measured in degrees.
- **g** is the acceleration due to gravity, which is approximately 9.8 m/sˆ2. It represents the downward acceleration experienced by the projectile.

1. The equation itself is derived from the kinematic equations of motion for projectile motion
2. By plugging in the values of the initial velocity and launch angle, the equation can be used to calculate the time of flight for a given projectile.

D. Horizontal range of a projectile launched at a given initial velocity and angle

Equation: $\mathbf{R} = \frac{\mathbf{u_0^2 \sin 2\theta}}{\mathbf{g}}$

- **R**: Horizontal range of a projectile launched (m)
- **u**: Initial velocity of the projectile (m/s)
- **:** Launch angle of the projectile (deg)
- **g:** Acceleration due to gravity (9.8 m/sˆ2)
- **R** represents the horizontal range of the projectile, which is the horizontal distance traveled by the projectile before it lands. It is measured in meters.
- **u** is the initial velocity of the projectile. It represents the magnitude of the velocity vector at the instant of launch. The velocity has both horizontal and vertical components.
- is the launch angle of the projectile. It determines the direction of the projectile's initial velocity vector. It is measured in degrees.
- **sin2** is the sine of twice the launch angle. The factor of 2 accounts for the symmetrical nature of the projectile's trajectory.
- **g** is the acceleration due to gravity, which is approximately 9.8 m/sˆ2. It represents the downward acceleration experienced by the projectile

Q2) Paragraph on how you went about choosing the equation.

Firstly, I choosed this equation, because we are dealing with projectile motion since class 11 and its interesting and easy to understand. Projectile motion refers to the path followed by an object in motion under the influence of gravity, where the only force acting on it is the force of gravity. To accurately describe this motion, I chose the equation that consists elements: initial velocity, launch angle, time of flight, horizontal and vertical displacements, and acceleration due to gravity. Moreover, working with projectile motion equations provided me with a practical toolkit for solving real-world problems. Whether it was analyzing the trajectory of a launched rocket, understanding the motion of a baseball, or predicting the range of a cannonball, I felt empowered to apply my knowledge and make meaningful calculations. It make us to think pratically. In conclusion, I have chosen parametric equations for projectile motion because they provide a comprehensive framework for understanding and analyzing the behavior of objects moving under the influence of gravity.

Conclusion:-

In conclusion, projectile motion is a fascinating phenomenon that occurs when

an object is launched into the air and moves under the influence of gravity alone. It involves the object following a parabolic trajectory, with its motion being divided into separate horizontal and vertical components. By understanding and applying the principles of projectile motion, we can analyze and predict the behavior of objects those launched at different angles and velocities
[1]

[1] Wikipedia,"Article:BiotProjectile Motion",(Accessed: June , 2023)