PROJECTILE MOTION

The motion of a body is said to be projectile motion if its velocity has two components, where one component remains constant and the other changes continuously throughout the motion. It is a two-dimensional motion under the influence of a gravitational force and negligible air friction; this motion follows a parabolic path.

EXAMPLES:-

Some good examples of projectile motion are

1. **An object thrown from a window**
2. **A bomb released from a bomber plane**
3. **A shell shot from a gun**
4. **A kicked or thrown ball obliquely into the air, etc**

ASSUMPTIONS-

The analysis of a projectile motion becomes very simple if the following assumptions are made.

1. **The effect of air resistance is negligible**
2. **The value of 'g' is constant over the range of the projectile.**
3. **The rotation of the Earth doesn't affect the motion**

1. TIME TO REACH MAXIMUM HEIGHT:

The time the projectile takes to move from the point of projection to the peak point on its path is called the time to reach the maximum height.

$$t = \frac{V_o \sin\theta}{g}$$

TOTAL TIME OF FLIGHT

The time taken by a projectile to move from the point of projection to the point where it hits the ground level from which it was launched is called the total time of flight. It is twice the time to reach the maximum height.

$$T = \frac{2V_o \sin\theta}{g}$$

MAXIMUM HEIGHT:

The maximum vertical distance attained by the projection is called the maximum height.

$$H = \frac{V_0^2 \sin^2\theta}{2g}$$

HORIZONTAL RANGE:-

The distance between the point of projection and the point where it hits the level from which it was launched is known as its horizontal range.

$$R = \frac{V_o^2 \ \sin 2\theta}{g}$$

THE MAXIMUM RANGE

Consider $R = \frac{V_o^2}{g} Sin2\theta$ **. It is clear form this equation that, for a given initial velocity V_o, the horizontal range depends upon the value of Sin2θ**

Therefore, when Sin2θ = 1, range will be maximum then R = R_{max}

Hence, $R_{max} = \frac{V_o^2}{g}$ **For Sin2θ =1; 2θ = 90º**

$$\theta = \frac{90^o}{2}$$

$$\theta = 45^0$$

Thus, a projectile must be projected at an angle of 45º to attain the maximum range R_{max}

THE RANGE OF PROJECTILE AT COMPLEMENTARY ANGLES ARE SAME

The angles 40° and 50° are called complementary angles because they add up to 90°. Other examples of complementary pairs are: 30° and 60°; 15° and 75° etc. In other words, the range of a projectile will be the same for elevation angles of θ and 90° – θ