# Important Projectile Motion Formulas PDF

Formulas
Examples
with Units

**List of 10**
**Important Projectile Motion Formulas**

## 1) Height of Object given Horizontal Distance Formula

Evaluate Formula

Formula

$$v = R \cdot \tan\left(\theta_{pr}\right) - \frac{g \cdot R^2}{2 \cdot \left(u \cdot \cos\left(\theta_{pr}\right)\right)^2}$$

Example with Units

$$0.8267\,\text{m} = 2\,\text{m} \cdot \tan\left(0.4\,\text{rad}\right) - \frac{9.8\,\text{m/s}^2 \cdot 2\,\text{m}^2}{2 \cdot \left(35\,\text{m/s} \cdot \cos\left(0.4\,\text{rad}\right)\right)^2}$$

## 2) Initial Speed given Maximum Height Formula

Evaluate Formula

Formula

$$u = \frac{\sqrt{H_{max} \cdot 2 \cdot g}}{\sin\left(\theta_{pr}\right)}$$

Example with Units

$$35.0038\,\text{m/s} = \frac{\sqrt{9.48\,\text{m} \cdot 2 \cdot 9.8\,\text{m/s}^2}}{\sin\left(0.4\,\text{rad}\right)}$$

## 3) Initial Speed using Time of Flight Formula

Evaluate Formula

Formula

$$u = \frac{T \cdot g}{2 \cdot \sin\left(\theta_{pr}\right)}$$

Example with Units

$$35\,\text{m/s} = \frac{2.78156\,\text{s} \cdot 9.8\,\text{m/s}^2}{2 \cdot \sin\left(0.4\,\text{rad}\right)}$$

## 4) Initial Velocity using Range Formula

Evaluate Formula

Formula

$$u = \sqrt{g \cdot \frac{R_{motion}}{\sin\left(2 \cdot \theta_{pr}\right)}}$$

Example with Units

$$35\,\text{m/s} = \sqrt{9.8\,\text{m/s}^2 \cdot \frac{89.66951\,\text{m}}{\sin\left(2 \cdot 0.4\,\text{rad}\right)}}$$

## 5) Maximum Height Attained by Object Formula

Evaluate Formula

Formula

$$v_{max} = \frac{\left(u \cdot \sin\left(\theta_{pr}\right)\right)^2}{2 \cdot g}$$

Example with Units

$$9.4779\,\text{m} = \frac{\left(35\,\text{m/s} \cdot \sin\left(0.4\,\text{rad}\right)\right)^2}{2 \cdot 9.8\,\text{m/s}^2}$$

## 6) Maximum Height Attained for Inclined Projectile Formula

Evaluate Formula

**Formula**

$$H_{max} = \frac{\left(u \cdot \sin\left(\theta_{inclination}\right)\right)^2}{2 \cdot g \cdot \cos\left(\alpha_{pl}\right)}$$

**Example with Units**

$$9.4826\,\text{m} = \frac{\left(35\,\text{m/s} \cdot \sin\left(0.3827\,\text{rad}\right)\right)^2}{2 \cdot 9.8\,\text{m/s}^2 \cdot \cos\left(0.405\,\text{rad}\right)}$$

## 7) Maximum Range of Flight for Inclined Projectile Formula

Evaluate Formula

**Formula**

$$R_{motion} = \frac{u^2 \cdot \left(1 - \sin\left(\alpha_{pl}\right)\right)}{g \cdot \left(\cos\left(\alpha_{pl}\right)\right)^2}$$

**Example with Units**

$$89.6688\,\text{m} = \frac{35\,\text{m/s}^2 \cdot \left(1 - \sin\left(0.405\,\text{rad}\right)\right)}{9.8\,\text{m/s}^2 \cdot \left(\cos\left(0.405\,\text{rad}\right)\right)^2}$$

## 8) Range of Projectile Motion Formula

Evaluate Formula

**Formula**

$$R_{motion} = \frac{u^2 \cdot \sin\left(2 \cdot \theta_{pr}\right)}{g}$$

**Example with Units**

$$89.6695\,\text{m} = \frac{35\,\text{m/s}^2 \cdot \sin\left(2 \cdot 0.4\,\text{rad}\right)}{9.8\,\text{m/s}^2}$$

## 9) Time of Flight Formula

Evaluate Formula

**Formula**

$$T = \frac{2 \cdot u \cdot \sin\left(\theta_{pr}\right)}{g}$$

**Example with Units**

$$2.7816\,\text{s} = \frac{2 \cdot 35\,\text{m/s} \cdot \sin\left(0.4\,\text{rad}\right)}{9.8\,\text{m/s}^2}$$

## 10) Time of Flight for Inclined Projectile Formula

Evaluate Formula

**Formula**

$$T = \frac{2 \cdot u \cdot \sin\left(\theta_{inclination}\right)}{g \cdot \cos\left(\alpha_{pl}\right)}$$

**Example with Units**

$$2.9021\,\text{s} = \frac{2 \cdot 35\,\text{m/s} \cdot \sin\left(0.3827\,\text{rad}\right)}{9.8\,\text{m/s}^2 \cdot \cos\left(0.405\,\text{rad}\right)}$$

## Variables used in list of Projectile Motion Formulas above

- **g** Acceleration due to Gravity *(Meter per Square Second)*
- $H_{max}$ Maximum Height *(Meter)*
- **R** Horizontal Distance *(Meter)*
- $R_{motion}$ Range of Motion *(Meter)*
- **T** Time of Flight *(Second)*
- **u** Initial Velocity *(Meter per Second)*
- **v** Height of Crack *(Meter)*
- $v_{max}$ Maximum Height of Crack *(Meter)*
- $\alpha_{pl}$ Angle of Plane *(Radian)*
- $\theta_{inclination}$ Angle of Inclination *(Radian)*
- $\theta_{pr}$ Angle of Projection *(Radian)*

## Constants, Functions, Measurements used in list of Projectile Motion Formulas above

- Functions: **cos**, cos(Angle)
  *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Functions: **sin**, sin(Angle)
  *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **sqrt**, sqrt(Number)
  *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Functions: **tan**, tan(Angle)
  *The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.*
- Measurement: **Length** in Meter (m)
  *Length Unit Conversion*
- Measurement: **Time** in Second (s)
  *Time Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s)
  *Speed Unit Conversion*
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  *Acceleration Unit Conversion*
- Measurement: **Angle** in Radian (rad)
  *Angle Unit Conversion*

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