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Projectile Motion Formulas

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List of 10 Projectile Motion Formulas

Projectile Motion

1) Height of Object given Horizontal Distance

Open Calculator

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

ex $$0.826726\text{m} = 2\text{m} \cdot \tan(0.4\text{rad}) - \frac{9.8\text{m/s}^2 \cdot (2\text{m})^2}{2 \cdot (35\text{m/s} \cdot \cos(0.4\text{rad}))^2}$$

2) Initial Speed given Maximum Height

Open Calculator

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

ex $$35.00385\text{m/s} = \frac{\sqrt{9.48\text{m} \cdot 2 \cdot 9.8\text{m/s}^2}}{\sin(0.4\text{rad})}$$

3) Initial Speed using Time of Flight

Open Calculator

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

ex $$35.00001\text{m/s} = \frac{2.78156\text{s} \cdot 9.8\text{m/s}^2}{2 \cdot \sin(0.4\text{rad})}$$

4) Initial Velocity using Range

Open Calculator

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

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

5) Maximum Height Attained by Object

Open Calculator

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

$$9.477915\text{m} = \frac{(35\text{m/s} \cdot \sin(0.4\text{rad}))^2}{2 \cdot 9.8\text{m/s}^2}$$

6) Maximum Height Attained for Inclined Projectile

Open Calculator

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

$$9.482578\text{m} = \frac{(35\text{m/s} \cdot \sin(0.3827\text{rad}))^2}{2 \cdot 9.8\text{m/s}^2 \cdot \cos(0.405\text{rad})}$$

7) Maximum Range of Flight for Inclined Projectile

Open Calculator

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

$$89.66881\mathrm{m} = \frac{(35\mathrm{m/s})^2 \cdot (1 - \sin(0.405\mathrm{rad}))}{9.8\mathrm{m/s^2} \cdot (\cos(0.405\mathrm{rad}))^2}$$

8) Range of Projectile Motion

Open Calculator

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

$$89.66951\mathrm{m} = \frac{(35\mathrm{m/s})^2 \cdot \sin(2 \cdot 0.4\mathrm{rad})}{9.8\mathrm{m/s^2}}$$

9) Time of Flight

Open Calculator

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

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

10) Time of Flight for Inclined Projectile

Open Calculator

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

ex $$2.902106s = \frac{2 \cdot 35m/s \cdot \sin(0.3827rad)}{9.8m/s^2 \cdot \cos(0.405rad)}$$

Variables Used

- **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)*
- α_{pl} Angle of Plane *(Radian)*
- $\theta_{inclination}$ Angle of Inclination *(Radian)*
- θ_{pr} Angle of Projection *(Radian)*

Constants, Functions, Measurements used

- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **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.
- Function: **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.
- Function: **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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- **Kinematics Formulas**
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