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Parabolic Orbits Formulas

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List of 14 Parabolic Orbits Formulas

Parabolic Orbits

Orbital Position as Function of Time

1) Mean Anomaly in Parabolic Orbit given Time since Periapsis

Open Calculator

fx $$M_p = \frac{[GM.Earth]^2 \cdot t_p}{h_p^3}$$

ex $$82.00394^\circ = \frac{[GM.Earth]^2 \cdot 3578s}{(73508km^2/s)^3}$$

2) Mean Anomaly in Parabolic Orbit given True Anomaly

Open Calculator

fx $$M_p = \frac{\tan\left(\frac{\theta_p}{2}\right)}{2} + \frac{\tan\left(\frac{\theta_p}{2}\right)^3}{6}$$

ex $$81.90074^\circ = \frac{\tan\left(\frac{115^\circ}{2}\right)}{2} + \frac{\tan\left(\frac{115^\circ}{2}\right)^3}{6}$$

3) Time since Periapsis in Parabolic Orbit given Mean Anomaly

Open Calculator

fx $$t_p = \frac{h_p^3 \cdot M_p}{[GM.Earth]^2}$$

ex $$3577.828s = \frac{(73508km^2/s)^3 \cdot 82^\circ}{[GM.Earth]^2}$$

4) True Anomaly in Parabolic Orbit given Mean Anomaly

Open Calculator

$$\theta_p = 2 \cdot a\tan\left(\left(3 \cdot M_p + \sqrt{(3 \cdot M_p)^2 + 1}\right)^{\frac{1}{3}} - \left(3 \cdot M_p + \sqrt{(3 \cdot M_p)^2 + 1}\right)^{-\frac{1}{3}}\right)$$

ex $115.0331^\circ = 2 \cdot a\tan\left(\left(3 \cdot 82^\circ + \sqrt{(3 \cdot 82^\circ)^2 + 1}\right)^{\frac{1}{3}} - \left(3 \cdot 82^\circ + \sqrt{(3 \cdot 82^\circ)^2 + 1}\right)^{-\frac{1}{3}}\right)$

Parabolic Orbit Parameters

5) Angular Momentum given Perigee Radius of Parabolic Orbit

Open Calculator

$$h_p = \sqrt{2 \cdot [GM.Earth] \cdot r_{p,perigee}}$$

ex $73508.01\text{km}^2/\text{s} = \sqrt{2 \cdot [GM.Earth] \cdot 6778\text{km}}$

6) Escape Velocity given Radius of Parabolic Trajectory

Open Calculator

$$v_{p,esc} = \sqrt{\frac{2 \cdot [GM.Earth]}{r_p}}$$

ex $5.826988\text{km/s} = \sqrt{\frac{2 \cdot [GM.Earth]}{23479\text{km}}}$

7) Parameter of Orbit given X Coordinate of Parabolic Trajectory

Open Calculator

$$p_p = x \cdot \frac{1 + \cos(\theta_p)}{\cos(\theta_p)}$$

ex $10801.19\text{km} = -7906\text{km} \cdot \frac{1 + \cos(115^\circ)}{\cos(115^\circ)}$

8) Parameter of Orbit given Y Coordinate of Parabolic Trajectory

Open Calculator

fx $$p_p = y \cdot \frac{1 + \cos(\theta_p)}{\sin(\theta_p)}$$

ex $$10800.25\text{km} = 16953\text{km} \cdot \frac{1 + \cos(115^\circ)}{\sin(115^\circ)}$$

9) Perigee Radius of Parabolic Orbit given Angular Momentum

Open Calculator

fx $$r_{p,perigee} = \frac{h_p^2}{2 \cdot [GM.Earth]}$$

ex $$6777.998\text{km} = \frac{(73508\text{km}^2/\text{s})^2}{2 \cdot [GM.Earth]}$$

10) Radial Position in Parabolic Orbit given Angular Momentum and True Anomaly

Open Calculator

fx $$r_p = \frac{h_p^2}{[GM.Earth] \cdot (1 + \cos(\theta_p))}$$

ex $$23478.39\text{km} = \frac{(73508\text{km}^2/\text{s})^2}{[GM.Earth] \cdot (1 + \cos(115^\circ))}$$

11) Radial Position in Parabolic Orbit given Escape Velocity

Open Calculator

fx $$r_p = \frac{2 \cdot [GM.Earth]}{v_{p,esc}^2}$$

ex $$23479\text{km} = \frac{2 \cdot [GM.Earth]}{(5.826988\text{km/s})^2}$$

12) True Anomaly in Parabolic Orbit given Radial Position and Angular Momentum

Open Calculator

fx $$\theta_p = a\cos\left(\frac{h_p^2}{[GM.Earth]\cdot r_p} - 1\right)$$

ex $$115.0009^\circ = a\cos\left(\frac{(73508km^2/s)^2}{[GM.Earth]\cdot 23479km} - 1\right)$$

13) X Coordinate of Parabolic Trajectory given Parameter of Orbit

Open Calculator

fx $$x = p_p \cdot \left(\frac{\cos(\theta_p)}{1+\cos(\theta_p)}\right)$$

ex $$-7905.129179km = 10800km \cdot \left(\frac{\cos(115^\circ)}{1+\cos(115^\circ)}\right)$$

14) Y Coordinate of Parabolic Trajectory given Parameter of Orbit

Open Calculator

fx $$y = p_p \cdot \frac{\sin(\theta_p)}{1+\cos(\theta_p)}$$

ex $$16952.6km = 10800km \cdot \frac{\sin(115^\circ)}{1+\cos(115^\circ)}$$

Variables Used

- h_p Angular Momentum of Parabolic Orbit *(Square Kilometer per Second)*
- M_p Mean Anomaly in Parabolic Orbit *(Degree)*
- p_p Parameter of Parabolic Orbit *(Kilometer)*
- r_p Radial Position in Parabolic Orbit *(Kilometer)*
- $r_{p,perigee}$ Perigee Radius in Parabolic Orbit *(Kilometer)*
- t_p Time since Periapsis in Parabolic Orbit *(Second)*
- $v_{p,esc}$ Escape Velocity in Parabolic Orbit *(Kilometer per Second)*
- x X Coordinate Value *(Kilometer)*
- y Y Coordinate Value *(Kilometer)*
- θ_p True Anomaly in Parabolic Orbit *(Degree)*

Constants, Functions, Measurements used

- Constant: **[GM.Earth]**, 3.986004418E+14
  Earth's Geocentric Gravitational Constant
- Function: **acos**, acos(Number)
  The inverse cosine function, is the inverse function of the cosine function. It is the function that takes a ratio as an input and returns the angle whose cosine is equal to that ratio.
- Function: **atan**, atan(Number)
  Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.
- 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 Kilometer (km)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Speed** in Kilometer per Second (km/s)
  Speed Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Specific Angular Momentum** in Square Kilometer per Second (km²/s)
  Specific Angular Momentum Unit Conversion

Check other formula lists

- **Elliptical Orbits Formulas**
- **Hyperbolic Orbits Formulas**
- **Parabolic Orbits Formulas**

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