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Parabolic Orbits Formulas

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List of 14 Parabolic Orbits Formulas

Parabolic Orbits

1) Escape Velocity given Radius of Parabolic Trajectory

Open Calculator

fx $$v_{esc} = \sqrt{\frac{2 \cdot \mu}{r_{or}}}$$

ex $$8560.561\text{m/s} = \sqrt{\frac{2 \cdot 3.98\text{E}14\text{m}^3/\text{s}^2}{10861.97\text{km}}}$$

2) Parameter of Orbit given X Coordinate of Parabolic Trajectory

Open Calculator

fx $$p = x \cdot \frac{1 + \cos(\theta)}{\cos(\theta)}$$

ex $$10861.96\text{km} = -5243.39\text{km} \cdot \frac{1 + \cos(109^\circ)}{\cos(109^\circ)}$$

3) Parameter of Orbit given Y Coordinate of Parabolic Trajectory

Open Calculator

fx $$p = y \cdot \frac{1 + \cos(\theta)}{\sin(\theta)}$$

ex $$10861.97\text{km} = 15227.92\text{km} \cdot \frac{1 + \cos(109^\circ)}{\sin(109^\circ)}$$

4) Radius of Parabolic Orbit given Escape Velocity

Open Calculator

fx $$r_{or} = \frac{2 \cdot \mu}{v_{esc}^2}$$

ex $$10807.66\text{km} = \frac{2 \cdot 3.98\text{E}14\text{m}^3/\text{s}^2}{(8582.043\text{m/s})^2}$$

5) X Coordinate of Parabolic Trajectory given Parameter of Orbit

Open Calculator

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

ex $$-5213.47871\text{km} = 10800\text{km} \cdot \left(\frac{\cos(109^\circ)}{1 + \cos(109^\circ)} \right)$$

6) Y Coordinate of Parabolic Trajectory given Parameter of Orbit

Open Calculator

fx $$y = p \cdot \frac{\sin(\theta)}{1 + \cos(\theta)}$$

ex $$15141.04\text{km} = 10800\text{km} \cdot \frac{\sin(109^\circ)}{1 + \cos(109^\circ)}$$

Angular Momentum

7) Angular Momentum given Perigee Radius of Parabolic Orbit

Open Calculator

fx $$h = \sqrt{2 \cdot [\text{GM.Earth}] \cdot r_{\text{perigee}}}$$

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

8) Perigee Radius of Parabolic Orbit given Angular Momentum

Open Calculator

fx $$r_{\text{perigee}} = \frac{h^2}{2 \cdot [\text{GM.Earth}]}$$

ex $$5422.802\text{km} = \frac{(65750\text{km}^2/\text{s})^2}{2 \cdot [\text{GM.Earth}]}$$

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

Open Calculator

fx $$r = \frac{h^2}{[GM.Earth] \cdot (1 + \cos(\theta))}$$

ex $$16081.1\text{km} = \frac{(65750\text{km}^2/\text{s})^2}{[GM.Earth] \cdot (1 + \cos(109^\circ))}$$

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

Open Calculator

fx $$\theta = a\cos\left(\frac{h^2}{[GM.Earth] \cdot r} - 1\right)$$

ex $$101.5645^\circ = a\cos\left(\frac{(65750\text{km}^2/\text{s})^2}{[GM.Earth] \cdot 13565\text{km}} - 1\right)$$

Orbital Position as Function of Time

11) Mean Anomaly in Parabolic Orbit given Time since Periapsis

Open Calculator

fx $$M = \frac{[GM.Earth]^2 \cdot t}{h^3}$$

ex $$448.3725^\circ = \frac{[GM.Earth]^2 \cdot 14000\text{s}}{(65750\text{km}^2/\text{s})^3}$$

12) Mean Anomaly in Parabolic Orbit given True Anomaly

Open Calculator

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

ex $$66.47568^\circ = \frac{\tan\left(\frac{109^\circ}{2}\right)}{2} + \frac{\tan\left(\frac{109^\circ}{2}\right)^3}{6}$$

13) Time since Periapsis in Parabolic Orbit given Mean Anomaly

Open Calculator

fx $$t = \frac{h^3 \cdot M}{[GM.Earth]^2}$$

ex $$2497.923\text{s} = \frac{(65750\text{km}^2/\text{s})^3 \cdot 80^\circ}{[GM.Earth]^2}$$

14) True Anomaly in Parabolic Orbit given Mean Anomaly

fx Open Calculator

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

ex $$114.3551^\circ = 2 \cdot a\tan\left(\left(3 \cdot 80^\circ + \sqrt{(3 \cdot 80^\circ)^2 + 1}\right)^{\frac{1}{3}} - \left(3 \cdot 80^\circ + \sqrt{(3 \cdot 80^\circ)^2 + 1}\right)^{-\frac{1}{3}}\right)$$

Variables Used

- **h** Angular Momentum of Orbit *(Square Kilometer per Second)*
- **M** Mean Anomaly *(Degree)*
- **p** Parameter of Orbit *(Kilometer)*
- **r** Radial Position of Satellite *(Kilometer)*
- r_{or} Orbit Radius *(Kilometer)*
- $r_{perigee}$ Perigee Radius *(Kilometer)*
- **t** Time since Periapsis *(Second)*
- v_{esc} Escape Velocity *(Meter per Second)*
- **x** X Coordinate Value *(Kilometer)*
- **y** Y Coordinate Value *(Kilometer)*
- **θ** True Anomaly *(Degree)*
- **μ** Standard Gravitational Parameter *(Cubic Meter per Square Second)*

Constants, Functions, Measurements used

- Constant: **[GM.Earth]**, 3.986004418×10^14 m^3 s^−2
  Earth's Geocentric Gravitational Constant
- Function: **acos**, acos(Number)
  Inverse trigonometric cosine function
- Function: **atan**, atan(Number)
  Inverse trigonometric tangent function
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- Function: **tan**, tan(Angle)
  Trigonometric tangent function
- Measurement: **Length** in Kilometer (km)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Gravitational Parameter** in Cubic Meter per Square Second (m³/s²)
  Gravitational Parameter 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**
- **Parabolic Orbits Formulas**
- **Hyperbolic Orbits Formulas**

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