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Circular Orbits Formulas

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List of 18 Circular Orbits Formulas

Circular Orbits

Circular Orbit Parameters

1) Circular Orbital Radius

Open Calculator

fx $$r = \frac{h_c^2}{[GM.Earth]}$$

ex $$10858.47\text{km} = \frac{(65789\text{km}^2/\text{s})^2}{[GM.Earth]}$$

2) Circular Orbital Radius Given Time Period of Circular Orbit

Open Calculator

fx $$r = \left(\frac{T_{or} \cdot \sqrt{[GM.Earth]}}{2 \cdot \pi}\right)^{\frac{2}{3}}$$

ex $$10859.33\text{km} = \left(\frac{11262\text{s} \cdot \sqrt{[GM.Earth]}}{2 \cdot \pi}\right)^{\frac{2}{3}}$$

3) Circular Orbital Radius Given Velocity of Circular Orbit

Open Calculator

fx $$r = \frac{[GM.Earth]}{v_{cir}^2}$$

ex $$10889.98km = \frac{[GM.Earth]}{(6.05km/s)^2}$$

4) Escape Velocity given Speed of Satellite in Circular Orbit

Open Calculator

fx $$v_{esc} = \sqrt{2} \cdot v_{cir}$$

ex $$8.555992km/s = \sqrt{2} \cdot 6.05km/s$$

5) Orbital Period

Open Calculator

fx $$T_{or} = 2 \cdot \pi \cdot \sqrt{\frac{r^3}{[G.] \cdot M}}$$

ex $$11235.52s = 2 \cdot \pi \cdot \sqrt{\frac{(10859km)^3}{[G.] \cdot 6E\hat{}24kg}}$$

6) Orbital Radius Given Specific Energy of Circular Orbit

Open Calculator

fx $$r = -\frac{[GM.Earth]}{2 \cdot \varepsilon}$$

ex $$10858.68km = -\frac{[GM.Earth]}{2 \cdot -18354kJ/kg}$$

7) Specific Energy of Circular Orbit

Open Calculator

fx $$\varepsilon = -\frac{[GM.Earth]^2}{2 \cdot h_c^2}$$

ex $$-18354.349007 kJ/kg = -\frac{[GM.Earth]^2}{2 \cdot (65789 km^2/s)^2}$$

8) Specific Energy of Circular Orbit Given Orbital Radius

Open Calculator

fx $$\varepsilon = -\frac{[GM.Earth]}{2 \cdot r}$$

ex $$-18353.459886 kJ/kg = -\frac{[GM.Earth]}{2 \cdot 10859 km}$$

9) Speed of Satellite in Circular LEO as Function of Altitude

Open Calculator

fx $$v = \sqrt{\frac{[GM.Earth]}{[Earth\text{-}R] + z}}$$

ex $$3.142202 km/s = \sqrt{\frac{[GM.Earth]}{[Earth\text{-}R] + 34000 km}}$$

10) Time Period of Circular Orbit

Open Calculator

fx $$T_{or} = \frac{2 \cdot \pi \cdot r^{\frac{3}{2}}}{\sqrt{[GM.Earth]}}$$

ex $$11261.49s = \frac{2 \cdot \pi \cdot (10859km)^{\frac{3}{2}}}{\sqrt{[GM.Earth]}}$$

11) Velocity of Circular Orbit

Open Calculator

fx $$v_{cir} = \sqrt{\frac{[GM.Earth]}{r}}$$

ex $$6.058624km/s = \sqrt{\frac{[GM.Earth]}{10859km}}$$

Geostationary Earth Satellite

12) Absolute Angular Velocity given Geo Radius of Earth and Geo Speed

Open Calculator

fx $$\Omega_E = \frac{v}{R_{gso}}$$

ex $$7.3E\hat{}\text{-}5rad/s = \frac{3.07km/s}{42164.17km}$$

13) Absolute Angular Velocity of Earth given Geo Radius

Open Calculator

fx $$\Omega_E = \sqrt{\frac{[GM.Earth]}{R_{gso}^3}}$$

ex $$7.3E\hat{}\text{-}5rad/s = \sqrt{\frac{[GM.Earth]}{(42164.17km)^3}}$$

14) Geo Radius given Absolute Angular Velocity of Earth

Open Calculator

fx $$R_{gso} = \left(\frac{[GM.Earth]}{\Omega_E^2}\right)^{\frac{1}{3}}$$

ex $$42164.17km = \left(\frac{[GM.Earth]}{(7.2921159E\hat{}\text{-}05rad/s)^2}\right)^{\frac{1}{3}}$$

15) Geo Radius given Absolute Angular Velocity of Earth and Geo Speed

Open Calculator

fx $$R_{gso} = \frac{v}{\Omega_E}$$

ex $$42100.26km = \frac{3.07km/s}{7.2921159E\hat{}\text{-}05rad/s}$$

16) Geo Radius given Speed of Satellite in its Circular Geo Orbit

Open Calculator

fx $$R_{gso} = \frac{[GM.Earth]}{v^2}$$

ex $$42292.27km = \frac{[GM.Earth]}{(3.07km/s)^2}$$

17) Geo Speed along its Circular Path given Absolute Angular Velocity of Earth

Open Calculator

fx $$v = \Omega_E \cdot R_{gso}$$

ex $$3.07466km/s = 7.2921159E\hat{}\text{-}05rad/s \cdot 42164.17km$$

18) Speed of Satellite in its Circular GEO of Radius

Open Calculator

fx $$v = \sqrt{\frac{[GM.Earth]}{R_{gso}}}$$

ex $$3.07466km/s = \sqrt{\frac{[GM.Earth]}{42164.17km}}$$

Variables Used

- h_c Angular Momentum of Circular Orbit *(Square Kilometer per Second)*
- **M** Central Body Mass *(Kilogram)*
- **r** Orbit Radius *(Kilometer)*
- R_{gso} Geostationary Radius *(Kilometer)*
- T_{or} Time Period of Orbit *(Second)*
- **v** Speed of Satellite *(Kilometer per Second)*
- v_{cir} Velocity of Circular Orbit *(Kilometer per Second)*
- v_{esc} Escape Velocity *(Kilometer per Second)*
- **z** Height of Satellite *(Kilometer)*
- **ε** Specific Energy of Orbit *(Kilojoule per Kilogram)*
- Ω_E Angular Speed of the Earth *(Radian per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[Earth-R]**, 6371.0088
  Earth mean radius
- Constant: **[GM.Earth]**, 3.986004418E+14
  Earth's Geocentric Gravitational Constant
- Constant: **[G.]**, 6.67408E-11
  Gravitational constant
- 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.
- Measurement: **Length** in Kilometer (km)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Speed** in Kilometer per Second (km/s)
  Speed Unit Conversion
- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  Angular Velocity Unit Conversion
- Measurement: **Specific Energy** in Kilojoule per Kilogram (kJ/kg)
  Specific Energy Unit Conversion
- Measurement: **Specific Angular Momentum** in Square Kilometer per Second (km²/s)
  Specific Angular Momentum Unit Conversion

Check other formula lists

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

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