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Gravitation Formulas

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List of 21 Gravitation Formulas

Gravitation

1) Gravitational Field Intensity

$$fx \quad E = \frac{F}{m}$$

Open Calculator 

$$ex \quad 0.075758N/Kg = \frac{2.5N}{33kg}$$

2) Gravitational Field Intensity due to Point Mass

$$fx \quad E = \frac{[G.] \cdot m \cdot m_o}{r}$$

Open Calculator 

$$ex \quad 1.8E^{-10}N/Kg = \frac{[G.] \cdot 33kg \cdot 0.5kg}{6m}$$

3) Gravitational Potential Energy

$$fx \quad U = - \frac{[G.] \cdot m_1 \cdot m_2}{r_c}$$

Open Calculator 

$$ex \quad -1.5E^{-10}J = - \frac{[G.] \cdot 14kg \cdot 16kg}{102m}$$



4) Time Period of Satellite

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)

$$fx \quad T = \left(\frac{2 \cdot \pi}{[\text{Earth-R}]} \right) \cdot \sqrt{\frac{([\text{Earth-R}] + h)^3}{g}}$$

$$ex \quad 1.407245h = \left(\frac{2 \cdot \pi}{[\text{Earth-R}]} \right) \cdot \sqrt{\frac{([\text{Earth-R}] + 13m)^3}{9.8m/s^2}}$$

5) Universal Law of Gravitation

[Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1_img.jpg\)](#)

$$fx \quad F = \frac{[G.] \cdot m_1 \cdot m_2}{r_c^2}$$

$$ex \quad 1.4E^{-12}N = \frac{[G.] \cdot 14kg \cdot 16kg}{(102m)^2}$$

Gravitational Field

6) Gravitational Field of Ring

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$fx \quad I = - \frac{[G.] \cdot m \cdot a}{\left(r_{\text{ring}}^2 + a^2 \right)^{\frac{3}{2}}}$$

$$ex \quad -3.4E^{-15}N/Kg = - \frac{[G.] \cdot 33kg \cdot 4m}{\left((5m)^2 + (4m)^2 \right)^{\frac{3}{2}}}$$



7) Gravitational Field of Ring given Angle at any Point Outside Ring

$$\text{fx } I = - \frac{[G.] \cdot m \cdot \cos(\theta)}{\left(a^2 + r_{\text{ring}}^2\right)^2}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$\text{ex } -1.1\text{E}^{-12}\text{N/Kg} = - \frac{[G.] \cdot 33\text{kg} \cdot \cos(30^\circ)}{\left((4\text{m})^2 + (5\text{m})^2\right)^2}$$

8) Gravitational Field of Thin Circular Disc

$$\text{fx } I = - \frac{2 \cdot [G.] \cdot m \cdot (1 - \cos(\theta))}{r_c^2}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$\text{ex } -5.7\text{E}^{-14}\text{N/Kg} = - \frac{2 \cdot [G.] \cdot 33\text{kg} \cdot (1 - \cos(30^\circ))}{(102\text{m})^2}$$

9) Gravitational Field when Point is Inside of Non Conducting Solid Sphere

$$\text{fx } I = - \frac{[G.] \cdot m \cdot a}{R^3}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$\text{ex } -4.5\text{E}^{-9}\text{N/Kg} = - \frac{[G.] \cdot 33\text{kg} \cdot 4\text{m}}{(1.25\text{m})^3}$$



10) Gravitational Field when Point is Outside of Conducting Solid Sphere

$$\text{fx } I = -\frac{[G.] \cdot m}{a^2}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$\text{ex } -1.4E^{-10}N/Kg = -\frac{[G.] \cdot 33kg}{(4m)^2}$$

11) Gravitational Field when Point is Outside of Non Conducting Solid Sphere

$$\text{fx } I = -\frac{[G.] \cdot m}{a^2}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } -1.4E^{-10}N/Kg = -\frac{[G.] \cdot 33kg}{(4m)^2}$$

Gravitational Potential

12) Gravitational Potential

$$\text{fx } V = -\frac{[G.] \cdot m}{s_{\text{body}}}$$

[Open Calculator !\[\]\(0fb13ad0bfa3d86868cdd3883e5665b3_img.jpg\)](#)

$$\text{ex } -5.9E^{-12}J/kg = -\frac{[G.] \cdot 33kg}{375m}$$



13) Gravitational Potential of Ring

$$\text{fx } V = - \frac{[G.] \cdot m}{\sqrt{r_{\text{ring}}^2 + a^2}}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } -3.4\text{E}^{-12}\text{J/kg} = - \frac{[G.] \cdot 33\text{kg}}{\sqrt{(5\text{m})^2 + (4\text{m})^2}}$$

14) Gravitational Potential of Thin Circular Disc

$$\text{fx } V = - \frac{2 \cdot [G.] \cdot m \cdot (\sqrt{a^2 + R^2} - a)}{R^2}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$\text{ex } -5.4\text{E}^{-10}\text{J/kg} = - \frac{2 \cdot [G.] \cdot 33\text{kg} \cdot (\sqrt{(4\text{m})^2 + (1.25\text{m})^2} - 4\text{m})}{(1.25\text{m})^2}$$

15) Gravitational Potential when Point is Inside of Conducting Solid Sphere

$$\text{fx } V = - \frac{[G.] \cdot m}{R}$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$\text{ex } -1.8\text{E}^{-9}\text{J/kg} = - \frac{[G.] \cdot 33\text{kg}}{1.25\text{m}}$$



16) Gravitational Potential when Point is Inside of Non Conducting Solid Sphere

$$\text{fx } V = - \frac{[G.] \cdot m \cdot (3 \cdot r_c^2 - a^2)}{2 \cdot R^3}$$

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

$$\text{ex } -1.8E^{-5} \text{J/kg} = - \frac{[G.] \cdot 33\text{kg} \cdot (3 \cdot (102\text{m})^2 - (4\text{m})^2)}{2 \cdot (1.25\text{m})^3}$$

17) Gravitational Potential when Point is Outside of Conducting Solid Sphere

$$\text{fx } V = - \frac{[G.] \cdot m}{a}$$

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5_img.jpg\)](#)

$$\text{ex } -5.5E^{-10} \text{J/kg} = - \frac{[G.] \cdot 33\text{kg}}{4\text{m}}$$

18) Gravitational Potential when Point is Outside of Non Conducting Solid Sphere

$$\text{fx } V = - \frac{[G.] \cdot m}{a}$$

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2_img.jpg\)](#)

$$\text{ex } -5.5E^{-10} \text{J/kg} = - \frac{[G.] \cdot 33\text{kg}}{4\text{m}}$$



Variation of Acceleration due to Gravity

19) Variation of Acceleration due to Gravity on Altitude

$$\text{fx } g_v = g \cdot \left(1 - \frac{2 \cdot h}{[\text{Earth-R}]} \right)$$

[Open Calculator !\[\]\(96cc62f861fdd6e50510c0224a756dff_img.jpg\)](#)

$$\text{ex } 9.79996\text{m/s}^2 = 9.8\text{m/s}^2 \cdot \left(1 - \frac{2 \cdot 13\text{m}}{[\text{Earth-R}]} \right)$$

20) Variation of Acceleration due to Gravity on Depth

$$\text{fx } g_v = g \cdot \left(1 - \frac{D}{[\text{Earth-R}]} \right)$$

[Open Calculator !\[\]\(f95dab70c751fda7d824b8b03650f7aa_img.jpg\)](#)

$$\text{ex } 9.799995\text{m/s}^2 = 9.8\text{m/s}^2 \cdot \left(1 - \frac{3\text{m}}{[\text{Earth-R}]} \right)$$

21) Variation of Acceleration on Surface of Earth due to Gravity Effect

$$\text{fx } g_v = g \cdot \left(1 - \frac{[\text{Earth-R}] \cdot \omega}{g} \right)$$

[Open Calculator !\[\]\(e9474ce1d70442456f8fe9c393ea149c_img.jpg\)](#)

$$\text{ex } -12742007.8\text{m/s}^2 = 9.8\text{m/s}^2 \cdot \left(1 - \frac{[\text{Earth-R}] \cdot 2\text{rad/s}}{9.8\text{m/s}^2} \right)$$











Variables Used



- **a** Distance from Center to Point (Meter)
- **D** Depth (Meter)
- **E** Gravitational Field Intensity (Newton per Kilogram)
- **F** Force (Newton)
- **g** Acceleration due to Gravity (Meter per Square Second)
- **g_v** Variation of Acceleration due to Gravity (Meter per Square Second)
- **h** Altitude (Meter)
- **I** Gravitational Field (Newton per Kilogram)
- **m** Mass (Kilogram)
- **m₁** Mass 1 (Kilogram)
- **m₂** Mass 2 (Kilogram)
- **m_o** Test Mass (Kilogram)
- **r** Distance between Two Bodies (Meter)
- **R** Radius (Meter)
- **r_c** Distance between Centers (Meter)
- **r_{ring}** Radius of Ring (Meter)
- **S_{body}** Displacement of Body (Meter)
- **T** Time period of Satellite (Hour)
- **U** Gravitational Potential Energy (Joule)
- **V** Gravitational Potential (Joule per Kilogram)
- **θ** Theta (Degree)
- **ω** Angular Velocity (Radian per Second)



Constants, Functions, Measurements used










- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Constant:** **[Earth-R]**, 6371.0088 Kilometer
Earth mean radius
- **Constant:** **[G.]**, $6.67408E-11 \text{ * Meter}^3/\text{Kiogram Second}^2$
Gravitational constant
- **Function:** **cos**, $\cos(\text{Angle})$
Trigonometric cosine function
- **Function:** **sqrt**, $\text{sqrt}(\text{Number})$
Square root function
- **Measurement:** **Length** in Meter (m)
Length Unit Conversion 
- **Measurement:** **Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement:** **Time** in Hour (h)
Time Unit Conversion 
- **Measurement:** **Acceleration** in Meter per Square Second (m/s^2)
Acceleration Unit Conversion 
- **Measurement:** **Energy** in Joule (J)
Energy Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Angle** in Degree ($^\circ$)
Angle Unit Conversion 
- **Measurement:** **Angular Velocity** in Radian per Second (rad/s)
Angular Velocity Unit Conversion 



- **Measurement: Gravitational Potential** in Joule per Kilogram (J/kg)
Gravitational Potential Unit Conversion 
- **Measurement: Gravitational Field Intensity** in Newton per Kilogram (N/Kg)
Gravitational Field Intensity Unit Conversion 



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