



# **Gravitation Formulas**

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#### **List of 20 Gravitation Formulas**

#### **Gravitation**

### Fundamental Concepts in Gravitation

1) Time Period of Satellite

$$ag{T} = \left(rac{2\cdot\pi}{ ext{[Earth-R]}}
ight)\cdot\sqrt{rac{\left( ext{[Earth-R]}+ ext{h}
ight)^3}{ ext{[g]}}}$$

Open Calculator

$$\boxed{ 11.11329 \text{h} = \left( \frac{2 \cdot \pi}{\text{[Earth-R]}} \right) \cdot \sqrt{\frac{\left( \text{[Earth-R]} + 189e5\text{m} \right)^3}{\text{[g]}} } }$$

2) Universal Law of Gravitation

$$extbf{F'} = rac{[\mathrm{G.}] \cdot \mathrm{m}_1 \cdot \mathrm{m}_2}{\mathrm{r}_\mathrm{c}^2}$$

Open Calculator

$$2 \text{E}^2 6 \text{N} = \frac{ [\text{G.}] \cdot 7.34 \text{E}^2 2 \text{kg} \cdot 5.97 \text{E}^2 4 \text{kg} }{ \left( 3.84 \text{E}^5 \text{m} \right)^2 }$$



#### 3) Variation of Acceleration due to Gravity on Altitude

 $\left|\mathbf{g}_{\mathrm{v}}=\left[\mathrm{g}
ight]\cdot\left(1-rac{2\cdot\mathrm{h_{\mathrm{sealevel}}}}{\left[\mathrm{Earth-R}
ight]}
ight)
ight|$ 

Open Calculator

 $\begin{array}{c} \textbf{ex} \ 9.806548 \text{m/s}^{_2} = [\text{g}] \cdot \left(1 - \frac{2 \cdot 33.2 \text{m}}{[\text{Earth-R}]}\right) \end{array}$ 

# 4) Variation of Acceleration due to Gravity on Depth

 $\left|\mathbf{g}_{\mathrm{v}}=\left[\mathrm{g}
ight]\cdot\left(1-rac{\mathrm{D}}{\left[\mathrm{Earth-R}
ight]}
ight)
ight|$ 

Open Calculator 🗗

 $oxed{egin{aligned} \mathbf{ex} } 9.806645 \mathrm{m/s^2} = [\mathrm{g}] \cdot \left(1 - rac{3\mathrm{m}}{[\mathrm{Earth-R}]}
ight) \end{aligned}}$ 

### 5) Variation of Acceleration on Surface of Earth due to Gravity Effect

 $\mathbf{f}\mathbf{x}egin{aligned} \mathbf{g}_{\mathrm{v}} = [\mathrm{g}] \cdot \left(1 - rac{[\mathrm{Earth-R}] \cdot \omega}{[\mathrm{g}]}
ight)^{T} \end{aligned}$ 

Open Calculator 🗗

 $\boxed{ 9.783714 \text{m/s}^2 = [\text{g}] \cdot \left(1 - \frac{[\text{Earth-R}] \cdot 3.6\text{e-}9\text{rad/s}}{[\text{g}]} \right) }$ 



#### Gravitational Field

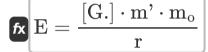
### 6) Gravitational Field Intensity

$$\mathbf{E} = \frac{\mathbf{F}}{\mathbf{m}}$$

Open Calculator 🗗

 $0.075758 {
m N/Kg} = rac{2.5 {
m N}}{33 {
m kg}}$ 

#### 7) Gravitational Field Intensity due to Point Mass



Open Calculator 🗗

 $\frac{\text{ex}}{0.073582 \text{N/Kg}} = \frac{[\text{G.}] \cdot 9000 \text{kg} \cdot 9800 \text{kg}}{0.08 \text{m}}$ 

## 8) Gravitational Field of Ring

$$extbf{I}_{ ext{ring}} = -rac{[ ext{G.}]\cdot ext{m}\cdot ext{a}}{\left( ext{r}_{ ext{ring}}^2+ ext{a}^2
ight)^{rac{3}{2}}}$$

Open Calculator 🗗

 $\boxed{ -3.2 \text{E}^{\text{-}}\text{-}16 \text{N}/\text{Kg} = -\frac{[\text{G.}] \cdot 33 \text{kg} \cdot 25 \text{m}}{\left(\left(6 \text{m}\right)^2 + \left(25 \text{m}\right)^2\right)^{\frac{3}{2}}} }$ 





9) Gravitational Field of Ring given Angle at any Point Outside Ring Open Calculator

$$ag{I_{
m ring}} = -rac{[{
m G.}]\cdot{
m m}\cdot{
m cos}( heta)}{\left({
m a}^2+{
m r}_{
m ring}^2
ight)^2}$$

$$\boxed{ -3.2 \text{E}^{\text{-}}\text{-}16 \text{N}/\text{Kg} = -\frac{[\text{G.}] \cdot 33 \text{kg} \cdot \cos(86.4^{\circ})}{\left(\left(25 \text{m}\right)^{2} + \left(6 \text{m}\right)^{2}\right)^{2}} }$$

## 10) Gravitational Field of Thin Circular Disc 🖸

$$I_{
m disc} = -rac{2\cdot [{
m G.}]\cdot {
m m}\cdot (1-\cos( heta))}{{
m r}_{
m c}^2}$$

Open Calculator

$$\boxed{ -2.8 \text{E}^2 - 20 \text{N/Kg} = -\frac{2 \cdot [\text{G.}] \cdot 33 \text{kg} \cdot (1 - \cos(86.4^\circ))}{(3.84 \text{E}^2 \text{5m})^2} }$$

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

$$\mathbf{E} = -rac{[\mathrm{G.}] \cdot \mathrm{m} \cdot \mathrm{a}}{\mathrm{R}^3}$$

$$oxed{ex}$$
 -3.5E^-15N/Kg  $=-rac{[\mathrm{G.}]\cdot33\mathrm{kg}\cdot25\mathrm{m}}{(250\mathrm{m})^3}$ 

Open Calculator G



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

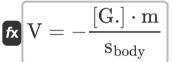
fx  $I = -rac{[\mathrm{G.}]\cdot\mathrm{m}}{\mathrm{a}^2}$ 

Open Calculator

 $extstyle -3.5 ext{E^--}12 ext{N/Kg} = -rac{ ext{[G.]} \cdot 33 ext{kg}}{ ext{(25m)}^2}$ 

#### **Gravitational Potential**

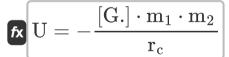
### 13) Gravitational Potential



Open Calculator 🗗

 $ext{ex} ext{-}2.9 ext{E^--}9 ext{J/kg} = -rac{[ ext{G.}]\cdot 33 ext{kg}}{0.75 ext{m}}$ 

#### 14) Gravitational Potential Energy 🚰



Open Calculator

 $-7.6 \text{E}^3 1 \text{J} = -rac{[ ext{G.}] \cdot 7.34 \text{E}^2 2 ext{kg} \cdot 5.97 \text{E}^2 4 ext{kg}}{3.84 \text{E}^5 ext{m}}$ 



#### 15) Gravitational Potential of Ring

 $V_{
m ring} = -rac{[{
m G.}]\cdot{
m m}}{\sqrt{r_{
m ring}^2+a^2}}$ 

Open Calculator

 $-8.6\text{E}^{-13\text{J/kg}} = -\frac{[\text{G.}] \cdot 33\text{kg}}{\sqrt{\left(6\text{m}\right)^{2} + \left(25\text{m}\right)^{2}}}$ 

### 16) Gravitational Potential of Thin Circular Disc

 $\left| ext{U}_{ ext{Disc}} 
ight| = -rac{2 \cdot [ ext{G.}] \cdot ext{m} \cdot \left( \sqrt{ ext{a}^2 + ext{R}^2} - ext{a} 
ight)}{ ext{R}^2}$ 

Open Calculator

 $-1.6\text{E}^--11\text{J} = -\frac{2\cdot[\text{G.}]\cdot33\text{kg}\cdot\left(\sqrt{\left(25\text{m}\right)^2+\left(250\text{m}\right)^2}-25\text{m}\right)}{\left(250\text{m}\right)^2}$ 

# 17) Gravitational Potential when Point is Inside of Conducting Solid Sphere

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

Open Calculator 🖒

 $oxed{ex}$ -8.8 $\mathrm{E^{\hat{}}$ -12 $\mathrm{J/kg}=-rac{[\mathrm{G.}]\cdot33\mathrm{kg}}{250\mathrm{m}}}$ 



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

 $\mathbf{x} = -rac{[\mathrm{G.}] \cdot \mathrm{m} \cdot \left(3 \cdot \mathrm{r_c^2} - \mathrm{a^2}
ight)}{2 \cdot \mathrm{R}^3}$ 

Open Calculator

# 19) Gravitational Potential when Point is Outside of Conducting Solid Sphere

 $V = -rac{[G.] \cdot m}{a}$ 

Open Calculator 🗗

 $extstyle -8.8 ext{E^--}11 ext{J/kg} = -rac{ ext{[G.]} \cdot 33 ext{kg}}{25 ext{m}}$ 

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

 $V = -rac{[G.] \cdot m}{a}$ 

Open Calculator 🗗

 $-8.8 \text{E}^{-11 \text{J/kg}} = -\frac{[\text{G.}] \cdot 33 \text{kg}}{25 \text{m}}$ 



#### Variables Used

- a Distance from Center to Point (Meter)
- **D** Depth (Meter)
- E Gravitational Field Intensity (Newton per Kilogram)
- F Force (Newton)
- F' Gravitational Force (Newton)
- g<sub>v</sub> Variation of Acceleration due to Gravity (Meter per Square Second)
- h Satellite Altitude (Meter)
- h<sub>sealevel</sub> Altitude (Meter)
- I Gravitational Field (Newton per Kilogram)
- Idisc Gravitational Field of Thin Circular Disc (Newton per Kilogram)
- Iring Gravitational Field of Ring (Newton per Kilogram)
- m Mass (Kilogram)
- m' Mass 3 (Kilogram)
- m<sub>1</sub> Mass 1 (Kilogram)
- m<sub>2</sub> Mass 2 (Kilogram)
- m<sub>o</sub> Mass 4 (Kilogram)
- r Distance between Two Bodies (Meter)
- R Radius (Meter)
- r<sub>c</sub> Distance between Centers (Meter)
- r<sub>ring</sub> Radius of Ring (Meter)
- Sbody Displacement of Body (Meter)
- T Time period of Satellite (Hour)





- **U** Gravitational Potential Energy (*Joule*)
- UDisc Gravitational Potential of Thin Circular Disc (Joule)
- **V** Gravitational Potential (Joule per Kilogram)
- V<sub>ring</sub> Gravitational Potential of Ring (Joule per Kilogram)
- **θ** Theta (Degree)
- w Angular Velocity (Radian per Second)





### Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
   Archimedes' constant
- Constant: [Earth-R], 6371.0088

  Earth mean radius
- Constant: [g], 9.80665
   Gravitational acceleration on Earth
- Constant: [G.], 6.67408E-11
   Gravitational constant
- 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: 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 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/s²)
   Acceleration Unit Conversion
- Measurement: Energy in Joule (J)

  Energy Unit Conversion
- Measurement: Force in Newton (N)
  Force Unit Conversion





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Measurement: Angle in Degree (°)
 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





#### **Check other formula lists**

- Elasticity Formulas
- Gravitation Formulas
- Kinematics and Dynamics
   Formulas

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