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# Gravitation Formulas

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# List of 20 Gravitation Formulas

## Gravitation

## Fundamental Concepts in Gravitation

### 1) Time Period of Satellite

Open Calculator

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

ex $$11.11329\text{h} = \left( \frac{2 \cdot \pi}{[\text{Earth-R}]} \right) \cdot \sqrt{\frac{([\text{Earth-R}] + 189\text{e}5\text{m})^3}{[g]}}$$

### 2) Universal Law of Gravitation

Open Calculator

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

ex $$2\text{E\^{}}26\text{N} = \frac{[\text{G.}] \cdot 7.34\text{E\^{}}22\text{kg} \cdot 5.97\text{E\^{}}24\text{kg}}{(3.84\text{E\^{}}5\text{m})^2}$$

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

Open Calculator

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

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

## 4) Variation of Acceleration due to Gravity on Depth

Open Calculator

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

ex $$9.806645 m/s^2 = [g] \cdot \left(1 - \frac{3m}{[Earth\text{-}R]}\right)$$

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

Open Calculator

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

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

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# Gravitational Field

## 6) Gravitational Field Intensity

Open Calculator

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

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

## 7) Gravitational Field Intensity due to Point Mass

Open Calculator

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

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

## 8) Gravitational Field of Ring

Open Calculator

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

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

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

Open Calculator

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

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

## 10) Gravitational Field of Thin Circular Disc

Open Calculator

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

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

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

Open Calculator

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

ex $$\text{-3.5E^-15N/Kg} = -\frac{[G.] \cdot 33\text{kg} \cdot 25\text{m}}{(250\text{m})^3}$$

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

Open Calculator

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

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

## Gravitational Potential

### 13) Gravitational Potential

Open Calculator

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

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

### 14) Gravitational Potential Energy

Open Calculator

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

ex $$\text{-7.6E^31J} = -\frac{[G.] \cdot 7.34\text{E^22kg} \cdot 5.97\text{E^24kg}}{3.84\text{E^5m}}$$

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## 15) Gravitational Potential of Ring

Open Calculator

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

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

## 16) Gravitational Potential of Thin Circular Disc

Open Calculator

fx $$U_{Disc} = -\frac{2 \cdot [G.] \cdot m \cdot \left(\sqrt{a^2 + R^2} - a\right)}{R^2}$$

ex $$\text{-1.6E^-11J} = -\frac{2 \cdot [G.] \cdot 33\text{kg} \cdot \left(\sqrt{(25\text{m})^2 + (250\text{m})^2} - 25\text{m}\right)}{(250\text{m})^2}$$

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

Open Calculator

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

ex $$\text{-8.8E^-12J/kg} = -\frac{[G.] \cdot 33\text{kg}}{250\text{m}}$$

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

Open Calculator

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

ex $$\text{-3.1E^-5J/kg} = -\frac{[G.] \cdot 33\text{kg} \cdot \left(3 \cdot (3.84\text{E^5m})^2 - (25\text{m})^2\right)}{2 \cdot (250\text{m})^3}$$

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

Open Calculator

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

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

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

Open Calculator

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

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

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# 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)*
- $g_v$ Variation of Acceleration due to Gravity *(Meter per Square Second)*
- **h** Satellite Altitude *(Meter)*
- $h_{sealevel}$ Altitude *(Meter)*
- **I** Gravitational Field *(Newton per Kilogram)*
- $I_{disc}$ Gravitational Field of Thin Circular Disc *(Newton per Kilogram)*
- $I_{ring}$ Gravitational Field of Ring *(Newton per Kilogram)*
- **m** Mass *(Kilogram)*
- **m'** Mass 3 *(Kilogram)*
- $m_1$ Mass 1 *(Kilogram)*
- $m_2$ Mass 2 *(Kilogram)*
- $m_o$ Mass 4 *(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)*

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- **U** Gravitational Potential Energy *(Joule)*
- **$U_{Disc}$** Gravitational Potential of Thin Circular Disc *(Joule)*
- **V** Gravitational Potential *(Joule per Kilogram)*
- **$V_{ring}$** Gravitational Potential of Ring *(Joule per Kilogram)*
- **θ** Theta *(Degree)*
- **ω** Angular Velocity *(Radian per Second)*

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# 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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