# Important Motion in Bodies Hanging by String Formulas PDF

Formulas
Examples
with Units

**List of 15**
**Important Motion in Bodies Hanging by String Formulas**

## 1) Body Lying on Rough Horizontal Plane Formulas

### 1.1) Acceleration of System with Bodies One Hanging Free and Other Lying on Rough Horizontal Plane Formula

Evaluate Formula

Formula

$$a_s = \frac{m_1 - \mu_{hs} \cdot m_2}{m_1 + m_2} \cdot [g]$$

Example with Units

$$5.9401\,\text{m/s}^2 = \frac{29\,\text{kg} - 0.24 \cdot 13.52\,\text{kg}}{29\,\text{kg} + 13.52\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

### 1.2) Tension in String given Coefficient of Friction of Horizontal Plane Formula

Evaluate Formula

Formula

$$T_{st} = \left(1 + \mu_{hor}\right) \cdot \frac{m_1 \cdot m_2}{m_1 + m_2} \cdot [g]$$

Example with Units

$$130.0352\,\text{N} = \left(1 + 0.438\right) \cdot \frac{29\,\text{kg} \cdot 13.52\,\text{kg}}{29\,\text{kg} + 13.52\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

## 2) Body Lying on Rough Inclined Plane Formulas

### 2.1) Acceleration of System with Bodies One Hanging Free, Other Lying on Rough Inclined Plane Formula

Evaluate Formula

Formula

$$a_i = \frac{m_1 - m_2 \cdot \sin\left(\theta_p\right) - \mu_{hs} \cdot m_2 \cdot \cos\left(\theta_p\right)}{m_1 + m_2} \cdot [g]$$

Example with Units

$$5.2463\,\text{m/s}^2 = \frac{29\,\text{kg} - 13.52\,\text{kg} \cdot \sin\left(13.23°\right) - 0.24 \cdot 13.52\,\text{kg} \cdot \cos\left(13.23°\right)}{29\,\text{kg} + 13.52\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

## 2.2) Coefficient of Friction given Frictional Force Formula

Evaluate Formula

Formula

$$\mu_{hs} = \frac{F_{fri}}{m_2 \cdot [g] \cdot \cos\left(\theta_p\right)}$$

Example with Units

$$0.24 = \frac{30.97607\,\text{N}}{13.52\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \cos\left(13.23°\right)}$$

## 2.3) Coefficient of Friction given Tension Formula

Evaluate Formula

Formula

$$\mu_{hs} = \frac{m_1 + m_2}{m_1 \cdot m_1 \cdot [g]} \cdot T_{st} \cdot \sec\left(\theta_b\right) - \tan\left(\theta_b\right) - \sec\left(\theta_b\right)$$

Example with Units

$$0.2461 = \frac{29\,\text{kg} + 13.52\,\text{kg}}{29\,\text{kg} \cdot 29\,\text{kg} \cdot 9.8066\,\text{m/s}^2} \cdot 130\,\text{N} \cdot \sec\left(327.5°\right) - \tan\left(327.5°\right) - \sec\left(327.5°\right)$$

## 2.4) Frictional Force Formula

Evaluate Formula

Formula

$$F_{fri} = \mu_{hs} \cdot m_2 \cdot [g] \cdot \cos\left(\theta_p\right)$$

Example with Units

$$30.9761\,\text{N} = 0.24 \cdot 13.52\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \cos\left(13.23°\right)$$

## 2.5) Inclination of Plane for given Frictional Force Formula

Evaluate Formula

Formula

$$\theta_p = \operatorname{acos}\left(\frac{F_{fri}}{\mu_{hs} \cdot m_2 \cdot [g]}\right)$$

Example with Units

$$13.23° = \operatorname{acos}\left(\frac{30.97607\,\text{N}}{0.24 \cdot 13.52\,\text{kg} \cdot 9.8066\,\text{m/s}^2}\right)$$

## 2.6) Mass of Body B given Frictional Force Formula

Evaluate Formula

Formula

$$m_2 = \frac{F_{fri}}{\mu_{hs} \cdot [g] \cdot \cos\left(\theta_p\right)}$$

Example with Units

$$13.52\,\text{kg} = \frac{30.97607\,\text{N}}{0.24 \cdot 9.8066\,\text{m/s}^2 \cdot \cos\left(13.23°\right)}$$

## 2.7) Tension in String given Coefficient of Friction of Inclined Plane Formula

Evaluate Formula

Formula

$$T_{st} = \frac{m_1 \cdot m_2}{m_1 + m_2} \cdot [g] \cdot \left(1 + \sin\left(\theta_p\right) + \mu_{hs} \cdot \cos\left(\theta_p\right)\right)$$

Example with Units

$$132.2499\,\text{N} = \frac{29\,\text{kg} \cdot 13.52\,\text{kg}}{29\,\text{kg} + 13.52\,\text{kg}} \cdot 9.8066\,\text{m/s}^2 \cdot \left(1 + \sin\left(13.23°\right) + 0.24 \cdot \cos\left(13.23°\right)\right)$$

## 3) Body Lying on Smooth Horizontal Plane Formulas

### 3.1) Acceleration in System Formula

Evaluate Formula

Formula

$$a_b = \frac{m_1}{m_1 + m_2} \cdot [g]$$

Example with Units

$$6.6884\,\text{m/s}^2 = \frac{29\,\text{kg}}{29\,\text{kg} + 13.52\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

### 3.2) Tension in String if only One Body is Freely Suspended Formula

Evaluate Formula

Formula

$$T_{fs} = \frac{m_1 \cdot m_2}{m_1 + m_2} \cdot [g]$$

Example with Units

$$90.4278\,\text{N} = \frac{29\,\text{kg} \cdot 13.52\,\text{kg}}{29\,\text{kg} + 13.52\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

## 4) Body Lying on Smooth Inclined Plane Formulas

### 4.1) Acceleration of System with Bodies One Hanging Free and Other Lying on Smooth Inclined Plane Formula

Evaluate Formula

Formula

$$a_s = \frac{m_1 - m_2 \cdot \sin\left(\theta_p\right)}{m_1 + m_2} \cdot [g]$$

Example with Units

$$5.9748\,\text{m/s}^2 = \frac{29\,\text{kg} - 13.52\,\text{kg} \cdot \sin\left(13.23°\right)}{29\,\text{kg} + 13.52\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

### 4.2) Angle of Inclination given Acceleration Formula

Evaluate Formula

Formula

$$\theta_p = a\sin\left(\frac{m_1 \cdot [g] - m_1 \cdot a_s - m_2 \cdot a_s}{m_2 \cdot [g]}\right)$$

Example with Units

$$13.8881° = a\sin\left(\frac{29\,\text{kg} \cdot 9.8066\,\text{m/s}^2 - 29\,\text{kg} \cdot 5.94\,\text{m/s}^2 - 13.52\,\text{kg} \cdot 5.94\,\text{m/s}^2}{13.52\,\text{kg} \cdot 9.8066\,\text{m/s}^2}\right)$$

## 4.3) Angle of Inclination given Tension Formula

Evaluate Formula

Formula

$$\theta_p = a\sin\left(\frac{T \cdot \left(m_1 + m_2\right)}{m_1 \cdot m_2 \cdot [g]} - 1\right)$$

Example with Units

$$13.23^\circ = a\sin\left(\frac{111.1232\,\text{N} \cdot \left(29\,\text{kg} + 13.52\,\text{kg}\right)}{29\,\text{kg} \cdot 13.52\,\text{kg} \cdot 9.8066\,\text{m/s}^2} - 1\right)$$

## 4.4) Tension in String when One Body is Lying on Smooth Inclined Plane Formula

Evaluate Formula

Formula

$$T = \frac{m_1 \cdot m_2}{m_1 + m_2} \cdot [g] \cdot \left(1 + \sin\left(\theta_p\right)\right)$$

Example with Units

$$111.1232\,\text{N} = \frac{29\,\text{kg} \cdot 13.52\,\text{kg}}{29\,\text{kg} + 13.52\,\text{kg}} \cdot 9.8066\,\text{m/s}^2 \cdot \left(1 + \sin\left(13.23^\circ\right)\right)$$

## Variables used in list of Motion in Bodies Hanging by String Formulas above

- $a_b$ Acceleration of System *(Meter per Square Second)*
- $a_i$ Acceleration of System in Inclined Plane *(Meter per Square Second)*
- $a_s$ Acceleration of Body *(Meter per Square Second)*
- $F_{fri}$ Force of Friction *(Newton)*
- $m_1$ Mass of Left Body *(Kilogram)*
- $m_2$ Mass of Right Body *(Kilogram)*
- $T$ Tension *(Newton)*
- $T_{fs}$ Tension in Freely Suspended String *(Newton)*
- $T_{st}$ Tension in String *(Newton)*
- $\theta_b$ Inclination of body *(Degree)*
- $\theta_p$ Inclination of Plane *(Degree)*
- $\mu_{hor}$ Coefficient of Friction for Horizontal Plane
- $\mu_{hs}$ Coefficient of Friction for Hanging String

## Constants, Functions, Measurements used in list of Motion in Bodies Hanging by String Formulas above

- constant(s): **[g]**, 9.80665
  *Gravitational acceleration on Earth*
- Functions: **acos**, acos(Number)
  *The inverse cosine function, is the inverse function of the cosine function. It is the function that takes a ratio as an input and returns the angle whose cosine is equal to that ratio.*
- Functions: **asin**, asin(Number)
  *The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.*
- Functions: **cos**, cos(Angle)
  *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Functions: **sec**, sec(Angle)
  *Secant is a trigonometric function that is defined ratio of the hypotenuse to the shorter side adjacent to an acute angle (in a right-angled triangle); the reciprocal of a cosine.*
- Functions: **sin**, sin(Angle)
  *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **tan**, tan(Angle)
  *The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.*
- Measurement: **Weight** in Kilogram (kg)
  *Weight Unit Conversion*
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  *Acceleration Unit Conversion*
- Measurement: **Force** in Newton (N)
  *Force Unit Conversion*
- Measurement: **Angle** in Degree (°)
  *Angle Unit Conversion*

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