Important Motion in Bodies Connected by Strings Formulas PDF

Formulas
Examples
with Units

List of 13
Important Motion in Bodies Connected by Strings Formulas

1) Body Lying on Rough Inclined Plane Formulas

1.1) Acceleration of System given Mass of Body A Formula

Evaluate Formula

Formula

$$a_{mb} = \frac{m_a \cdot [g] \cdot \sin(\alpha_1) - \mu_{cm} \cdot m_a \cdot [g] \cdot \cos(\alpha_1) - T}{m_a}$$

Example with Units

$$3.3574\,\text{m/s}^2 = \frac{29.1\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \sin(34°) - 0.2 \cdot 29.1\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \cos(34°) - 14.56\,\text{N}}{29.1\,\text{kg}}$$

1.2) Acceleration of System given Mass of Body B Formula

Evaluate Formula

Formula

$$a_{mb} = \frac{T - m_b \cdot [g] \cdot \sin(\alpha_2) - \mu_{cm} \cdot m_b \cdot [g] \cdot \cos(\alpha_2)}{m_b}$$

Example with Units

$$3.959\,\text{m/s}^2 = \frac{14.56\,\text{N} - 1.11\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \sin(55°) - 0.2 \cdot 1.11\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \cos(55°)}{1.11\,\text{kg}}$$

1.3) Frictional Force on Body A Formula

Evaluate Formula

Formula

$$F_A = \mu_{cm} \cdot m_a \cdot [g] \cdot \cos(\alpha_1)$$

Example with Units

$$47.3171\,\text{N} = 0.2 \cdot 29.1\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \cos(34°)$$

1.4) Frictional Force on Body B Formula

Evaluate Formula

Formula

$$F_B = \mu_{cm} \cdot m_b \cdot [g] \cdot \cos(\alpha_2)$$

Example with Units

$$1.2487\,\text{N} = 0.2 \cdot 1.11\,\text{kg} \cdot 9.8066\,\text{m/s}^2 \cdot \cos(55°)$$

1.5) Tension in String given Mass of Body A Formula

Evaluate Formula

Formula

$$T_a = m_a \cdot \left([g] \cdot \sin\left(\alpha_1 \right) - \mu_{cm} \cdot [g] \cdot \cos\left(\alpha_1 \right) - a_{min} \right)$$

Example with Units

$$97.7118\,\text{N} = 29.1\,\text{kg} \cdot \left(9.8066\,\text{m/s}^2 \cdot \sin\left(34° \right) - 0.2 \cdot 9.8066\,\text{m/s}^2 \cdot \cos\left(34° \right) - 0.5\,\text{m/s}^2 \right)$$

1.6) Tension in String given Mass of Body B Formula

Evaluate Formula

Formula

$$T_b = m_b \cdot \left([g] \cdot \sin\left(\alpha_2 \right) + \mu_{cm} \cdot [g] \cdot \cos\left(\alpha_2 \right) + a_{mb} \right)$$

Example with Units

$$13.884\,\text{N} = 1.11\,\text{kg} \cdot \left(9.8066\,\text{m/s}^2 \cdot \sin\left(55° \right) + 0.2 \cdot 9.8066\,\text{m/s}^2 \cdot \cos\left(55° \right) + 3.35\,\text{m/s}^2 \right)$$

2) Body Lying on Smooth Inclined Plane Formulas

2.1) Acceleration of System with Bodies Connected by String and Lying on Smooth Inclined Planes Formula

Evaluate Formula

Formula

$$a_{mb} = \frac{m_a \cdot \sin\left(\alpha_a \right) - m_b \cdot \sin\left(\alpha_b \right)}{m_a + m_b} \cdot [g]$$

Example with Units

$$3.3488\,\text{m/s}^2 = \frac{29.1\,\text{kg} \cdot \sin\left(23.11° \right) - 1.11\,\text{kg} \cdot \sin\left(84.85° \right)}{29.1\,\text{kg} + 1.11\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

2.2) Angle of Inclination of Plane with Body A Formula

Evaluate Formula

Formula

$$\alpha_a = a\sin\left(\frac{m_a \cdot a_{mb} + T}{m_a \cdot [g]} \right)$$

Example with Units

$$23.118° = a\sin\left(\frac{29.1\,\text{kg} \cdot 3.35\,\text{m/s}^2 + 14.56\,\text{N}}{29.1\,\text{kg} \cdot 9.8066\,\text{m/s}^2} \right)$$

2.3) Angle of Inclination of Plane with Body B Formula

Evaluate Formula

Formula

$$\alpha_b = a\sin\left(\frac{T - m_b \cdot a_{mb}}{m_b \cdot [g]} \right)$$

Example with Units

$$84.8536° = a\sin\left(\frac{14.56\,\text{N} - 1.11\,\text{kg} \cdot 3.35\,\text{m/s}^2}{1.11\,\text{kg} \cdot 9.8066\,\text{m/s}^2} \right)$$

2.4) Tension in String if Both Bodies are Lying on Smooth Inclined Planes Formula

Evaluate Formula

Formula

$$T = \frac{m_a \cdot m_b}{m_a + m_b} \cdot [g] \cdot \left(\sin\left(\alpha_1 \right) + \sin\left(\alpha_2 \right) \right)$$

Example with Units

$$14.4525\,\text{N} = \frac{29.1\,\text{kg} \cdot 1.11\,\text{kg}}{29.1\,\text{kg} + 1.11\,\text{kg}} \cdot 9.8066\,\text{m/s}^2 \cdot \left(\sin\left(34° \right) + \sin\left(55° \right) \right)$$

3) Body Passing Over Smooth Pulley Formulas

3.1) Acceleration of Bodies Formula

Evaluate Formula

Formula

$$a_{bs} = \frac{m_a - m_b}{m_a + m_b} \cdot [g]$$

Example with Units

$$9.086\,\text{m/s}^2 = \frac{29.1\,\text{kg} - 1.11\,\text{kg}}{29.1\,\text{kg} + 1.11\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

3.2) Mass of Body B of Smaller Mass Formula

Evaluate Formula

Formula

$$m_b = \frac{T}{a_{mb} + [g]}$$

Example with Units

$$1.1067\,\text{kg} = \frac{14.56\,\text{N}}{3.35\,\text{m/s}^2 + 9.8066\,\text{m/s}^2}$$

3.3) Tension in String if Both Bodies are Freely Hanging Formula

Evaluate Formula

Formula

$$T_h = \frac{2 \cdot m_a \cdot m_b}{m_a + m_b} \cdot [g]$$

Example with Units

$$20.9708\,\text{N} = \frac{2 \cdot 29.1\,\text{kg} \cdot 1.11\,\text{kg}}{29.1\,\text{kg} + 1.11\,\text{kg}} \cdot 9.8066\,\text{m/s}^2$$

Variables used in list of Motion in Bodies Connected by Strings Formulas above

- a_{bs} Acceleration of Bodies *(Meter per Square Second)*
- a_{mb} Acceleration of Body in Motion *(Meter per Square Second)*
- a_{min} Minimum Acceleration of Body in Motion *(Meter per Square Second)*
- F_A Frictional Force A *(Newton)*
- F_B Frictional Force B *(Newton)*
- m_a Mass of Body A *(Kilogram)*
- m_b Mass of Body B *(Kilogram)*
- T Tension of String *(Newton)*
- T_a Tension of String in Body A *(Newton)*
- T_b Tension of String in Body B *(Newton)*
- T_h Tension in Hanging String *(Newton)*
- α_1 Inclination of Plane 1 *(Degree)*
- α_2 Inclination of Plane 2 *(Degree)*
- α_a Angle of Inclination with Body A *(Degree)*
- α_b Angle of Inclination with Body B *(Degree)*
- μ_{cm} Coefficient of Friction

Constants, Functions, Measurements used in list of Motion in Bodies Connected by Strings Formulas above

- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- 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: **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.
- 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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