



Motion of Connected Bodies Formulas

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List of 28 Motion of Connected Bodies Formulas

Motion of Connected Bodies &

Bodies Connected by String and Lying on Rough Inclined Plane

1) Acceleration of System given Mass of Body A

1) Acceleration of System given mass of Body A C

$$\mathbf{a} = rac{\mathbf{m}_1 \cdot [\mathrm{g}] \cdot \sin(lpha_1) - \mu \cdot \mathbf{m}_1 \cdot [\mathrm{g}] \cdot \cos(lpha_1) - \mathrm{T}}{\mathbf{a}}$$

ex

fx

$$-0.464523 \mathrm{m/s^2} = rac{29 \mathrm{kg} \cdot [\mathrm{g}] \cdot \sin(35\degree) - 0.2 \cdot 29 \mathrm{kg} \cdot [\mathrm{g}] \cdot \cos(35\degree) - 130 \mathrm{N}}{29 \mathrm{kg}}$$

2) Acceleration of System given Mass of Body B

$$\mathrm{a} = rac{\mathrm{T} - \mathrm{m}_2 \cdot [\mathrm{g}] \cdot \sin(lpha_2) - \mu \cdot \mathrm{m}_2 \cdot [\mathrm{g}] \cdot \cos(lpha_2)}{\mathrm{m}_2}$$

ex

$$-0.67416 ext{m/s}^2 = rac{130 ext{N} - 17 ext{kg} \cdot [ext{g}] \cdot ext{sin}(45\degree) - 0.2 \cdot 17 ext{kg} \cdot [ext{g}] \cdot ext{cos}(45\degree)}{17 ext{kg}}$$





3) Frictional Force on Body A

 $\mathbf{F}_{\mathrm{friction}} = \mu \cdot \mathrm{m}_1 \cdot [\mathrm{g}] \cdot \mathrm{cos}(lpha_1)$

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 $\texttt{ex} \hspace{0.1cm} 46.5922 \mathrm{N} = 0.2 \cdot 29 \mathrm{kg} \cdot [\mathrm{g}] \cdot \cos(35\degree)$

4) Frictional Force on Body B

fx $\mathbf{F}_{\mathrm{friction}} = \mu \cdot \mathbf{m}_2 \cdot [\mathbf{g}] \cdot \cos(lpha_2)$

Open Calculator

 $= 23.57679 \mathrm{N} = 0.2 \cdot 17 \mathrm{kg} \cdot [\mathrm{g}] \cdot \cos(45\degree)$

5) Tension in String given Mass of Body A

fx $T = m_1 \cdot ([g] \cdot \sin(lpha_1) - \mu \cdot [g] \cdot \cos(lpha_1) - a)$

Open Calculator

 $ext{ex} ext{ } ext{-}28.471159 ext{N} = 29 ext{kg} \cdot ([ext{g}] \cdot \sin(35\degree) - 0.2 \cdot [ext{g}] \cdot \cos(35\degree) - 5 ext{m/s}^2)$

6) Tension in String given Mass of Body B

 $ag{T} = ext{m}_2 \cdot ([ext{g}] \cdot ext{sin}(lpha_2) + \mu \cdot [ext{g}] \cdot ext{cos}(lpha_2) + ext{a})$ Open Calculator lacksquare

 $\texttt{ex} \ 226.4607 \text{N} = 17 \text{kg} \cdot ([\text{g}] \cdot \sin(45°) + 0.2 \cdot [\text{g}] \cdot \cos(45°) + 5 \text{m/s}^2)$

Bodies Connected by String and Lying on Smooth Inclined Planes

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

$$\mathbf{x} = rac{\mathrm{m}_1 \cdot \sin(lpha_1) - \mathrm{m}_2 \cdot \sin(lpha_2)}{\mathrm{m}_1 + \mathrm{m}_2} \cdot [\mathrm{g}]$$

Open Calculator

$$oxed{ex} 0.983415 ext{m/s}^2 = rac{29 ext{kg} \cdot \sin(35°) - 17 ext{kg} \cdot \sin(45°)}{29 ext{kg} + 17 ext{kg}} \cdot [ext{g}]$$

8) Angle of Inclination of Plane with Body A

$$oxed{lpha_1 = a \sinigg(rac{\mathrm{m}_1 \cdot \mathrm{a} + \mathrm{T}}{\mathrm{m}_1 \cdot [\mathrm{g}]}igg)}$$

Open Calculator 🗗

$$ag{75.23343}^{\circ} = a \sinigg(rac{29 ext{kg} \cdot 5 ext{m/s}^2 + 130 ext{N}}{29 ext{kg} \cdot [ext{g}]}igg)$$

9) Angle of Inclination of Plane with Body B

$$lpha_1 = a \sin\!\left(rac{\mathrm{T} - \mathrm{m}_2 \cdot \mathrm{a}}{\mathrm{m}_2 \cdot [\mathrm{g}]}
ight)$$

$$oxed{ex} 15.6598\degree = a \sinigg(rac{130 \mathrm{N} - 17 \mathrm{kg} \cdot 5 \mathrm{m/s^2}}{17 \mathrm{kg} \cdot [\mathrm{g}]}igg)$$



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

 $\mathbf{E} = rac{\mathbf{m}_1 \cdot \mathbf{m}_2}{\mathbf{m}_1 + \mathbf{m}_2} \cdot [\mathbf{g}] \cdot (\sin(\alpha_1) + \sin(\alpha_2))$

Open Calculator

Bodies Connected by String and Passing over Smooth Pulley

11) Acceleration of Bodies

 $\mathbf{f} \mathbf{x} = \frac{\mathbf{m}_1 - \mathbf{m}_2}{\mathbf{m}_1 + \mathbf{m}_2} \cdot [\mathbf{g}]$

Open Calculator

 $oxed{ex} \left[2.558257 ext{m/s}^2 = rac{29 ext{kg} - 17 ext{kg}}{29 ext{kg} + 17 ext{kg}} \cdot [ext{g}]
ight]$

12) Mass of Body B of Smaller Mass

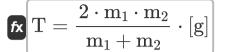
 $\mathbf{m}_2 = rac{\mathrm{T}}{\mathrm{a} + [\mathrm{g}]}$

Open Calculator

 $m = 8.779839 kg = rac{130 N}{5 m/s^2 + [g]}$



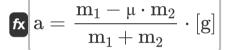
13) Tension in String if Both Bodies are Freely Hanging 🚰



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Bodies Connected by String One Hanging Free Other Lying on Rough Horizontal Plane

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



Open Calculator 🗗

$$ext{ex} \left[5.457614 ext{m/s}^2 = rac{29 ext{kg} - 0.2 \cdot 17 ext{kg}}{29 ext{kg} + 17 ext{kg}} \cdot [ext{g}]
ight]$$

15) Tension in String given Coefficient of Friction of Horizontal Plane

$$\mathbf{K} = (1+\mu) \cdot rac{\mathrm{m}_1 \cdot \mathrm{m}_2}{\mathrm{m}_1 + \mathrm{m}_2} \cdot [\mathrm{g}]$$

$$ext{ex} 126.122 ext{N} = (1+0.2) \cdot rac{29 ext{kg} \cdot 17 ext{kg}}{29 ext{kg} + 17 ext{kg}} \cdot [ext{g}]$$



Bodies Connected by String One Hanging Free Other Lying on Rough Inclined Plane

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

$$\mathbf{x} = \frac{m_1 - m_2 \cdot \sin(\theta) - \mu \cdot m_2 \cdot \cos(\theta)}{m_1 + m_2} \cdot [g]$$

Open Calculator

17) Coefficient of Friction given Frictional Force

$$\mu = rac{\mathrm{F}_{\mathrm{friction}}}{\mathrm{m}_2 \cdot [\mathrm{g}] \cdot \mathrm{cos}(heta)}$$

Open Calculator 🗗

$$\boxed{0.103894 = \frac{15\mathrm{N}}{17\mathrm{kg}\cdot[\mathrm{g}]\cdot\cos(30°)}}$$

18) Coefficient of Friction given Tension

$$m_1 + m$$

$$egin{aligned} \mu = rac{\mathrm{m}_1 + \mathrm{m}_2}{\mathrm{m}_1 \cdot \mathrm{m}_1 \cdot [\mathrm{g}]} \cdot \mathrm{T} \cdot \mathrm{sec}(heta) - \mathrm{tan}(heta) - \mathrm{sec}(heta) \end{aligned}$$

$$\boxed{ -0.894803 = \frac{29 \text{kg} + 17 \text{kg}}{29 \text{kg} \cdot 29 \text{kg} \cdot [\text{g}]} \cdot 130 \text{N} \cdot \sec(30°) - \tan(30°) - \sec(30°) }$$



19) Frictional Force

 $\mathbf{F}_{\mathrm{friction}} = \mu \cdot \mathrm{m}_2 \cdot [\mathrm{g}] \cdot \mathrm{cos}(heta)$

Open Calculator 🚰

 $\texttt{ex} \ 28.87555 \texttt{N} = 0.2 \cdot 17 \texttt{kg} \cdot [\texttt{g}] \cdot \cos(30°)$

20) Inclination of Plane for given Frictional Force

 $heta = a \cos \left(rac{\mathrm{F}_{\mathrm{friction}}}{\mu \cdot \mathrm{m}_2 \cdot [\mathrm{g}]}
ight)$

Open Calculator

 $oxed{ex} 63.26435^\circ = a \cosigg(rac{15 \mathrm{N}}{0.2 \cdot 17 \mathrm{kg} \cdot [\mathrm{g}]}igg)$

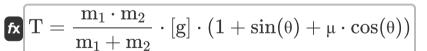
21) Mass of Body B given Frictional Force

 $\mathbf{f}_{\mathbf{z}}\mathbf{m}_{2}=rac{\mathrm{F}_{\mathrm{friction}}}{\mathbf{\mu}\cdot[\mathbf{g}]\cdot\cos(\mathbf{ heta})}$

Open Calculator 🗗

 $oxed{8.831001 ext{kg} = rac{15 ext{N}}{0.2 \cdot [ext{g}] \cdot \cos(30\degree)}}$

22) Tension in String given Coefficient of Friction of Inclined Plane





Bodies Connected by String One Hanging Free Other Lying on Smooth Horizontal Plane 🗗

23) Acceleration in System

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

Open Calculator

$$oxed{6.182453 ext{m/s}^2 = rac{29 ext{kg}}{29 ext{kg} + 17 ext{kg}} \cdot [ext{g}]}$$

24) Tension in String if only One Body is Freely Suspended 🗹

 $T = rac{ ext{m}_1 \cdot ext{m}_2}{ ext{m}_1 + ext{m}_2} \cdot [ext{g}]$

Open Calculator G

$$=$$
 $105.1017 \mathrm{N} = rac{29 \mathrm{kg} \cdot 17 \mathrm{kg}}{29 \mathrm{kg} + 17 \mathrm{kg}} \cdot [\mathrm{g}]$

Bodies Connected by String One Hanging Free Other Lying on Smooth Inclined Plane

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

 $\mathbf{x} = rac{\mathrm{m}_1 - \mathrm{m}_2 \cdot \sin(heta)}{\mathrm{m}_1 + \mathrm{m}_2} \cdot [\mathrm{g}]$

$$\mathbf{a} = \frac{\mathbf{m}_1 - \mathbf{m}_2 \cdot \mathbf{sm}(\mathbf{0})}{\mathbf{m}_1 + \mathbf{m}_2} \cdot [\mathbf{g}]$$







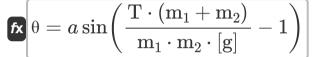
26) Angle of Inclination given Acceleration

 $egin{aligned} ag{k} & ag{g} = a \sinigg(rac{\mathrm{m}_1 \cdot [\mathrm{g}] - \mathrm{m}_1 \cdot \mathrm{a} - \mathrm{m}_2 \cdot \mathrm{a}}{\mathrm{m}_2 \cdot [\mathrm{g}]}igg) \end{aligned}$

Open Calculator

 $\boxed{19.04231° = a\sin\biggl(\frac{29 \text{kg} \cdot [\text{g}] - 29 \text{kg} \cdot 5 \text{m/s}^2 - 17 \text{kg} \cdot 5 \text{m/s}^2}{17 \text{kg} \cdot [\text{g}]}\biggr)}$

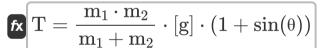
27) Angle of Inclination given Tension



Open Calculator 🗗

 $oxed{ex} egin{aligned} 13.70348 \ ^{\circ} = a \sinigg(rac{130 \mathrm{N} \cdot (29 \mathrm{kg} + 17 \mathrm{kg})}{29 \mathrm{kg} \cdot 17 \mathrm{kg} \cdot [\mathrm{g}]} - 1igg) \end{aligned}$

28) Tension in String when One Body is Lying on Smooth Inclined Plane



Open Calculator 🗗

 $ext{ex} 157.6526 ext{N} = rac{29 ext{kg} \cdot 17 ext{kg}}{29 ext{kg} + 17 ext{kg}} \cdot [ext{g}] \cdot (1 + \sin(30°))$



Variables Used

- a Acceleration (Meter per Square Second)
- F_{friction} Force of Friction (Newton)
- m₁ Mass of Body A (Kilogram)
- **m₂** Mass of Body B (Kilogram)
- **T** Tension of String (Newton)
- α₁ Inclination of Plane 1 (Degree)
- α₂ Inclination of Plane 2 (Degree)
- θ Inclination of Plane (Degree)
- µ Coefficient of Friction





Constants, Functions, Measurements used

- Constant: [g], 9.80665 Meter/Second²
 Gravitational acceleration on Earth
- Function: acos, acos(Number)

 Inverse trigonometric cosine function
- Function: asin, asin(Number)
 Inverse trigonometric sine function
- Function: cos, cos(Angle)
 Trigonometric cosine function
- Function: **sec**, sec(Angle)

 Trigonometric secant function
- Function: sin, sin(Angle)
 Trigonometric sine function
- Function: tan, tan(Angle)
 Trigonometric tangent function
- 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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