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Friction Formulas

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List of 23 Friction Formulas

Friction

1) Angle of Repose

$$\text{fx } \alpha_r = a \tan\left(\frac{F_{\Rightarrow}}{R_n}\right)$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$\text{ex } 22.61986^\circ = a \tan\left(\frac{2.50\text{N}}{6\text{N}}\right)$$

2) Coefficient of Friction

$$\text{fx } \mu = \frac{F_{\Rightarrow}}{R_n}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$\text{ex } 0.416667 = \frac{2.50\text{N}}{6\text{N}}$$

3) Coefficient of Friction between Cylinder and Surface of Inclined Plane for Rolling without Slipping

$$\text{fx } \mu = \frac{\tan(\theta_i)}{3}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$\text{ex } 83.39953 = \frac{\tan(89.771^\circ)}{3}$$



4) Frictional Force between Cylinder and Inclined Plane surface for Rolling without Slipping

$$\text{fx } F_{\text{friction}} = \frac{M_{\text{cylinder}} \cdot g \cdot \sin(\theta_i)}{3}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$\text{ex } 31.35975\text{N} = \frac{9.6\text{kg} \cdot 9.8\text{m/s}^2 \cdot \sin(89.771^\circ)}{3}$$

5) Limiting Angle of Friction

$$\text{fx } \Phi = a \tan\left(\frac{F_{\Rightarrow}}{R_n}\right)$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$\text{ex } 22.61986^\circ = a \tan\left(\frac{2.50\text{N}}{6\text{N}}\right)$$

6) Minimum Force Required to Slide Body on Rough Horizontal Plane

$$\text{fx } P_{\text{min}} = W \cdot \sin(\theta_e)$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{ex } 10\text{N} = 20\text{N} \cdot \sin(30^\circ)$$

7) Total Torque Required to Overcome Friction in Rotating Screw

fx
[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$T = W \cdot \tan(\psi + \Phi) \cdot \frac{d_{\text{mean}}}{2} + \mu_{\text{collar}} \cdot W \cdot R_{\text{collar}}$$

$$\text{ex } 1.592576\text{N}\cdot\text{m} = 20\text{N} \cdot \tan(25^\circ + 2^\circ) \cdot \frac{0.3\text{m}}{2} + 0.16 \cdot 20\text{N} \cdot 0.02\text{m}$$



Efficiency

8) Efficiency of Inclined Plane when Effort Applied Horizontally to Move Body Downward

$$\text{fx } \eta = \frac{\tan(\alpha_i - \Phi)}{\tan(\alpha_i)}$$

[Open Calculator !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5_img.jpg\)](#)

$$\text{ex } 0.904327 = \frac{\tan(23^\circ - 2^\circ)}{\tan(23^\circ)}$$

9) Efficiency of Inclined Plane when Effort Applied Horizontally to Move Body Upward

$$\text{fx } \eta = \frac{\tan(\alpha_i)}{\tan(\alpha_i + \Phi)}$$

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a_img.jpg\)](#)

$$\text{ex } 0.910289 = \frac{\tan(23^\circ)}{\tan(23^\circ + 2^\circ)}$$

10) Efficiency of Inclined Plane when Effort Applied Parallel to Move Body Downward

$$\text{fx } \eta = \frac{\sin(\alpha_i - \Phi)}{\sin(\alpha_i) \cdot \cos(\Phi)}$$

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a_img.jpg\)](#)

$$\text{ex } 0.917732 = \frac{\sin(23^\circ - 2^\circ)}{\sin(23^\circ) \cdot \cos(2^\circ)}$$



11) Efficiency of Inclined Plane when Effort Applied Parallel to Move Body Upward

$$\text{fx } \eta = \frac{\sin(\alpha_i) \cdot \cos(\Phi)}{\sin(\alpha_i + \Phi)}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$\text{ex } 0.923985 = \frac{\sin(23^\circ) \cdot \cos(2^\circ)}{\sin(23^\circ + 2^\circ)}$$

12) Efficiency of Inclined Plane when Effort Applied to Move Body Downward

$$\text{fx } \eta = \frac{\cot(\alpha_i) - \cot(\theta_e)}{\cot(\alpha_i - \Phi) - \cot(\theta_e)}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } 0.714518 = \frac{\cot(23^\circ) - \cot(30^\circ)}{\cot(23^\circ - 2^\circ) - \cot(30^\circ)}$$

13) Efficiency of Inclined Plane when Effort Applied to Move Body Upward

$$\text{fx } \eta = \frac{\cot(\alpha_i + \Phi) - \cot(\theta_e)}{\cot(\alpha_i) - \cot(\theta_e)}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$\text{ex } 0.661198 = \frac{\cot(23^\circ + 2^\circ) - \cot(30^\circ)}{\cot(23^\circ) - \cot(30^\circ)}$$



Effort

14) Effort Applied Parallel to Inclined Plane to Move Body Downward Considering Friction

$$fx \quad P = W \cdot (\sin(\alpha_i) - \mu \cdot \cos(\alpha_i))$$

[Open Calculator !\[\]\(950a62bbddad88d64435fd35607dfc42_img.jpg\)](#)

$$ex \quad 0.450584N = 20N \cdot (\sin(23^\circ) - 0.4 \cdot \cos(23^\circ))$$

15) Effort Applied Parallel to Inclined Plane to Move Body Upward Considering Friction

$$fx \quad P = W \cdot (\sin(\alpha_i) + \mu \cdot \cos(\alpha_i))$$

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719_img.jpg\)](#)

$$ex \quad 15.17866N = 20N \cdot (\sin(23^\circ) + 0.4 \cdot \cos(23^\circ))$$

16) Effort Applied Parallel to Inclined Plane to Move Body Upward or Downward Neglecting Friction

$$fx \quad P_0 = W \cdot \sin(\alpha_i)$$

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7_img.jpg\)](#)

$$ex \quad 7.814623N = 20N \cdot \sin(23^\circ)$$

17) Effort Applied Perpendicular to Inclined Plane to Move Body along Inclination Neglecting Friction

$$fx \quad P_0 = W \cdot \tan(\alpha_i)$$

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58_img.jpg\)](#)

$$ex \quad 8.489496N = 20N \cdot \tan(23^\circ)$$



18) Effort Applied Perpendicular to Inclined Plane to Move Body Downward Considering Friction

$$\text{fx } P = W \cdot \tan(\alpha_i - \Phi)$$

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

$$\text{ex } 7.677281\text{N} = 20\text{N} \cdot \tan(23^\circ - 2^\circ)$$

19) Effort Applied Perpendicular to Inclined Plane to Move Body Upward Considering Friction

$$\text{fx } P = W \cdot \tan(\alpha_i + \Phi)$$

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5_img.jpg\)](#)

$$\text{ex } 9.326153\text{N} = 20\text{N} \cdot \tan(23^\circ + 2^\circ)$$

20) Effort Applied to Move Body Downward on Inclined Plane Considering Friction

$$\text{fx } P = \frac{W \cdot \sin(\alpha_i - \Phi)}{\sin(\theta_e - (\alpha_i - \Phi))}$$

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2_img.jpg\)](#)

$$\text{ex } 45.81701\text{N} = \frac{20\text{N} \cdot \sin(23^\circ - 2^\circ)}{\sin(30^\circ - (23^\circ - 2^\circ))}$$

21) Effort Applied to Move Body Upward on Inclined Plane Considering Friction

$$\text{fx } P = \frac{W \cdot \sin(\alpha_i + \Phi)}{\sin(\theta_e - (\alpha_i + \Phi))}$$

[Open Calculator !\[\]\(06a315363e7801bba8c7489a6694af19_img.jpg\)](#)

$$\text{ex } 96.98001\text{N} = \frac{20\text{N} \cdot \sin(23^\circ + 2^\circ)}{\sin(30^\circ - (23^\circ + 2^\circ))}$$



22) Effort Required to Move Body down Plane Neglecting Friction

[Open Calculator !\[\]\(3d8c13c92b853674f749aac6fa869926_img.jpg\)](#)

$$fx \quad P_0 = \frac{W \cdot \sin(\alpha_i)}{\sin(\theta_e - \alpha_i)}$$

$$ex \quad 64.12296N = \frac{20N \cdot \sin(23^\circ)}{\sin(30^\circ - 23^\circ)}$$

23) Effort Required to Move Body up Plane Neglecting Friction

[Open Calculator !\[\]\(17acf1afa8cdf0b67c53d4865a5ed469_img.jpg\)](#)

$$fx \quad P_0 = \frac{W \cdot \sin(\alpha_i)}{\sin(\theta_e - \alpha_i)}$$

$$ex \quad 64.12296N = \frac{20N \cdot \sin(23^\circ)}{\sin(30^\circ - 23^\circ)}$$









Variables Used

- d_{mean} Mean Diameter of Screw (Meter)
- F_{friction} Force of Friction (Newton)
- $F \Rightarrow$ Limiting Force (Newton)
- g Acceleration due to Gravity (Meter per Square Second)
- M_{cylinder} Mass of Cylinder (Kilogram)
- P Effort Required to Move Considering Friction (Newton)
- P_0 Effort Required to Move Neglecting Friction (Newton)
- P_{min} Minimum Effort (Newton)
- R_{collar} Mean Radius of Collar (Meter)
- R_n Normal Reaction (Newton)
- T Total Torque (Newton Meter)
- W Weight of Body (Newton)
- α_i Angle of Inclination of Plane to Horizontal (Degree)
- α_r Angle of Repose (Degree)
- η Efficiency of Inclined Plane
- θ_e Angle of Effort (Degree)
- θ_i Angle of Inclination (Degree)
- μ Coefficient of Friction
- μ_{collar} Coefficient of Friction for Collar
- Φ Limiting Angle of Friction (Degree)
- ψ Helix Angle (Degree)



Constants, Functions, Measurements used

- **Function:** **atan**, atan(Number)
Inverse trigonometric tangent function
- **Function:** **cos**, cos(Angle)
Trigonometric cosine function
- **Function:** **cot**, cot(Angle)
Trigonometric cotangent function
- **Function:** **sin**, sin(Angle)
Trigonometric sine function
- **Function:** **tan**, tan(Angle)
Trigonometric tangent function
- **Measurement:** **Length** in Meter (m)
Length Unit Conversion 
- **Measurement:** **Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement:** **Acceleration** in Meter per Square Second (m/s^2)
Acceleration Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Angle** in Degree ($^\circ$)
Angle Unit Conversion 
- **Measurement:** **Torque** in Newton Meter ($N*m$)
Torque Unit Conversion 



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