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Friction Formulas

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List of 23 Friction Formulas

Friction

1) Angle of Repose

Open Calculator

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

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

2) Coefficient of Friction

Open Calculator

fx $$\mu = \frac{F\Rightarrow}{R_n}$$

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

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

Open Calculator

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

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

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

Open Calculator

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

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

5) Limiting Angle of Friction

Open Calculator

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

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

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

Open Calculator

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

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

7) Total Torque Required to Overcome Friction in Rotating Screw

Open Calculator

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

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

Efficiency

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

$$P = W \cdot \tan(\alpha_i - \Phi)$$

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

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

Open Calculator

$$P = W \cdot \tan(\alpha_i + \Phi)$$

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

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

Open Calculator

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

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

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

Open Calculator

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

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

22) Effort Required to Move Body down Plane Neglecting Friction

Open Calculator

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

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

23) Effort Required to Move Body up Plane Neglecting Friction

Open Calculator

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

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

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/s²)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Torque** in Newton Meter (N*m)
  Torque Unit Conversion

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