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Friction Formulas

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List of 28 Friction Formulas

Friction

Angle Friction

1) Angle of Repose

Open Calculator

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

ex $$18.45335^\circ = a\tan\left(\frac{2.15\text{N}}{6.4431\text{N}}\right)$$

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

Open Calculator

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

ex $$0.333333 = \frac{\tan(45^\circ)}{3}$$

3) 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 $$0.904327 = \frac{\tan(23^\circ - 2^\circ)}{\tan(23^\circ)}$$

4) 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 $$0.910289 = \frac{\tan(23^\circ)}{\tan(23^\circ + 2^\circ)}$$

5) 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 $$0.917732 = \frac{\sin(23^\circ - 2^\circ)}{\sin(23^\circ) \cdot \cos(2^\circ)}$$

6) 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 $$0.923985 = \frac{\sin(23^\circ) \cdot \cos(2^\circ)}{\sin(23^\circ + 2^\circ)}$$

7) 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 $$0.901002 = \frac{\cot(23^\circ) - \cot(85^\circ)}{\cot(23^\circ - 2^\circ) - \cot(85^\circ)}$$

8) 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 $$0.906829 = \frac{\cot(23^\circ + 2^\circ) - \cot(85^\circ)}{\cot(23^\circ) - \cot(85^\circ)}$$

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

Open Calculator

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

$$10.06758\text{N} = 120\text{N} \cdot (\sin(23^\circ) - 0.333333 \cdot \cos(23^\circ))$$

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

Open Calculator

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

$$83.70789\text{N} = 120\text{N} \cdot (\sin(23^\circ) + 0.333333 \cdot \cos(23^\circ))$$

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

Open Calculator

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

$$46.88774\text{N} = 120\text{N} \cdot \sin(23^\circ)$$

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

Open Calculator

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

$$50.93698\text{N} = 120\text{N} \cdot \tan(23^\circ)$$

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

Open Calculator

fx $$P_d = W \cdot \tan(\alpha_i - \Phi)$$

ex $$46.06368\text{N} = 120\text{N} \cdot \tan(23^\circ - 2^\circ)$$

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

Open Calculator

fx $$P_u = W \cdot \tan(\alpha_i + \Phi)$$

ex $$55.95692\text{N} = 120\text{N} \cdot \tan(23^\circ + 2^\circ)$$

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

Open Calculator

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

ex $$47.84651\text{N} = \frac{120\text{N} \cdot \sin(23^\circ - 2^\circ)}{\sin(85^\circ - (23^\circ - 2^\circ))}$$

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

Open Calculator

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

ex $$58.5597\text{N} = \frac{120\text{N} \cdot \sin(23^\circ + 2^\circ)}{\sin(85^\circ - (23^\circ + 2^\circ))}$$

17) 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 $$53.10364\text{N} = \frac{120\text{N} \cdot \sin(23^\circ)}{\sin(85^\circ - 23^\circ)}$$

18) 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 $$53.10364\text{N} = \frac{120\text{N} \cdot \sin(23^\circ)}{\sin(85^\circ - 23^\circ)}$$

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

Open Calculator

fx $$F_f = \frac{M_c \cdot g \cdot \sin(\theta_i)}{3}$$

ex $$22.17487\text{N} = \frac{9.6\text{kg} \cdot 9.8\text{m/s}^2 \cdot \sin(45^\circ)}{3}$$

20) Limiting Angle of Friction

Open Calculator

$$\Phi = a\tan\left(\frac{F_{lf}}{R_n}\right)$$

$$2.000018^\circ = a\tan\left(\frac{0.225N}{6.4431N}\right)$$

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

Open Calculator

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

$$119.5434N = 120N \cdot \sin(85^\circ)$$

Laws of Friction

22) Coefficient of Friction

Open Calculator

$$\mu = \frac{F_{lim}}{R_n}$$

$$0.33369 = \frac{2.15N}{6.4431N}$$

23) Coefficient of Friction using Forces

Open Calculator

$$\mu = \frac{F_c \cdot \tan(\theta_f) + P_t}{F_c - P_t \cdot \tan(\theta_f)}$$

$$0.600559 = \frac{1200N \cdot \tan(29.793805347^\circ) + 25N}{1200N - 25N \cdot \tan(29.793805347^\circ)}$$

24) Total Torque Required to Overcome Friction in Rotating Screw

Open Calculator

fx $$T = W \cdot \tan(\psi + \Phi) \cdot \frac{d_m}{2} + \mu_c \cdot W \cdot R_c$$

ex $$52.3556\text{N*m} = 120\text{N} \cdot \tan(25.00^\circ + 2^\circ) \cdot \frac{1.7\text{m}}{2} + 0.16 \cdot 120\text{N} \cdot 0.02\text{m}$$

Screw Friction

25) Angle of inclination of thread

Open Calculator

fx $$\theta_t = a\tan\left(\frac{P_s}{\pi \cdot d_m}\right)$$

ex $$66.86508^\circ = a\tan\left(\frac{12.5\text{m}}{\pi \cdot 1.7\text{m}}\right)$$

26) Pitch of screw

Open Calculator

fx $$P_s = \frac{L}{n}$$

ex $$12.53333\text{m} = \frac{188\text{m}}{15}$$

27) Slope of thread

Open Calculator

fx $$\alpha = \frac{P_s}{\pi \cdot d_m}$$

ex $$2.340514 = \frac{12.5\text{m}}{\pi \cdot 1.7\text{m}}$$

28) Slope of thread in multi-threaded screw

Open Calculator

fx $$\alpha_m = \frac{n \cdot P_s}{\pi \cdot d_m}$$

ex $$35.10771 = \frac{15 \cdot 12.5\text{m}}{\pi \cdot 1.7\text{m}}$$

Variables Used

- d_m Mean Diameter of Screw *(Meter)*
- F_c Centripetal Force *(Newton)*
- F_f Force of Friction *(Newton)*
- F_{lf} Limit Force *(Newton)*
- F_{lim} Limiting Force *(Newton)*
- g Acceleration Due to Gravity *(Meter per Square Second)*
- L Lead of Screw *(Meter)*
- M_c Mass of Cylinder *(Kilogram)*
- n Number of Threads
- P_0 Effort Required to Move Neglecting Friction *(Newton)*
- P_d Effort to Move Downwards Considering Friction *(Newton)*
- P_{min} Minimum Effort *(Newton)*
- P_s Pitch *(Meter)*
- P_t Tangential Force *(Newton)*
- P_u Effort to Move Upwards Considering Friction *(Newton)*
- R_c Mean Radius of Collar *(Meter)*
- R_n Normal Reaction *(Newton)*
- T Total Torque *(Newton Meter)*
- W Weight of Body *(Newton)*
- α Slope of Thread
- α_i Angle of Inclination of Plane to Horizontal *(Degree)*

- α_m Slope of Multiple Threads
- α_r Angle of Repose *(Degree)*
- η Efficiency of Inclined Plane
- θ_e Angle of Effort *(Degree)*
- θ_f Angle of Friction *(Degree)*
- θ_i Angle of Inclination *(Degree)*
- θ_t Thread Angle *(Degree)*
- μ Coefficient of Friction
- μ_c Coefficient of Friction For Collar
- Φ Limiting Angle of Friction *(Degree)*
- ψ Helix Angle *(Degree)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **atan**, atan(Number)
  Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **cot**, cot(Angle)
  Cotangent is a trigonometric function that is defined as the ratio of the adjacent side to the opposite side in a right triangle.
- Function: **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.
- Function: **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: **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

Check other formula lists

- **Engineering Mechanics Formulas**
- **Friction Formulas**

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