



Lifting Machines Formulas

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Examples!

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List of 33 Lifting Machines Formulas

Lifting Machines &

Machine Design Characteristics 2

1) Efficiency of Machine given Mechanical Advantage and Velocity Ratio

$$\eta = rac{M_a}{V_i}$$

Open Calculator

$$ex 0.833333 = \frac{5}{6}$$

2) Effort Required by Machine to Overcome Resistance to Get Work Done

$$extbf{Fx} P = rac{W}{M_a}$$

Open Calculator 🗗

$$\boxed{ 200 \mathrm{N} = \frac{1000 \mathrm{N}}{5} }$$



3) Frictional Effort Lost

 $\mathbf{F}_{\mathrm{e}} = \mathrm{P} - rac{\mathrm{W}}{\mathrm{V_{i}}}$

Open Calculator

 $= 33.33333N = 200N - \frac{1000N}{1000N}$

0

4) Ideal Effort given Load and Velocity Ratio

 $extbf{P}_{
m o} = rac{
m W}{
m V_{
m i}}$

Open Calculator

5) Ideal Load given Velocity Ratio and Effort

fx $W_i = V_i \cdot P$

Open Calculator

 $\boxed{1200\mathrm{N} = 6\cdot200\mathrm{N}}$

6) Load Lifted given Effort and Mechanical Advantage

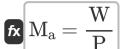
fx $W=M_a\cdot P$

Open Calculator

 $\textbf{ex} \ 1000 \text{N} = 5 \cdot 200 \text{N}$



7) Mechanical Advantage given Load and Effort



Open Calculator

$$\boxed{\mathbf{ex}} \ 5 = \frac{1000 \mathrm{N}}{200 \mathrm{N}}$$

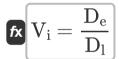
8) Useful Work Output of Machine



Open Calculator

 $= 3750 J = 1000 N \cdot 3.75 m$

9) Velocity Ratio given Distance Moved due to Effort and Distance Moved due to Load



Open Calculator

$$6.4 = \frac{24m}{3.75m}$$

10) Work Done by Effort 🗗



Open Calculator

$$ext{ex} \ 3750 ext{J} = 1000 ext{N} \cdot 3.75 ext{m}$$



Pulley Block

11) Efficiency of Geared Pulley Block

Open Calculator 🖸

Open Calculator

Open Calculator

 $0.833333 = \frac{5}{6}$

12) Efficiency of Weston's Differential Pulley Block 🖸

fx $\eta = rac{
m M_a}{
m V_s}$

 $0.833333 = \frac{5}{6}$

13) Efficiency of Worm Geared Pulley Block 🗗

 $0.833333 = \frac{5}{c}$



14) Net Shortening of Chain in Weston's Differential Pulley Block 🖒

fx $m L_c = \pi \cdot (d_l - d_s)$

Open Calculator

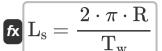
 $= 0.062832 \text{m} = \pi \cdot (0.06 \text{m} - .04 \text{m})$







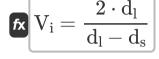
15) Net Shortening of String in Worm Gear Pulley Block



Open Calculator

 $= 2 \cdot \pi \cdot 1.4$ $= \frac{2 \cdot \pi \cdot 1.4 }{32}$

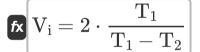
16) Velocity Ratio in Weston's Differential Pulley Block



Open Calculator

 $= \frac{2 \cdot 0.06 \text{m}}{0.06 \text{m} - .04 \text{m}}$

17) Velocity Ratio in Weston's Differential Pulley given Number of Teeth 🗗



Open Calculator

 $\boxed{ 6.1333333 = 2 \cdot \frac{46}{46 - 31} }$

18) Velocity Ratio in Weston's Differential Pulley given Radius of Pulleys

$$V_{
m i} = 2 \cdot rac{{
m r}_1}{{
m r}_1 - {
m r}_2}$$

Open Calculator

$$oxed{6.545455} = 2 \cdot rac{9 ext{m}}{9 ext{m} - 6.25 ext{m}}$$





19) Velocity Ratio of Worm Geared Pulley Block

 $V_{
m i} = rac{{
m d}_{
m w} \cdot {
m T}_{
m w}}{{
m R}}$

Open Calculator

Open Calculator

Open Calculator 2

 $= 6.857143 = \frac{0.3 \text{m} \cdot 32}{1.4 \text{m}}$

Screw Jack

20) Efficiency of Differential Screw Jack

 $\eta = rac{M_a}{V_i}$

 $0.833333 = \frac{5}{6}$

21) Efficiency of Screw Jack

 $\eta = rac{ an(\psi)}{ an(\psi+ heta)} \cdot 100$

 $extbf{ex} 0.839817 = rac{ an(12.9\degree)}{ an(12.9\degree + 75\degree)} \cdot 100$



22) Efficiency of Worm Geared Screw Jack

 $\eta = rac{
m M_a}{
m V_{\cdot}}$

Open Calculator

23) Torque Required while Load is Ascending in Screw Jack

 $\mathbf{T}_{
m asc} = rac{
m d_m}{2} \cdot \mathrm{W} \cdot an(heta + \Phi)$

Open Calculator 🗗

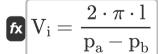
 $\boxed{ 2748.452 \text{N*m} = \frac{0.24 \text{m}}{2} \cdot 1000 \text{N} \cdot \tan(75^{\circ} + 12.5^{\circ}) }$

24) Torque Required while Load is Descending in Screw Jack

 $\mathbf{T}_{ ext{des}} = rac{ ext{d}_{ ext{m}}}{2} \cdot ext{W} \cdot an(heta - \Phi)$

Open Calculator 🗗

25) Velocity Ratio of Differential Screw Jack

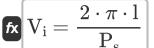


Open Calculator



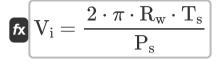


26) Velocity Ratio of Simple Screw Jack



Open Calculator 🚰

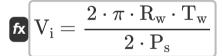
27) Velocity Ratio of Worm Geared Screw Jack



Open Calculator

 $\mathbf{ex} = 6.485145 = rac{2 \cdot \pi \cdot 0.85 \mathrm{m} \cdot 17}{14 \mathrm{m}}$

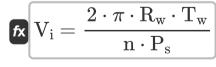
28) Velocity Ratio of Worm Geared Screw Jack with Double Threaded



Open Calculator

 $\mathbf{ex} = 6.103666 = rac{2 \cdot \pi \cdot 0.85 \mathrm{m} \cdot 32}{2 \cdot 14 \mathrm{m}}$

29) Velocity Ratio of Worm Geared Screw Jack with Multiple Threads



Open Calculator 🗗

 $= \frac{2 \cdot \pi \cdot 0.85 \text{m} \cdot 32}{2 \cdot 14 \text{m}}$





Worm Wheel

30) Efficiency of Worm and Worm Wheel

 $\eta = rac{\mathrm{M_a}}{\mathrm{V_i}}$

Open Calculator

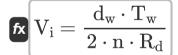
 $\boxed{0.833333 = \frac{5}{6} }$

31) Velocity Ratio of Worm and Worm Wheel

 $extbf{V}_{ ext{i}} = rac{ ext{D}_{ ext{m}} \cdot ext{T}_{ ext{w}}}{2 \cdot ext{R}_{ ext{d}}}$

Open Calculator 🗗

32) Velocity Ratio of Worm and Worm Wheel, if Worm has Multiple Threads

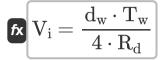


Open Calculator

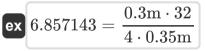


33) Velocity Ratio of Worm and Worm Wheel, if Worm is Double Threaded





Open Calculator 🗗





Variables Used

- **D**_e Distance Moved Due to Effort (*Meter*)
- **d**_I Diameter of Larger Pulley (*Meter*)
- D_I Distance Moved Due to Load (Meter)
- dm Mean Diameter of Screw (Meter)
- **D**_m Minimum Diameter of Effort Wheel (Meter)
- d_s Diameter of Smaller Pulley (Meter)
- d_w Diameter of Effort Wheel (Meter)
- **F**_e Frictional Effort Lost (Newton)
- I Length of Lever Arm (Meter)
- L_c Net Shortening of Chain (Meter)
- L_S Net Shortening of String (Meter)
- Ma Mechanical Advantage
- n Number of Threads
- P Effort (Newton)
- pa Pitch of Screw A (Meter)
- **p**_b Pitch of Screw B (Meter)
- Po Ideal Effort (Newton)
- Ps Pitch (Meter)
- R Radius of Pulley (Meter)
- **r**₁ Radius of Larger Pulley (Meter)
- r₂ Radius of Smaller Pulley (Meter)





- R_d Radius of Load Drum (Meter)
- Rw Radius of Effort Wheel (Meter)
- T₁ Number of Teeth of Larger Pulley
- T₂ Number of Teeth of Smaller Pulley
- Tasc Torque Required While Load is Ascending (Newton Meter)
- T_{des} Torque Required While Load is Descending (Newton Meter)
- T_S Number of Teeth in Screw Shaft
- T_w Number of Teeth on Worm Wheel
- Vi Velocity Ratio
- W Load (Newton)
- Wi Ideal Load (Newton)
- W_I Work Done (Joule)
- n Efficiency
- **0** Angle of Friction (Degree)
- Φ Limiting Angle of Friction (Degree)
- Ψ Helix Angle (Degree)



Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
 Archimedes' constant
- 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: Energy in Joule (J)
 Energy 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

• Lifting Machines Formulas

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