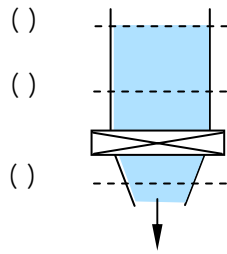


($\rho = 1 \text{ kg/m}^3$ $\rho = 1 \text{ kg/m}^3$)



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() ()
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() ()
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()

() :

$$\vec{v} = 2tx\hat{i} - t^2y\hat{j} + 3xz\hat{k}$$



() ()
() ()

:

$$\vec{v} = 4zt\hat{i} + 3x\hat{j}$$



() ()
() ()

() :

:()

psi () *hp* () *N/m* () / *mm* ()

- °F () / *J* () × ⁻ *N.s/m* () / *slug* ()

$$P = \gamma Q H$$

$\frac{Btu}{ft} \times \frac{acre}{ft} \times \frac{N/m}{ft} \times \frac{ft}{km}$

$$\frac{1}{g} \frac{\partial u}{\partial t} + \frac{u}{g} \frac{\partial u}{\partial x} + \frac{\partial h}{\partial x} = \frac{iu}{gh}$$

$$F = 3\pi\mu DV$$

$$a = \sqrt{\frac{E_v/\rho}{1 + \frac{E_v D}{E e} c}}$$

$$D = 0.66 \left[\epsilon^{1.25} \left(\frac{\ell Q^2}{g h_f} \right)^{4.75} + \nu Q^{9.4} \left(\frac{\ell}{g h_f} \right)^{5.2} \right]^{0.04}$$

$$\Delta h = \left(h_i + \frac{p_g + p_{atm}}{2\gamma_{hg}} \right) - \sqrt{\left(h_i + \frac{p_g + p_{atm}}{2\gamma_{hg}} \right)^2 - \frac{2p_g h_i}{\gamma_{hg}}}$$

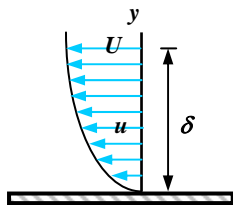


kPa $^{\circ}C$
 $^{\circ}C$ $| m$
 kPa
 $\times J.kg/K$
 $| kN/m$ $^{\circ}C$ $| kg$
 $| kN/m$ $| ^{\circ}C$
 $| kg :$
 N
 $| m/s$
 kN $| kN$
 $| ^{\circ}C$
 $| kg/m$ $| kN/m :$
 (T) (ρ)

 (kg/m)
 $(^{\circ}C)$

$$\rho = c + c T$$

$| ^{\circ}C$

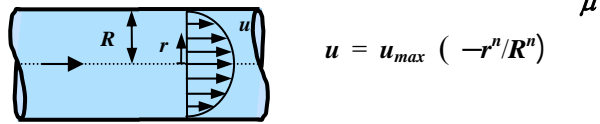
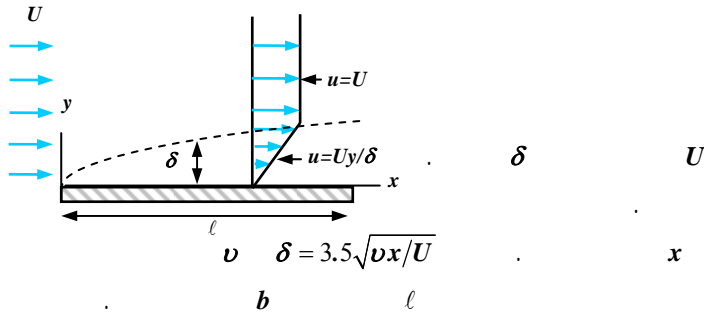


$$\frac{u}{U} = \frac{3}{2} \frac{y}{\delta} - \frac{1}{2} \left(\frac{y}{\delta} \right)^3$$

$| m/s$

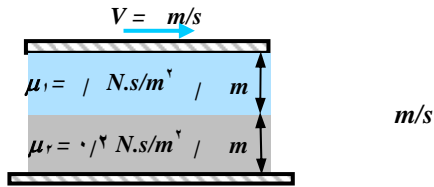
δ U

U/δ :

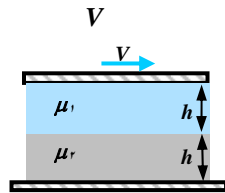


u_{max}

$F = \pi \mu n u_{max}$:



V

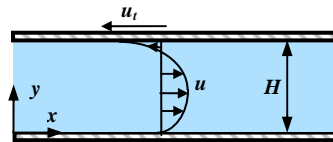


$(\mu_1 V)/(\mu_1 + \mu_2)$:

x

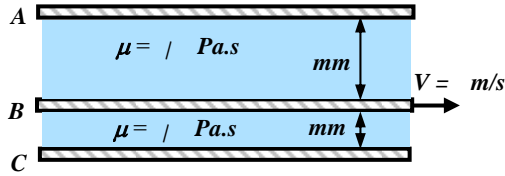
u_t

$$u = -\frac{1}{2} \frac{\gamma}{\mu} \frac{dp}{dx} (Hy - y^2) + u_t \frac{y}{H}$$



C B A

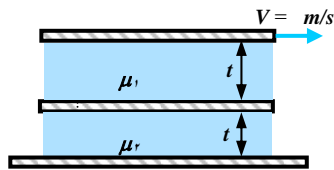
B



B A



() :



t μ μ

μ = 1 Pa.s

t

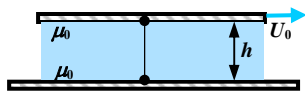
(m/s)

t = 1 mm t = 1 mm μ = 1 Pa.s

(/ ((/ (



μ0

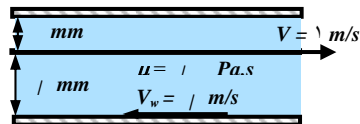


(U0)

τ = τ (τ > τ (τ < τ (

() (

() :



/ m × / m

/ mm

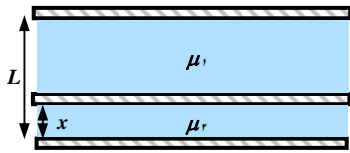
m/s

/ m/s



μ μ

()



F

L

$\mu = \mu$

U

F

(x)

μ

— (

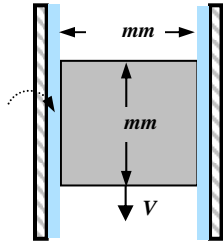
— (

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()

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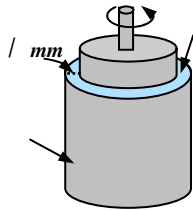
mm

mm

m/s

m/s

mm



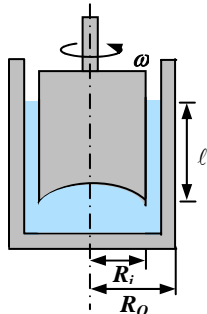
/ mm

/ m

mm

/ N.m

/ × Pa.s :



(T)

ω

ω

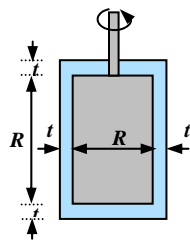
R

R



μ

t



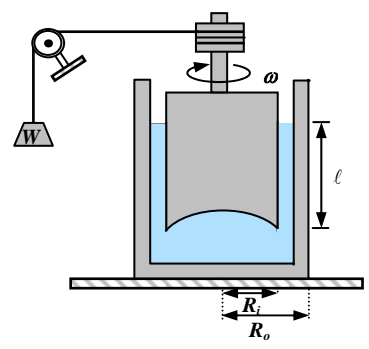
$\frac{\pi\mu\omega}{t} R$ (

$\frac{\partial \pi\mu\omega}{t} R$ (

$\frac{\forall \pi\mu\omega}{t} R$ (

$\frac{\pi\mu\omega}{\forall t} R$ (

() :

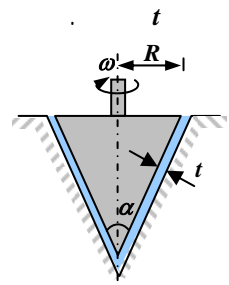


r_s

ω

$l \ \omega \ W$

ω



μ

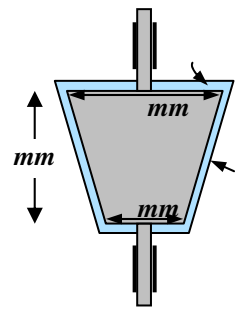
$$T = \frac{\pi \omega \mu R^4}{2t \sin(\alpha/2)} \quad ($$

$$T = \frac{\pi \omega^2 \mu R^4}{t \sin(\alpha/2)} \quad ($$

$$T = \frac{\pi \omega \mu R^4}{t \sin \alpha} \quad ($$

$$T = \frac{2\pi \omega \mu R^4}{t \sin(\alpha/2)} \quad ($$

() :

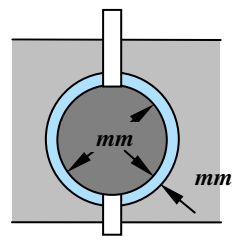


/ mm

/ Pa.s °C

°C

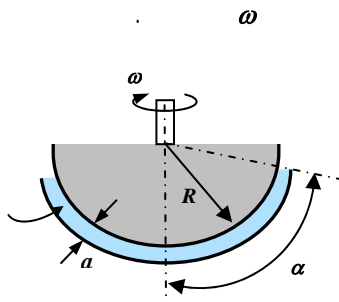
/ Pa.s °C



mm

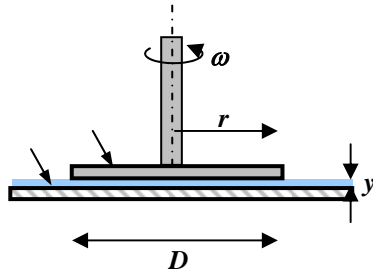
/ Pa.s

/ × ⁻ N.m :



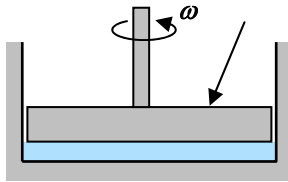
$\mu = Pa.s$
(a)

(ω)
mm (R) / mm
 α



$D = mm \quad \omega = rad/s \quad \mu = / Pa.s$

$y = mm$
 $/ \times N.m$ ($/ \times N.m$ ($/ \times N.m$ ($/ \times N.m$ ($()$:



$^{\circ}C$ / mm

$^{\circ}C$

$^{\circ}C$

$/ \times kPa$

- $/ MPa$:

% MPa

kg/m

kg

/ kPa

MPa

$/ \times kPa$

$$\frac{m}{\text{Pa}} \times (\Delta\rho/\rho) \left(\frac{m}{\text{Pa}} \right) \left(\frac{m}{\text{Pa}} \right) \left(\frac{m}{\text{Pa}} \right) \left(\frac{m}{\text{Pa}} \right)$$

/ × Pa

/ × Pa

() :

/ MPa

m

/ GPa

N/m

/ kPa

°C

kPa

k = /

/ kPa

kPa :

kPa

$$R = \frac{J}{\text{kg}\cdot\text{K}}$$

k = / ()

c_v = c_p = (

c_v = c_p = (

() :

/ kPa

°C

/ × J/(kg.K)

kPa

k = /

°C

/ kg/m :

۵۳

..... / / × **kPa** °C

kg/m °C

k = /

/ **m/s** :

k = /

kPa °C

..... °C

Pa :

..... °C

..... **kPa**

..... °C

Pa :

mm

..... / **N/m**



σ **d**

$p = \frac{4\sigma}{d}$ (

$p = \frac{2\sigma}{d}$ (

$p = \frac{\sigma}{2d}$ (

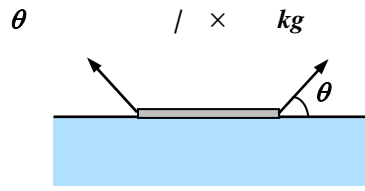
$p = \frac{\sigma}{d}$ (

() :

kg/m

..... °C

kg/m



$^{\circ}\text{C}$ mm
 / $^{\circ}$:

kg/m / mm
 mm

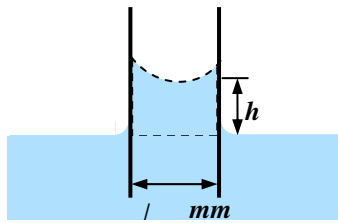


$^{\circ}$ $^{\circ}\text{C}$ / mm

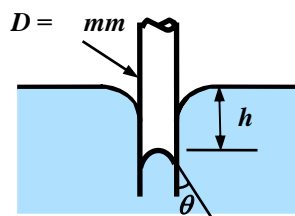
/ m :

/ mm

/ N/m



/ mm $^{\circ}\text{C}$
 / N/m / N/m
 / mm :



$\theta = ^{\circ}$ mm

: