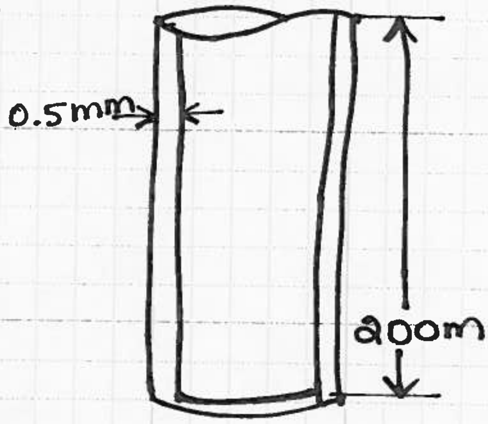
2.37) A cylinder falls inside a pipe filled with oi

$d = 100\,mm$; $D = 100.5\,mm$; $l = 200\,mm$

$W = 15\,N$

SKETCH:



UNKNOWN:

speed @ which the cylinder slides down the pipe.

KNOWN:

$T_{oil} = 10°C$

From Fig. A2: $\mu = 0.35\,N\cdot s/m^2$

assume buoyant forces can be neglected

GOVERNING EQS:

$\tau = \mu \frac{dV}{dy}$; $\frac{W}{\pi d l} = \frac{\mu V_{fall}}{(D-d)/2}$

SOLUTION:

$V_{fall} = \frac{W(D-d)}{2\pi d l \mu}$

$V_{fall} = \frac{15N(0.5 \times 10^{-3}\,m)}{(2\pi \times 0.1m \times 0.2m \times 3.5 \times 10^{-1}\,Ns/m^2)}$

$\boxed{V_{fall} = 0.17\ m/s}$

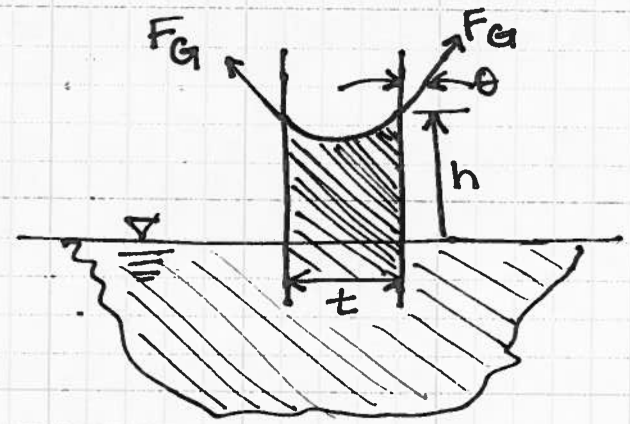
2.61) Two vertical glass plates with a thickness of 1m

KNOWN:

$t = 1mm$

From table A.4, surface water tension, $\sigma = 7.3\times10^{-2}\ \frac{N}{m}$

SKETCH:



UNKNOWN:

h = capillary rise between the plates.

GOVERNING EQS:

$$h = \frac{2\sigma}{\gamma t}$$

SOLUTION:

Force due to surface tension = weight of fluid that has been pulled upward

$$(2l)\sigma = (hlt)\gamma$$

Equilibrium $\Sigma F_y = 0$

$$\therefore\ 2\sigma l - hlt\gamma = 0$$

$$h = \frac{2\sigma}{\gamma t}$$

$$h = \frac{2\times(7.3\times10^{-2}N/m)}{9810N/m^3 \times 0.001m}$$

$$= 0.0149\ m$$

$$\boxed{h = 14.9mm}$$