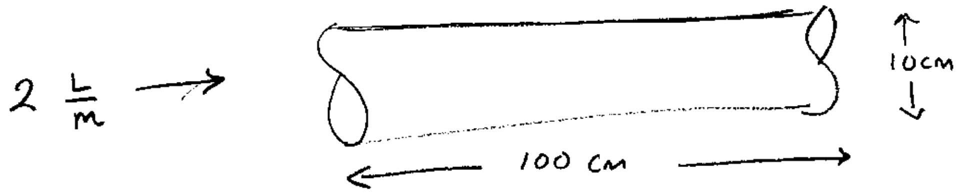
EXAMPLES

FIND VELOCITY FROM FLOW-RATE

$$Q = \bar{V} \cdot A$$



$$Q = 2 \frac{\text{Liter}}{\text{min}} \cdot$$

CONVERT

$$= 2 \frac{\cancel{L}}{\cancel{min}} \cdot \frac{1 \cancel{min}}{60\ s} \frac{0.001\ m^3}{1\ \cancel{L}}$$

$$= \frac{2\,(0.001)}{60} \left[\frac{m^3}{s}\right] \checkmark$$

$$= 3.3 \times 10^{-5} \left[\frac{m^3}{s}\right]$$

$$A = \frac{\pi D^2}{4} = \left(\frac{22}{7}\right) \frac{10^2}{4} = \frac{\cancel{22} \cdot \cancel{100}}{28} \cancel{cm^2} \frac{m^2}{100^2\ \cancel{cm^2}}$$

I just use this for π ...

$$= 0.008\ m^2$$

$$\bar{V} = \frac{Q}{A} = 0.004 \left[\frac{m}{s}\right]$$

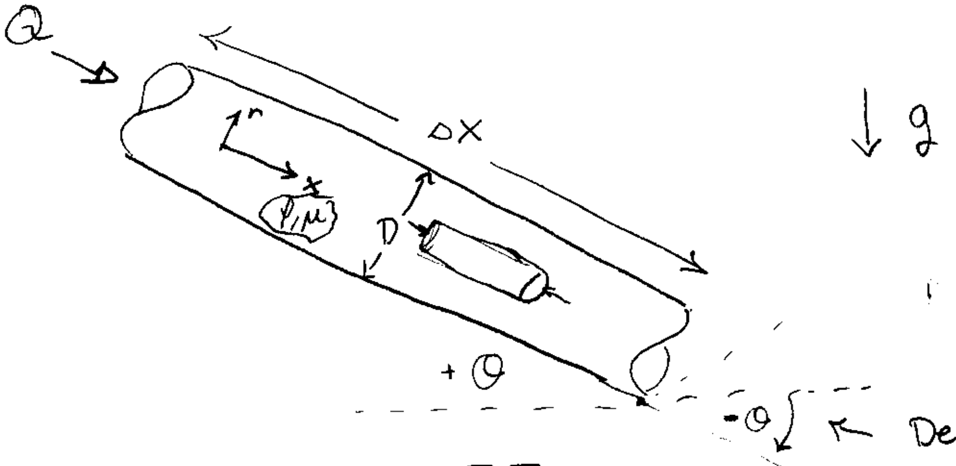
MAX VELOCITY?

$$\bar{V} = \frac{V_{max}}{2}$$

$$V_{max} = 0.008 \left[\frac{m}{s}\right]$$

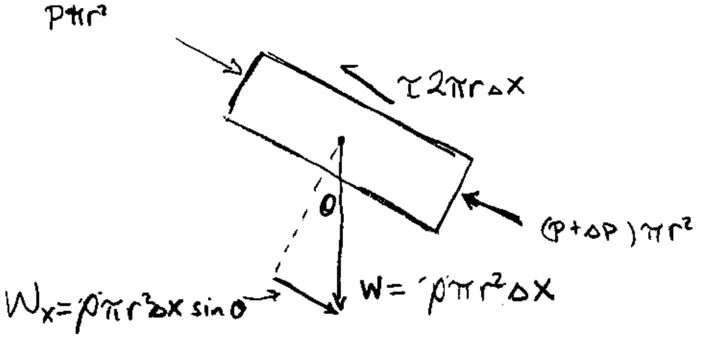
EXAMPLES ANGLED PIPES

WHAT CHANGES IF THE PIPE IS ANGLED?



← Define this orientation as negative

$$\Sigma F_x = 0$$

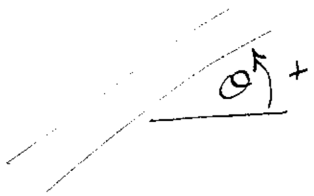


$$0 = P\pi r^2 + \rho\pi r^2\Delta x \sin(-\theta) - \tau 2\pi r\Delta x - (P+\Delta P)\pi r^2$$

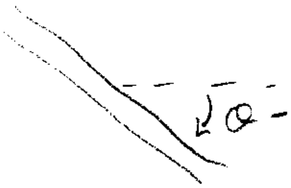
$$\frac{\Delta P - \underbrace{\rho\Delta x\sin\theta}_{\text{correction term.}}}{\Delta x} = \frac{2\tau}{r}$$

So JUST SUB IN $\Delta P + \rho\Delta x\sin\theta$ WHEREEVER YOU SEE A ΔP IN STRAIGHT PIPE RESULTS.

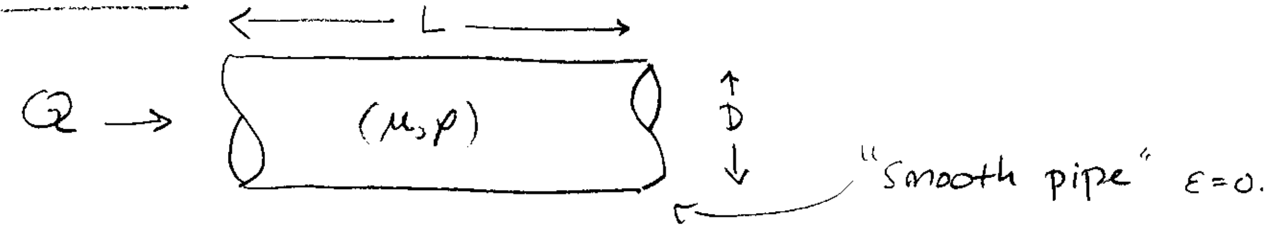
!! WATCH FOR SIGNS THOUGH !!



is DIFFERENT THAN



EXAMPLES



Given (Q, L, D, μ, ρ) FIND FRICTION FACTOR.

1) GET Velocity from $Q = \bar{V} A$

$$\bar{V} = \frac{Q}{A}$$

2) Calculate Reynolds

$$Re = \frac{\rho \bar{V} D}{\mu}$$

Laminar or Turbulent?

3) Let's say $Re < 2000$.

$$f = \frac{64}{Re}$$

4) If $Re > 2000$ (Turbulent) We have to use the nasty equation.

$$\frac{1}{\sqrt{f}} = 2.00 \log_{10}(Re\sqrt{f}) - 0.8 \quad \text{(Smooth pipe)}$$

Values of f lie usually between [0.008 - 0.1]

5) Guess a value of $f_0 = 0.05$ (Pick anything)

$$\frac{1}{\sqrt{f_1}} = 2.00 \log_{10}(Re\sqrt{f_0}) - 0.8$$

$$\frac{1}{\sqrt{f_2}} = 2.00 \log_{10}(Re\sqrt{f_1}) - 0.8$$

Keep doing this until $f_n \cong f_{n+1}$.

EXTRA CREDIT MAKE EXCEL DO THIS FOR YOU GIVEN A f_0