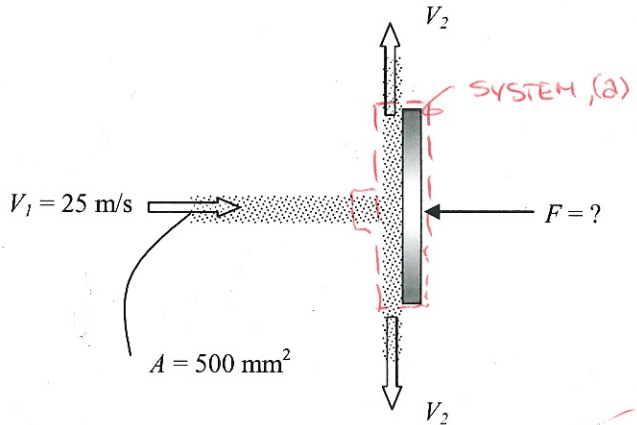
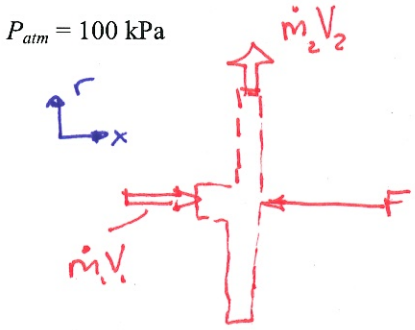
EXAMPLE

A jet of water impinges a circular plate (D = 10 cm) with a velocity of 25 m/s. Calculate

a) the force F required to hold the plate stationary, and
b) the force on the front of the plate at the water/plate interface.

USE $\rho = 1000 \frac{kg}{m^3}$





CAN I FIND THIS? YES!

a) $\rightarrow \frac{dP_{sys_x}}{dt} = \sum F_x + \sum_{IN} \dot{m} V_x - \sum_{OUT} \dot{m} V_x$ (IN + X DIR)

$\frac{dP_{sys_x}}{dt} \rightarrow 0$

$0 = -F + \dot{m}_1 V_1 - \dot{m}_2 V_{2_x}$ ...

$+P_{ATM} A_{PLATE} - P_{ATM} A_{PLATE}$ 0? NO! 0? YES! NO x-COMPONENT of V_2!

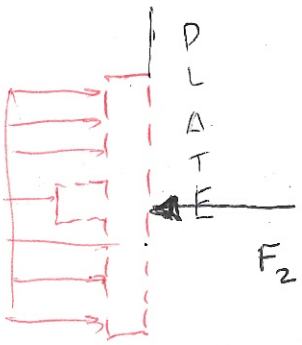
$F = (\dot{m}_1 V_1)$

$\dot{m}_1 = \rho A_1 V_1$

$\therefore F = (\rho A_1 V_1) V_1 = \left(1000 \frac{kg}{m^3} \cdot 500\ mm^2 \frac{(0.001)^2\ m^2}{(1\ mm)^2} \cdot 25 \frac{m}{s}\right) 25 \frac{m}{s}$

$= 312.5 = \boxed{313.\ N}$

b)



X MOM REDUCES TO (YOU SHOULD SHOW IT!)

DOESN'T CANCEL HERE!

... $0 = -F_2 + P_{ATM} A_{PLATE} + \dot{m}_1 V_1$

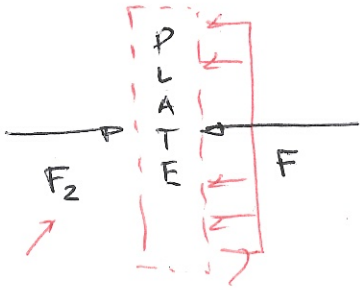
$F_2 = \dot{m} V_1 + P_{ATM} A_{PLATE}$

$= 313\ N + (100\ kPa)\left(\frac{\pi}{4}\right) 0.10^2\ m^2$

$= 313\ N + 785\ N$

$= \boxed{1098\ N}$

COULD YOU PICK A DIFFERENT SYSTEM?



WHY → ?

$$0 = F_2 - F - P_{ATM} A_{PLATE}$$

AGAIN, X MOM REDUCES TO...

$$F_2 = F + P_{ATM} A_{PLATE}$$

(YOU SHOULD SHOW IT!)

$$= \ldots\ldots$$

$$\boxed{1098\ N}$$