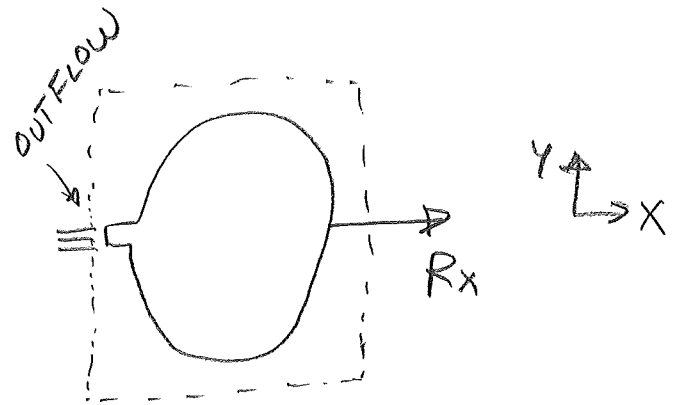


6.1

GIVEN: BALLOON ROCKET
 AS SHOWN. NOZZLE
 IS 1 CM. IN DIAMETER,
 AIR VELOCITY AT EXIT
 IS 40 m/s. AIR
 DENSITY IS $1.2 \frac{\text{kg}}{\text{m}^3}$.



FIND: FORCE TO HOLD THE BALLOON
 STATIONARY.

SOLUTION: ASSUME VELOCITY AND
 DENSITY ARE STEADY (NO OTHER
 INFORMATION IS GIVEN)

$$\sum F_x = \frac{d}{dt} \int_{CV} v_x \rho dV + \int_{CS} v_x \rho \underbrace{V \cdot dA}_{+\dot{m}}$$

$$R_x = v_{ix} \dot{m} = v_{ix} (\rho VA)$$

$$v_{ix} = -40 \text{ m/s} \quad (\text{VELOCITY IS DIRECTED IN THE NEGATIVE X-DIRECTION})$$

$$R_x = - (1.2) \left(\frac{\pi}{4} \right) (0.01)^2 (40)^2$$

$$R_x = -0.151 \text{ N}$$

6.16

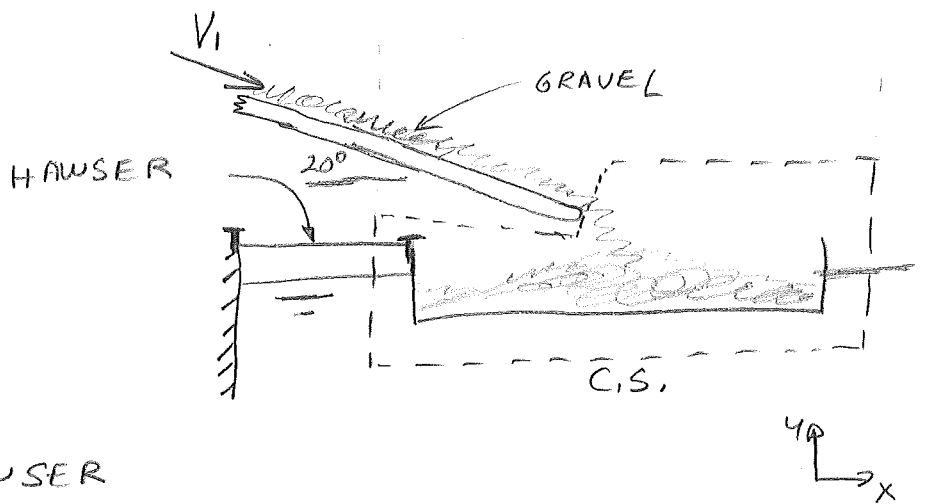
GIVEN: GRAVEL

DELIVERED TO BARGE
AT $50 \text{ yd}^3/\text{min}$.

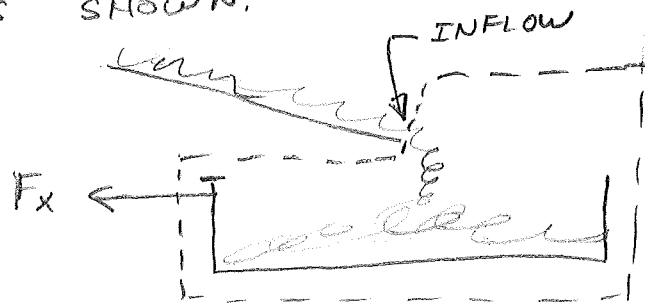
$$\gamma = 120 \frac{\text{LBF}}{\text{FT}^3}$$

$$V_i = 10 \text{ FT/S}$$

FIND: TENSION IN HAWSER



SOLUTION: DRAW C.S. AS SHOWN.



$$0 - F_x = 0 - \dot{m} V_{ix} + 0$$

$$F_x = \dot{m} V \cos \alpha$$

$$F_x = \rho Q V \cos \alpha \quad \rho = \frac{\gamma}{g}$$

$$F_x = \frac{120 \frac{\text{LBF}}{\text{FT}^3}}{32.2 \frac{\text{FT}}{\text{S}^2}} \left(50 \frac{\text{yd}^3}{\text{min}} \right) \left(\frac{3 \text{ FT}}{\text{yd}} \right)^3 \left(\frac{1 \text{ min}}{60 \text{ s}} \right) \left(10 \frac{\text{FT}}{\text{S}} \right) (\cos 20^\circ)$$

$$F_x = 788 \text{ LBF}$$

6.17

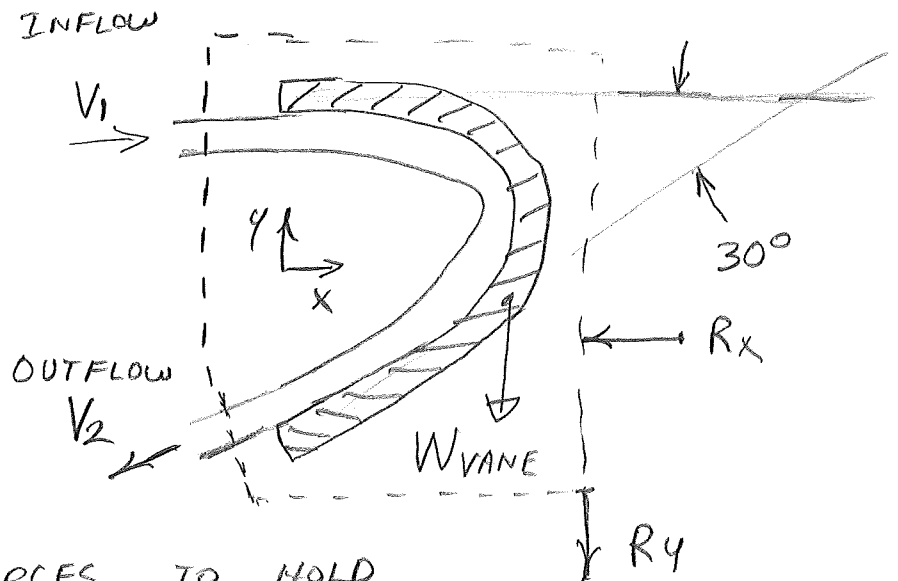
GIVEN:

$$V_1 = 18 \text{ m/s}$$

$$V_2 = 17 \text{ m/s}$$

$$Q = 0.15 \frac{\text{m}^3}{\text{s}}$$

$$S = 0.90$$



FIND: REACTIONS FORCES TO HOLD
VANE IN PLACE

SOLUTION:

$$\sum F_x = \dot{m} (V_{2x} - V_{1x})$$

$$-R_x + \cancel{F_{px}} = \rho Q [V_2 \cos \alpha - V_1]$$

$$-R_x = (0.90)(998)(0.15) [17(-0.866) - 18]$$

$$R_x = 4409 \text{ N}$$

$$\sum F_y = \dot{m} (V_{2y} - V_{1y})$$

$$-R_y + \cancel{F_{py}} - \cancel{W_{\text{VANE}}} = \dot{m} [V_2 \sin(210^\circ) - V_1(\sin 0^\circ)]$$

$$\begin{aligned} -R_y &= \rho Q V_2 \sin(210^\circ) \\ &= (0.90)(998)(0.15)(17) \sin(210^\circ) \end{aligned}$$

$$R_y = 1145 \text{ N}$$

$$\alpha = 180^\circ + 30^\circ = 210^\circ$$

