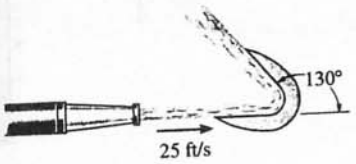
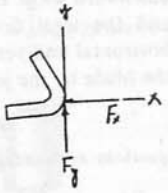
*15-112. A jet of water having a cross-sectional area of 4 in^2 strikes the fixed blade with a speed of 25 ft/s. Determine the horizontal and vertical components of force which the blade exerts on the water. $\gamma_w = 62.4$ lb/ft^3.



$$Q = Av = \left(\frac{4}{144}\right)(25) = 0.6944 \text{ ft}^3/\text{s}$$

$$\frac{dm}{dt} = \rho Q = \left(\frac{62.4}{32.2}\right)(0.6944) = 1.3458 \text{ slug/s}$$



$v_{Ax} = 25$ ft/s $\quad v_{Ay} = 0$

$v_{Bx} = -25\cos 50°$ ft/s $\quad v_{By} = 25\sin 50°$ ft/s

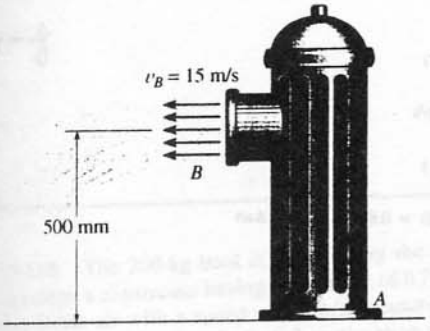
$$\stackrel{+}{\rightarrow} \Sigma F_x = \frac{dm}{dt}(v_{Bx} - v_{Ax}); \quad -F_x = 1.3458[-25\cos 50° - 25]$$

$$F_x = 55.3 \text{ lb} \quad \textbf{Ans}$$

$$+\uparrow \Sigma F_y = \frac{dm}{dt}(v_{By} - v_{Ay}); \quad F_y = 1.3458(25\sin 50° - 0)$$

$$F_y = 25.8 \text{ lb} \quad \textbf{Ans}$$

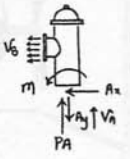
15-113. Water is flowing from the 150-mm-diameter fire hydrant with a velocity $v_B = 15$ m/s. Determine the horizontal and vertical components of force and the moment developed at the base joint A, if the static (gauge) pressure at A is 50 kPa. The diameter of the fire hydrant at A is 200 mm. $\rho_w = 1$ Mg/m^3.



$$\frac{dm}{dt} = \rho v_A A_B = 1000(15)(\pi)(0.075)^2$$

$$\frac{dm}{dt} = 265.07 \text{ kg/s}$$

$$v_A = \left(\frac{dm}{dt}\right)\frac{1}{\rho A_A} = \frac{265.07}{1000(\pi)(0.1)^2}$$



$v_A = 8.4375$ m/s

$$\stackrel{+}{\leftarrow} \Sigma F_x = \frac{dm}{dt}(v_{Bx} - v_{Ax})$$

$$A_x = 265.07(15 - 0) = 3.98 \text{ kN} \quad \textbf{Ans}$$

$$+\uparrow \Sigma F_y = \frac{dm}{dt}(v_{By} - v_{Ay})$$

$$-A_y + 50(10^3)(\pi)(0.1)^2 = 265.07(0 - 8.4375)$$

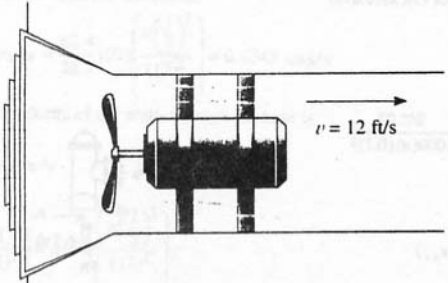
$$A_y = 3.81 \text{ kN} \quad \textbf{Ans}$$

$$(+\Sigma M_A = \frac{dm}{dt}(d_{AB} v_B - d_{AA} v_A)$$

$$M = 265.07(0.5(15) - 0)$$

$$M = 1.99 \text{ kN}\cdot\text{m} \quad \textbf{Ans}$$

15-115. The fan draws air through a vent with a speed of 12 ft/s. If the cross-sectional area of the vent is 2 ft^2, determine the horizontal thrust on the blade. The specific weight of the air is $\gamma_a = 0.076$ lb/ft^3.



$$\frac{dm}{dt} = \rho v A$$

$$= \frac{0.076}{32.2}(12)(2)$$

$$= 0.05665 \text{ slug/s}$$

$$\Sigma F = \frac{dm}{dt}(v_B - v_A)$$

$$T = 0.05665(12 - 0) = 0.680 \text{ lb} \quad \textbf{Ans}$$