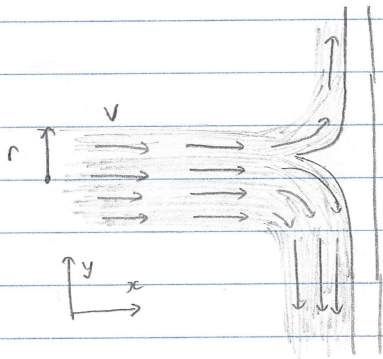
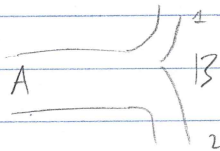


20-P-MOM-04-34

A water jet has a circular cross-section with the radius $r = 2\text{cm}$ and travels at the velocity $v = 1.5\text{ m/s}$. The jet is traveling in the positive x -direction and is split into two streams by a blade. A quarter of the stream flows in the positive y direction and $3/4$ th of the stream travels in the negative y -direction. Determine the force applied on the blade by the water. Specify blade $\rho = 997\text{ kg/m}^3$



Solution:



conservation of mass

$$\rho Q_A = \rho Q_{B1} + \rho Q_{B2}$$

$$\rho A_A v_A = \rho A_{B1} v_{B1} + \rho A_{B2} v_{B2}$$

$$A_{B1} = \frac{1}{4} A_A \quad A_{B2} = \frac{3}{4} A_A$$

$$\rho A_A v_A - \rho \frac{1}{4} A_A v_{B1} = \rho \frac{3}{4} A_A v_{B2}$$

$$v_{B1} = v_{B2} = v_A = v$$

$$\uparrow \sum F = \rho \pi r_A^2 v (v_B - v_A) \quad v_{B1} = 0 \quad \sum F = -2.819 \text{ N} \uparrow$$

$$\downarrow \sum F = \rho \pi r_{B1}^2 v (v_{B1} - 0) + \rho \pi r_{B2}^2 v (-v_{B2} - 0)$$

$$= 0.7047 - 2.1142 = -1.4095 \text{ N} \downarrow$$