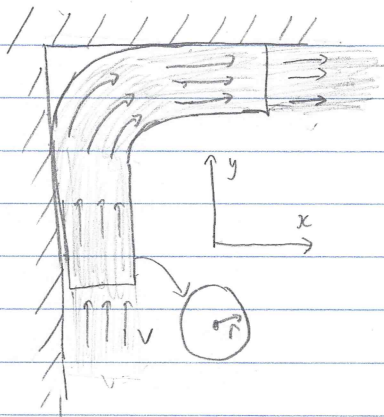20-P-MOM-DY-32

A plumbing tube redirects water traveling in the positive y-direction to the positive x-direction. The pipe has a circular cross-section with a radius r = 2cm and the water moves at a velocity v = 1 m/s in and out of the tube. Determine the magnitude of force that the tube experiences. Neglect the mass of the tube and the mass of the water on the tube. $\rho = 997 \, kg/m^3$

Solution:

$$\Sigma F = \frac{dm}{dt}(v_B - v_A)$$
$$= \frac{dm}{dt}(vi - vj)$$
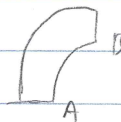
$$\frac{dm}{dt} = \rho Q \qquad Q = \pi r^2 v$$

$$\Sigma F = \rho \pi r^2 v(vi - vj) = 1.25\,\hat{i} - 1.25\,\hat{j}$$

$$|F| = 1.77 \, N$$