

Question #72067, Physics / Mechanics | Relativity

Water flows from a tube of radius r at velocity v , hits the wall perpendicularly and doesn't rebound back. How much force does the water exert on the wall?

Solution

Force is equal to impulse per unit time, or change in momentum per unit time:

$$F = \frac{m\Delta v}{\Delta t};$$

Since the water does not rebound, $\Delta v = v$;

$$F = \frac{mv}{\Delta t}$$

$$m = \rho V = \rho dA = \rho \times d \times \pi r^2,$$

where d is the length of the stream striking the wall, which is equal to the distance passed by the cross-section.

Hence

$$F = \rho \times d \times \pi r^2 \times \frac{v}{\Delta t} = \pi r^2 \rho v \frac{d}{\Delta t} = \pi r^2 \rho v^2;$$

$$F = \pi \times 1000 \times r^2 v^2 = 3142 r^2 v^2 \text{ N}$$

Answer: $3142r^2v^2$ N.