33.35 $5gpm$ **of water exits a pressure washer nozzle with a** $\frac{3}{4}in$ **diameter. What is the force of the water as it exits the nozzle?**

A. $0.08lb_f$

B. $0.3lb_f$

C. $0.7lb_f$

D. $2.5lb_f$

This problem relates to Jet Propulsion for an incompressible fluid. Use the equation for the Propulsive Force of a jet.

$$F = Q\rho v$$

For US customary units, g_c must be included in the denominator to make the units work. If the problem was stated in SI units the formula above would be valid.

$$F = \frac{Q\rho v}{g_c}$$

Change the volume flow rate units to $\frac{ft^3}{s}$.

$$Q = 5\frac{gal}{min}\left(\frac{1ft^3}{7.48gal}\right)\left(\frac{1min}{60s}\right) = 0.011\frac{ft^3}{s}$$

Determine the velocity.

$$Q = vA$$

$$v = \frac{Q}{A} = \frac{0.011\frac{ft^3}{s}}{\frac{\pi}{4}\left(\frac{\frac{3}{4}in}{12\frac{in}{ft}}\right)^2} = 3.63\frac{ft}{s}$$

Calculate the propulsive force.

$$F = \frac{Q\rho v}{g_c} = \frac{\left(0.011\frac{ft^3}{s}\right)\left(62.4\frac{lb_m}{ft^3}\right)\left(3.63\frac{ft}{s}\right)}{32.2\frac{lb_m \cdot ft}{lb_f \cdot s^2}} = 0.08lb_f$$

Answer A