9. The Mariana trench is located in the floor of the Pacific Ocean at a depth of about 11 000 m below the surface of the water. The density of seawater is 1025 kg/m³. **(a)** If an underwater vehicle were to explore such a depth, what force would the water exert on the vehicle's observation window (radius = 0.10 m)? **(b)** For comparison, determine the weight of a jetliner whose mass is 1.2 x 10⁵ kg.

$$F = (\Delta P)A = (P_{outside} - P_{inside})A$$

We will assume inside is 1 atm or 1.01 x 10⁵ N/m²

$$P_{outside} = \rho g d = \left(1025 \,{}^{kg}/_{m^3}\right)\left(9.80 \,{}^{m}/_{s^2}\right)(11\,000\,m) = 1.105\ x\ 10^8 \,{}^{N}/_{m^2}$$

$$F = (P_{outside} - P_{inside})A = (P_{outside} - P_{inside})\pi R^2$$

$$F = (P_{outside} - P_{inside})\pi R^2 = \left(1.105\ x\ 10^8 \,{}^{N}/_{m^2} - 1.01\ x10^5 \,{}^{N}/_{m^2}\right)\pi(0.10\,m)^2$$

$$F = \left(1.104\ x\ 10^8 \,{}^{N}/_{m^2}\right)(3.1416\ x\ 10^{-2}m^2) = 3.468\ x\ 10^6 N$$

$$W = mg = \left(1.2\ x\ 10^5\,kg\right)\left(9.80 \,{}^{m}/_{s^2}\right) = 1.176\ x\ 10^6 N$$

$$\boxed{\begin{array}{l} F = 3.5\ x\ 10^6 N \\ W = 1.2\ x\ 10^6 N \end{array}}$$