Question: 01

$d = 4\ in = 0.1016\ m$

$\dot{m} = \rho (V_{avg})(A) \leftarrow A = \frac{\pi}{4} d^2 = \frac{\pi}{4}(0.1016\ m)^2 = 0.0081\ m^2 = A$

$$V_{avg} = \frac{\dot{m}}{\rho * A} = \frac{0.5\ kg/s}{(1.22\ \frac{kg}{m^3})(0.0081\ m^2)} = 50.55\ m/s$$

$$V_{avg} = \frac{1}{2} V_{max} \rightarrow V_{max} = 2 * V_{avg} = 2 * (50.55\ m/s)$$

$$\boxed{V_{max} = 101.07\ m/s}$$ ← This will be used to determine dynamic pressure because the Pitot is located in the center.

$$\frac{1}{2}(\rho_{air})(V_{max})^2 = (\lambda_{oil})(\Delta h) = (\rho_{oil})(g)(\Delta h)$$ ← Setting dynamic pressure equal to hydrostatic pressure

$$\Delta h = \frac{(\rho_{air})(V_{max})^2}{2(\rho_{oil})(g)} = \frac{(1.22\ \frac{kg}{m^3})(101.07\ m/s)^2}{2(800\ \frac{kg}{m^3})(9.81\ m/s^2)}$$

$\Delta h = 0.794\ m$ — 1 sig fig → $\Delta h = 0.8\ m$

$$\boxed{\Delta h = 80\ cm}$$