Question: 01

$d = 4\ in = 0.1016\ m$

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

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

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

$$\boxed{V_{max} = 101.07\ m/s}$$ ← 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 → $\Delta h = 0.8\ m$

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

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% Code by Michael White for Pre-Lab Question 01
clear;clc;

% Setup initial variables
rho_air = 1.22;
rho_liquid = 800;
mdot = 0.5;
d = 4;

% Convert diameter from inches to meters
d = 0.0254*d;

% Calculate the area of the tube
A = pi/4*(d)^2;

% Calculate Vavg from mdot, rho_air, and the Area
Vavg = mdot/(rho_air*A);

% Calculate Vmax from Vavg, being 2*Vavg
Vmax = Vavg*2;

% Calculate delta_h by equating dynamic pressure and hydrostatic pressure+
delta_h = (Vmax^2)*rho_air/(2*rho_liquid*9.81);

% Convert delta_h to both 1 significant figure and centimeters
delta_h = round(delta_h,1)*100;

% Display results
disp(strcat("The height difference (delta h) is ",num2str(delta_h)," cm."));
```

```
The height difference (delta h) is 80 cm.
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