Physics 2010
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EXAM 4

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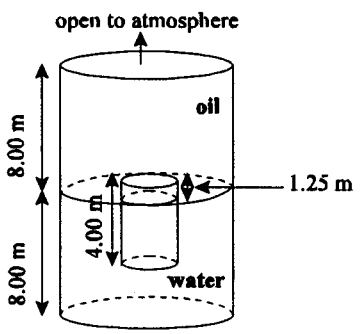
A solid cylinder is floating at the interface between water and oil. With the solid cylinder shown in the picture the height of **each** fluid layer is 8.00 m and the height of the cylinder is 4.00 m. The height of the cylinder that is just in the oil layer is 1.25 m. The density of the oil is 7.25×10^2 kg/m^3 and the density of water is 1.00×10^3 kg/m^3.



A. *[16 pts.]* What is the density of the solid cylinder?

$W_{CYL} = B$ $\quad W_{CYL} = \rho_{CYL} V_{CYL} g = \rho_{CYL} A h_{CYL} g$

$B = B_{OIL} + B_W = \rho_o V_o g + \rho_w V_w g$

$= \rho_o A h_o g + \rho_w A h_w g$

$\therefore \rho_{CYL} A h_{CYL} g = \rho_o A h_o g + \rho_w A h_w g$

$h_{CYL} = 4.00\,m$
$h_o = 1.25\,m$
$h_w = 2.75\,m$

$$\rho_{CYL} = \frac{\rho_o h_o + \rho_w h_w}{h_{CYL}} = \frac{(725\,kg/m^3)(1.25\,m) + (10^3\,kg/m^3)(2.75\,m)}{4.00\,m}$$

$$\boxed{\rho_{CYL} = 9.14 \times 10^2\,kg/m^3}$$

B. Find the absolute pressures at

$h_{TOP} = 8.00 - 1.25\,m = 6.75\,m$

1. *[10 pts.]* the top surface of the solid cylinder; [Note: $P_{ATM} = 1.01 \times 10^5$ N/m^2]

$P_{TOP} = P_{ATM} + \rho_{OIL} g h_{TOP} = 1.01 \times 10^5\,N/m^2 + (725\,kg/m^3)(9.8\,m/s^2)(6.75\,m)$

$P_{TOP} = 1.48 \times 10^5\,N/m^2$

2. *[10 pts.]* the bottom surface of the solid cylinder.

$P_{BOT} = P_{ATM} + \rho_{OIL} g h_{OIL(TOT)} + \rho_W g h_{BOT}$

$= 1.01 \times 10^5\,N/m^2 + (725\,kg/m^3)(9.8\,m/s^2)(8\,m) +$
$(10^3\,kg/m^3)(9.8\,m/s^2)(2.75\,m)$

$P_{BOT} = 1.85 \times 10^5\,N/m^2$