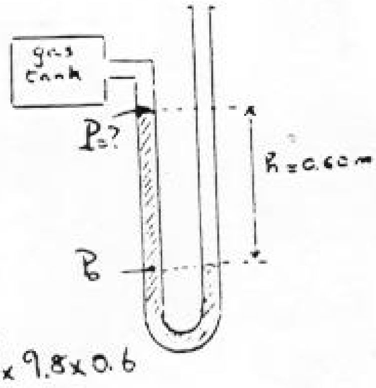
Chapter 15

An open-tube mercury manometer (see figure) is connected to a gas tank. What is the absolute pressure of the gas if h = 0.60 m and a nearby mercury barometer reads 76 cm-Hg ? (Density of mercury = 13.6*10**3 kg/m**3)



A. 1.93*10**4 Pa
B. 7.55*10**4 Pa
C. 2.00*10**5 Pa
(D) 2.13*10**4 Pa
E. 1.01*10**5 Pa

$P_o = P + \rho g h$

$\Rightarrow P = P_o - \rho g h$

$= 1.01\times10^5 - 13.6\times10^3 \times 9.8 \times 0.6$

$= 2.1 \times 10^4$ Pa

A block of wood floats in water with 2/3 of its volume submerged. In oil, it has 0.900 of its volume submerged. Find the density of oil.

(A) 741 kg/m**3
B. 621 kg/m**3
C. 921 kg/m**3
D. 1060 kg/m**3
E. 562 kg/m**3

$\frac{1}{3} = 1 - \frac{\rho_o}{\rho_w} \Rightarrow \rho_o = \rho_w \times \frac{2}{3} = 667$ kg/m^3

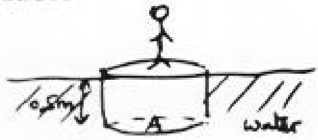
$0.1 = 1 - \frac{\rho_o}{\rho_{oil}} \Rightarrow \rho_{oil} = \frac{\rho_o}{0.9} = \frac{667}{0.9} = 741$ kg/m^3

A block of wood floats in water with 0.67 of its volume submerged. The density of water is 1000 kg/(m**3). When the same block floats ~~floats~~ in oil, 0.90 of its volume is submerged. Find the density of the oil.

(A) 744 kg/(m**3)
B. 838 kg/(m**3)
C. 500 kg/(m**3)
D. 626 kg/(m**3)
E. 893 kg/(m**3)

Same idea as above.

What is the area of the smallest cylindrical slab of ice, 0.5 m thick, that will just support a man of mass 100 kg. The density of the ice is 0.917*(10**3) kg/(m**3), and it is floating on fresh water.



(A) 2.41 m**2
B. 0.20 m**2
C. 0.10 m**2
D. none of these answers
E. 1.20 m**2

$$Mg + mg = F_b = \rho_w g V$$

$$Mg + \rho_{ice} g V = \rho_w g V$$

$$V = A h \Rightarrow Mg = (\rho_w - \rho_{ice}) g h A$$

$$\Rightarrow A = \frac{Mg}{(\rho_w - \rho_{ice}) g h} = \frac{100}{(1000-917)\times 0.5} = \underline{\underline{2.41\ m^2}}$$

The rate of flow of water through a horizontal pipe is 4.0 m**3/minute. What is speed of flow at point where the radius of the pipe is 0.05 m?

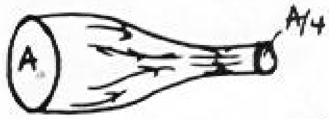
(A) 8.5 m/s
B. 9.4 m/s
C. 7.6 m/s
D. 6.5 m/s
E. 5.5 m/s

$$Av = \text{Constant}$$

$$\frac{4}{60} = 0.067\ \frac{m^3}{s} = \pi R^2 v$$

$$v = \frac{0.067}{\pi (0.05)^2} = \underline{\underline{8.5\ m/s}}$$

Water flows through a horizontal pipe of non-uniform crosssection. The pressure is 4.50 *(10**5) Pascals at a point where the speed is 2.00 m/s and the cross-sectional area is "A". Find the pressure at a point where the area is "A/4". The density of water is 1000 kg/(m**3).



A. 3.24*(10**5) Pascals
B. 3.83*(10**5) Pascals
C. 4.50*(10**5) Pascals
(D) 4.20*(10**5) Pascals
E. 4.02*(10**5) Pascals

$$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$$

$$A_1 v_1 = A_2 v_2 \Rightarrow v_2 = \frac{A_1}{A_2} v_1 = 4\times 2 = 8\ m/s$$

$$4.5\times10^5 + \frac{1}{2}(1000)(2)^2 = P_2 + \frac{1}{2}(1000)(8)^2$$

$$\Rightarrow P_2 = \underline{4.2\times10^5\ Pa}$$

Water is flowing at 5.00 m/s in a pipe where the cross section is 4.00 cm**2 and the pressure is 1.5 * 10**5 N/m**2. If the area gradually becomes 8.00 cm**2 at a point 10.0 m below the first point, find the pressure at the second point.

(A) 2.57 * 10**5 N/m**2
B. 2.31 * 10**5 N/m**2
C. 1.42 * 10**3 N/m**2
D. 0.79 * 10**4 N/m**2
E. 3.10 * 10**8 N/m**2

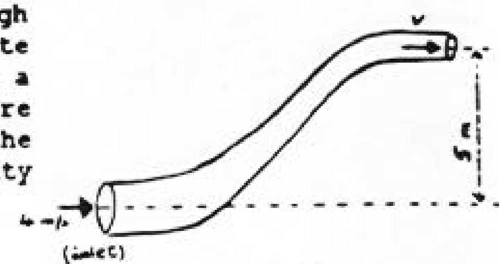
$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

$$A_1 v_1 = A_2 v_2 \Rightarrow v_2 = \frac{A_1}{A_2} v_1 = 5\left(\frac{4}{8}\right) = 2.5 \frac{m}{s}$$

$$1.5\times10^5 + \frac{1}{2}(1000)(5)^2 + (1000)(9.8)(10) = P_2 + \frac{1}{2}(1000)(2.5)^2$$

$$\Rightarrow P_2 = 2.57\times10^5 \frac{N}{m^2}$$

Water enters the first floor of a house through a pipe 2.0 cm in diameter and at an absolute pressure of 4*(10**5) Pa. The pipe leads to a second floor room 5 m above (see figure) where the diameter is 1.0 cm. The flow velocity in the inlet pipe is 4 m/s. What is the flow velocity and pressure in the second room ?

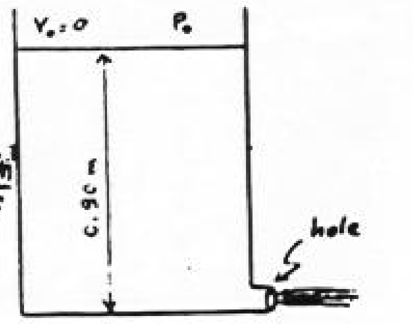


A. 32 m/s ; 9.90*(10**5) Pa
B. 10 m/s ; 16.60*(10**5) Pa
C. 4 m/s ; 4.00*(10**5) Pa
(D.) 16 m/s ; 2.31*(10**5) Pa
E. 20 m/s ; 1.80*(10**5) Pa

$$A_1 v_1 = A_2 v_2 \Rightarrow v_2 = \frac{A_1}{A_2} v_1$$

$$v_2 = \left(\frac{1}{0.5}\right)^2 4 = 16 \text{ m/s}$$

Water flows at the rate of 8.00 liter/min from a small hole at the bottom of a tank which is 0.900 m deep (see figure). Find the area of the hole.



A. 1.32 * 10**(-1) m**2
(B.) 3.17 * 10**(-5) m**2
C. 1.21 * 10**(-4) m**2
D. 5.14 * 10**(-5) m**2
E. 8.71 * 10**(-2) m**2

$$Av = \frac{8\times10^{-3}}{60} = 1.3\times10^{-4} \frac{m^3}{s}$$

$$P_1 = P_2 = P_o$$

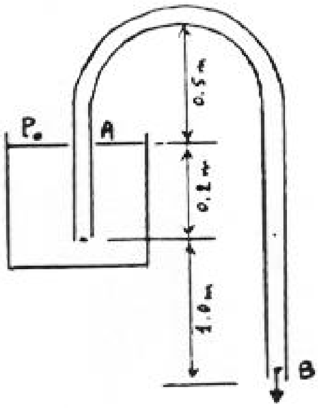
$$v_1 = 0$$

$$\cancel{P_o} + \cancel{\frac{1}{2}\rho v_1^2} + \rho g h_1 = \cancel{P_o} + \frac{1}{2}\rho v_2^2 + \cancel{\rho g h_2}$$

$$\Rightarrow v_2 = \sqrt{2gh_1} = 4.2 \text{ m/s}$$

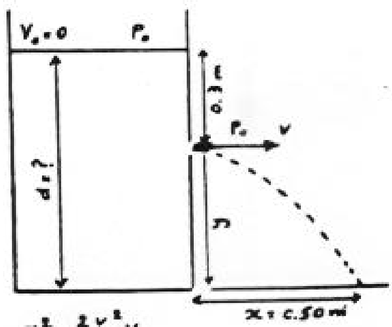
$$Av = 1.3\times10^{-4} \Rightarrow A = \frac{1.3\times10^{-4}}{4.2} = 3.17\times10^{-5} \text{ m}^2$$

A siphon is used to remove water from a container, as shown in the figure. [redacted]. The cross-sectional area of the siphon is 1 cm**2. Assume that the cross-sectional area of the container is much greater than that of the siphon. How much water is removed from the container in 10 s ?



A. 15.12*10**(-3) m**3
B. 0.53*10**(-3) m**3
C. 1.25*10**(-3) m**3
D. 8.23*10**(-3) m**3
(E) 4.85*10**(-3) m**3

A tank is filled with water. A hole is punched at a depth of 0.30 m below the surface of the water. The stream strikes the floor at a distance of 0.50 m from bottom of the tank (see figure). Find the depth of water in the tank.



$x^2 = \frac{2v^2}{g} y$

A. 0.031 m
B. 16 m
(C) 0.51 m
D. 0.61 m
E. 0.29 m

$x = vt$

$y = \frac{1}{2} g t^2$

$P_0 + \frac{1}{2}\rho v_1^2 + \rho g h = P_0 + \frac{1}{2}\rho v_2^2 + \rho g h$

$v_2 = \sqrt{2gh} = 2.42 \text{ m/s}$

$t = \frac{x}{v} = \frac{0.5}{2.42} = 0.2 \text{ s}$ $\quad y = \frac{1}{2} g t^2 = 4.9 \times (0.2)^2 = 0.21 \text{ m}$

$d = 0.51 \text{ m}$