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### HW 4

Note:  $g = 10 \text{ m/s}^2$

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	

1. Two pistons of a hydraulic lift have diameters of 60 cm and 5 cm. What is the force exerted by the larger piston when 50 N is placed on the smaller piston?

- a) -                      b) -                      c) -                      d) -

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$\frac{50}{(0.025)^2} = \frac{F}{(0.3)^2}$$

$$F = 7200$$

2. An object, of density 7.9 g/cm<sup>3</sup>, hangs from a balance. The balance reads 80 N when the object is in air, and 71 N when completely immersed in a liquid. What is the density of the liquid?

- A) 0.89 g/cm<sup>3</sup>      B) 8.8 g/cm<sup>3</sup>      C) 0.58 g/cm<sup>3</sup>      D) 1.5 g/cm<sup>3</sup>

$$F_B = 9$$

$$F = \rho_f V g$$

$$9 = \rho_f \cdot 10 \cdot \frac{8}{7900}$$

$$\rho_f = 888.75$$

$$= 8.88 \times 10^2 \text{ kg/m}^3$$

$$= 0.888$$

3. A piece of metal of unknown volume is suspended from a string  $T_1 = 10 \text{ N}$ , when it submerged in water  $T_2 = 8 \text{ N}$ . what is the density of the metal?

- A)  $4 \times 10^3 \text{ Kg/m}^3$       B)  $5 \times 10^3 \text{ Kg/m}^3$       C)  $2 \times 10^3 \text{ Kg/m}^3$       D)  $3 \times 10^3 \text{ Kg/m}^3$

$$T_1 = 10 = mg$$

$$T_2 = 8 = mg - \rho_f V g$$

$$2 = \rho_f V g$$

$$2 = 10000 V$$

$$V = 2 \times 10^{-4}$$

4. An ice cube floats in a glass of water, what fraction of the ice cube lies above the water level?

- A) 0.04      B) 0.08      C) 0.06      D) 0.02

$$\frac{\rho_{\text{ice}}}{\rho_{\text{water}}} = \frac{920}{1000} = 0.92$$

$$1 - 0.92 = 0.08$$

5. A closed empty bottle has a mass of 112 g. If fully submerged in water it displaces  $1.63 \times 10^{-4} \text{ m}^3$  of water. What volume of mercury ( $\rho_{\text{Hg}} = 13.6 \times 10^3 \text{ kg/m}^3$ ) must be added to the empty bottle so that it will just submerge?

- A) 3.75 cm<sup>3</sup>      B) 2.15 cm<sup>3</sup>      C) 1.00 cm<sup>3</sup>      D) 4.50 cm<sup>3</sup>

$$F_B = m_{\text{bottle}} g + m_{\text{Hg}} g$$

$$\rho_f V = m_{\text{bottle}} + m_{\text{Hg}}$$

$$1000(1.63 \times 10^{-4}) = 0.112 + m_{\text{Hg}}$$

$$m_{\text{Hg}} = 0.051$$

$$V = \frac{m}{\rho} = \frac{0.051}{13600} = 3.75 \times 10^{-6} \text{ m}^3$$

6. Your blood pressure is reported as 50 mm of Hg. The density of mercury is 13.6 g/cm<sup>3</sup>. Your pressure (in Pa) is equivalent to

- A)  $6.8 \times 10^3$       B) 6.8      C)  $6.8 \times 10^6$       D)  $6.8 \times 10^2$

$$P = \rho g h$$

$$= 13.6 (9.8) (50 \times 10^{-3})$$

$$= 6664$$

7. The rate of flow of water through a horizontal pipe is 2.0 m<sup>3</sup>/minute. Determine the speed of flow at a point where the radius of the pipe is 4.0 cm.

- A) 6.6 m/s      B) 400 m/s      C) 2.3 m/s      D) 0.84 m/s E) 9.8 m/s

$$Q = A v$$

$$v = \frac{Q}{A} = \frac{0.0333}{0.0016} = 20.8$$

8. What is the pressure difference (in Pa) between the heart and the brain of a human, if the the brain is 0.5 m above the heart.

- a.  $7.3 \times 10^3$       b.  $2.2 \times 10^3$       c.  $5.3 \times 10^3$       d.  $4.6 \times 10^3$

$$\Delta P = \rho g h = 1000 (9.8) (0.5) = 5000$$

9. A cube with a volume of 4 cm<sup>3</sup> is submerged halfway into water. What is the buoyant force (in N) experienced by the cube?

- a.  $11.4 \times 10^{-3}$       b.  $8.6 \times 10^{-3}$       c.  $19.6 \times 10^{-3}$       d.  $12.2 \times 10^{-3}$

$$F_B = \rho_f V$$

$$= 1000 (9.8) (2 \times 10^{-3})$$

$$= 19.6$$

10. A water hose 2 cm in diameter is used to fill a 20 liter bucket. If it takes 1 min to fill the bucket, what is the speed (in m/s) at which the water leaves the hose?

- a. 40      b. 30      c. 10      d. 1.06

$$r = 0.01$$

$$V = 0.02 \text{ m}^3$$

$$\theta = \frac{V}{A t} = \frac{0.02}{\pi (0.01)^2 \cdot 60} = 3.33 \times 10^{-4}$$

$$Q = A \cdot v$$

$$v = \frac{Q}{A} = \frac{3.33 \times 10^{-4}}{\pi (0.01)^2} = 1.06$$

Hw. 4

# Fluids:

1)  $P_{in} = P_{out}$

$$\frac{F}{A} = \frac{F}{A} \Rightarrow \frac{F}{\pi(30 \times 10^{-2})^2} = \frac{50 \times 10}{\pi(\frac{5}{2} \times 10^{-2})^2}$$

$$F = 72000 \text{ N} = 72 \text{ kN}$$

2)  $\rho = 7.9 \text{ g/cm}^3 \Rightarrow \frac{7.9 \text{ g}}{\text{cm}^3} \Rightarrow \frac{7.9 \times 10^{-3}}{10^{-6}} = 7900 \text{ kg/m}^3$

$$W = 80 \text{ N}$$

الوزن بعد  
كفر الجسم  $\leftarrow W' = 71 \text{ N}$

$$F_B = W - W' = 80 - 71 = 9$$

$$F_B = \rho_F \cdot g \cdot V$$

من الوزن  
الظاهري  $\uparrow$   
 $m = 8 \text{ kg}$

$$9 = \rho_F \cdot 10 \times \frac{8}{7900}$$

$$\rho_{obj} = \frac{m}{V} \uparrow$$
$$V = \frac{8}{7900}$$

$$\rho_F = \frac{9 \times 7900}{8} = 8887.5 \text{ kg/m}^3 = 8.8 \text{ g/cm}^3 \quad \text{B)}$$

3)  $T_i = W = 10 \text{ N} \Rightarrow m = 1 \text{ kg}$   
 $T_F = W' = 8 \text{ N}$  للقطعة المعلقة

$$F_B = W - W' = 2 \text{ N} = \text{وزن الماء المزيغ}$$

طريقة اخرى  
 $F_B = \rho_F g V$   
 $2 = \frac{1000(9.8)V}{1000}$   
 $V = 2 \times 10^{-4}$

كتلة الماء المزيغ  $\leftarrow m = 0.2$

الحجم المزيغ  $V =$

$$V_{water} = \frac{m}{\rho} = \frac{0.2}{1000} = 2 \times 10^{-4} \text{ m}^3$$

الحجم المزيغ

$$\rho_{metal} = \frac{m}{V} = \frac{1 \text{ kg}}{2 \times 10^{-4}} = 5000 \text{ kg/m}^3 \quad \text{B)}$$

4) fraction: نسبة الجزيء النظام

نسبة الجزيء النظام  
 $1 - 0.92 = 0.08$

$$\frac{\rho_{ice}}{\rho_{water}} = \frac{920}{1000} = 0.92$$

نسبة الجزيء  
المختصر

B) 0.08

5)  $m = 112g = 0.112 Kg$   
 $V = 1.63 \times 10^{-4} m^3$

← كلمة الزجاجة الخارجية

$$\rho_{Hg} = 13.6 \times 10^3$$

الزئبق

المطلوب: ما كمية الزئبق التي يجب إضافتها للعلبة لتتوازن

وزن العبة + الزئبق = وزن الماء المزجج

$$F_B = \rho_{water} \cdot g \cdot V = \text{وزن الماء المزجج} = 1.63 N$$

$$1.12 N = mg = \text{وزن الزجاجة}$$

$$W_{Hg} = F_B - W_{bottle} = 0.51 N = \text{وزن الزئبق}$$

$$V_{Hg} = \frac{W_{Hg}}{\rho_{Hg}} = \frac{0.51}{13600}$$

حجم الزئبق

$$= 3.75 \times 10^{-6} m^3 = 3.75 cm^3$$

A)

6)  $50 mm$  of Hg = ضغط الدم  
بـ الزئبق

$$\rho_{Hg} = 13.6 g/cm^3$$

العلاقة بين الضغط

$$P = \rho g h$$

لـ تحويل لـ  $1 Kg/m^3 \leftarrow Pa$  لأن لكل

وارتفاع السائل

$$\rho = 13600 \times 10 \times 0.055 m$$

$$\rho = 6.8 \times 10^3 Pa$$

A)

سؤال 7 ← فكر سؤال 5

7

$Q = 2 \text{ m}^3/\text{min}$        $v = ?$   
 معدل التدفق      speed of flow  
 $r = 4 \text{ cm}$

$$Q = Av \rightarrow v = \frac{Q}{A}$$

$$\begin{aligned}
 A &= \pi r^2 \\
 &= \pi (0.04)^2 \\
 &= 0.005024 \text{ m}^2
 \end{aligned}$$

$Q$  تحويل  $\frac{\text{m}^3}{\text{s}}$   $\rightarrow \frac{2 \text{ m}^3}{1 \text{ min}} \times \frac{1}{60} = 0.0333 \text{ m}^3/\text{s}$

$$v = \frac{0.0333 \text{ m}^3/\text{s}}{0.005024} = 6.63 \text{ m/s} \quad \text{A)}$$

8

$\Delta P = P - P_0 = \rho g h$        $h = 0.5 \text{ m}$

$\Delta P = \rho \cdot g \cdot h = 1000 \times 10 \times 0.5 = 5 \times 10^3 \text{ Pa}$   
 water  $\downarrow$       c)

9

$V = 4 \text{ cm}^3 = 4 \times 10^{-6} \text{ m}^3$

submerged halfway  
 $\rightarrow V_{\text{dis}} = \frac{1}{2} V_0$

buoyant force  $F_b = \frac{\rho}{F} g V_{\text{dis}}$

$$F_b = 1000 \cdot 10 \cdot \frac{1}{2} \times 4 \times 10^{-6} = 0.02 \text{ N} = 20 \times 10^{-3} \text{ N} \quad \text{c)}$$

10

11)

water hose:

فترطوم ماء

$$R = 2r = 2 \text{ cm}$$

$$r = 1 \text{ cm} = 10^{-2} \text{ m}$$

$$V = 20 \text{ L} = 0.02 \text{ m}^3$$

$$\rightarrow \left[ 1 \text{ m}^3 = 1000 \text{ L} \right]$$

$$t = 1 \text{ min} = 60 \text{ s}$$

المطلوب: سرعة مغادرة الماء للخرطوم (سرعة التدفق)

$$Q = A \cdot v \quad \left. \begin{array}{l} \text{سرعة م} \\ v = \frac{Q}{A} = \frac{0.000333}{0.000314} = 1.06 \text{ m/s} \\ \text{d)} \end{array} \right\} \begin{array}{l} Q = \frac{V}{t} = \frac{0.02}{60} = 0.000333 \text{ m}^3/\text{s} \\ A = \pi r^2 = \pi (0.01)^2 = 0.000314 \text{ m}^2 \end{array}$$

$$(2) \quad v_1 = 3 \text{ m/s}$$

$$v_2 = 2 \text{ m/s}$$

فوق النفاذ بحسب باستخدام معادلة برنولي

$$\Delta P = \frac{1}{2} \rho (v_1^2 - v_2^2)$$

$$* \rho_{\text{water}} = 1000$$

$$= \frac{1}{2} \times 1000 (3^2 - 2^2) = 2500 \text{ Pa}$$

$$= 2.5 \text{ kPa} \quad \text{D)}$$