THE UNIVERSITY OF JORDAN — PHYSICS DEPARTMENT

PHYSICS 105 (2nd EXAM) — SECOND SEMESTER (December 5th, 2017)

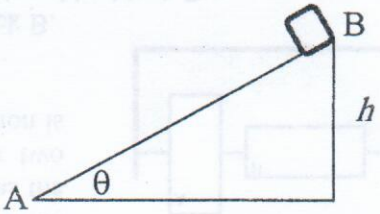
Student's Name (Arabic):..... Registration #:..... Sec #.....

*Useful Information: $R = 8.314$ J/mole.K; $k_B = 1.38\times10^{-23}$ J/K; $N_A = 6.02 \times 10^{23}$ molecules/mole; $g = 9.8$ m/s^2 ; $\rho_{water} = 1000.0$ kg/m^3 , $\rho_{mercury} = 13600.0$ kg/m^3 and $P_{atm} = 1.013 \times 10^5$ Pa.

1. Two balls, A and B, of masses $2m$ and m, respectively, are raised to the same height h and then back to the initial point. The total work done by the gravitational force on B is:

A) the same as the work done on A. B) one quarter the work done on A.
C) one half the work done on A. D) twice the work done on A.
E) four times the work done on A.

2. An object of mass 2 kg starts sliding from rest at the top of a rough inclined plane of height h =10 m, as shown in the figure,. If the speed of the object at the bottom of the inclined plane is 10 m/s, how much work (in J) is done by the force of friction?

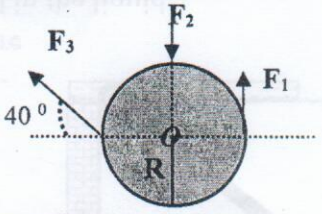


A) +96 B) -96
C) 0 D) -192 E) +192

3. Power P is required to lift a body a distance d at a constant speed v. The power required to lift the body a distance $2d$ at constant speed $6v$ is: (ignore air resistance)

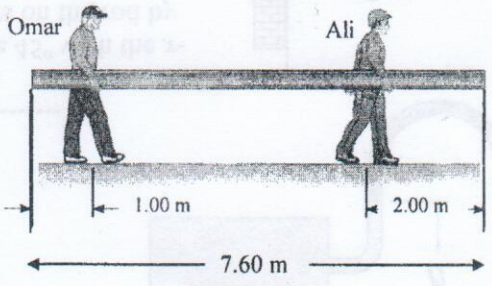
A) P B) $2P$ C) $3P$ D) $6P$ E) $3P/2$

4. If F_1= 15 N, F_2 = 22 N, F_3 = 9 N, the magnitude of the net torque around point O (in N.m) applied to the wheel of radius R= 0.80 m is:



A) 7.4 B) 5.2 C) 4.6
D) 2.9 E) 1.5

5. A uniform beam of length 7.60 m and weight 3.50 × 10^2 N is carried by two workers, Omar and Ali, as shown in the figure. The force that Omar exerts on the beam (in N) is:

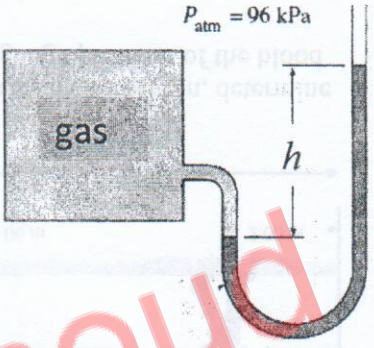


A) 176 B) 137 C) 96
D) 470 E) 320

6. If a vertical tube open to the atmosphere is connected to the vein in the arm of a person, determine how high the blood will rise in the tube (in m). Take the density and the gauge pressure of the blood to be 1050 kg/m^3 and 110 mmHg, respectively.

A) 0.76 B) 1.00 C) 1.42 D) 1.55 E) 0.07

7. A manometer is used to measure the pressure of a gas in a tank. The fluid used has a specific gravity of 0.85, and the manometer column height is $h = 35$ cm, as shown in the figure. If the atmospheric pressure is 96 kPa, the absolute pressure within the tank (in kPa) is:



A) 50.2 B) 70.1 C) 98.9
D) 120.9 E) 100.6

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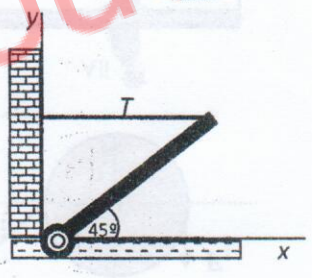
8. In the figure, the weight of the rod $W = 431$ N, and its length L = 8 m. The rod is at equilibrium making an angle 45° with the x-axis. The vertical component of the reaction force that acts on the rod by the hinge (in N)?



A) 352 N B) 500 N
C) 707 N D) 100 N E) 431

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9. Two balls of the same radius but densities $\rho_1 = 2\rho_L$ and $\rho_2 = 4\rho_L$ are placed in a liquid of density ρ_L. What is the ratio $\left(\frac{\text{the weight of ball 1 in the liquid}}{\text{the weight of ball 2 in the liquid}}\right)$?

A) 2/3 B) 1/2 C) 3/4 D) 4/3 E) 1/3

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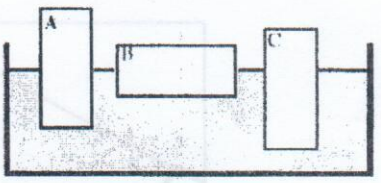
10. Three blocks labeled A, B, and C are floating in water as shown in the figure. Blocks A and B have the same mass and volume. Block C has the same volume, but is submerged to a greater depth than the other two blocks. Which one of the following statements concerning this situation is **false**?



A) The density of block A is less than that of block C.
B) The buoyant force acting on block A is equal to that acting on block B.
C) The volume of water displaced by block A is greater than that displaced by block B.
D) The buoyant force acting on block C is greater than that acting on block B.
E) The volume of water displaced by block C is greater than that displaced by block B.

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11. Air flowing horizontally with a speed v over the flat roof of a building reduces the pressure on the roof by an amount ΔP. What is the pressure reduction if the speed of the air is $3v$? Assume that the air was still initially.

A) 0 B) $4\Delta P$ C) $9\Delta P$ D) $\Delta P/9$ E) $\Delta P/4$

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12. 2 Liters/s of water enter a pipe of radius 1 cm. The speed of the water inside the pipe (in m/s) is:

A) 6.37 B) 3.71 C) 0.28 D) 8.46 E) 12.7

List your final answers in this table. Only the answer in this table will be graded..

Question	Q1:	Q2:	Q3:	Q4:	Q5:	Q6:	Q7:	Q8:	Q9:	Q10:	Q11:	Q12:
Final Answer	A	B	D	A	B	C	C	E	E	C	C	A

Physics (105)
Second Exam Solutions
5/DEC/2017

Q1] Vertical displacement = 0 $\Rightarrow$ <u>total</u> work done on each ball = 0 .

Q2] $\Delta K + \Delta U = W_{nc}$

$\therefore W_{nc} = \frac{1}{2}(2)(100-0) - 2g(10) = -96$ J

Q3] in each case $F = mg$ since $a = 0$ as the speed is constant.

$P = F v$

$P' = F(6v) = 6Fv = 6P$

Q4] $+\circlearrowleft$ O) $\tau = F_1(0.8) - F_3 \sin 40\,(0.8)$

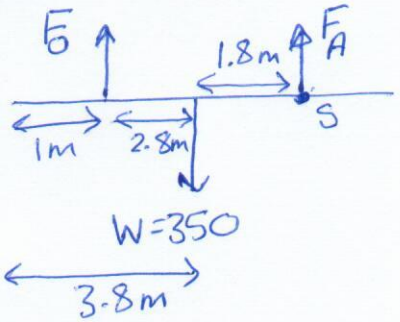
$= 0.8(F_1 - F_3 \sin 40) \approx 7.4$ N.m

(Note: F_2 does no torque about O as its line of action passes through point O).

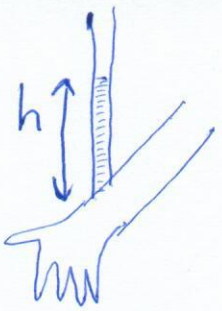
Q5] $+\circlearrowleft$ S) $350(1.8) - F_o(4.6) = 0$

$\therefore F_o \simeq 137$ N.

F_{omar}



Q6] $P_{blood} = \rho_{blood} g h + P_{atm}$



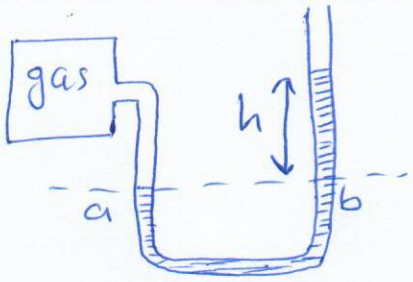
$P_{blood} - P_{atm} = \rho_{blood} g h$

$P^{gage}_{blood} = \rho_{blood} g h$

$$\Rightarrow h = \frac{P^{gage}_{blood}}{\rho_{blood} g} = \frac{110\ mm\,Hg \times \left(\frac{1.013\times10^5\ Pa}{760\ mm\,Hg}\right)}{1050\ \frac{kg}{m^3} \times 9.8\ \frac{m}{s^2}}$$

$h = 1.42\ m$

Q7] $P_a = P_b$

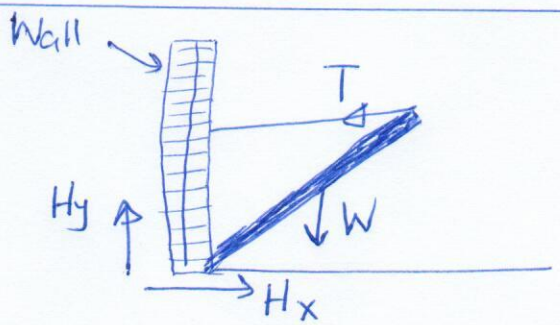


$P_{gas} = \rho_F g h + P_{atm}$

$= (0.85\times1000)(9.8)(0.35) + 96\times10^3$

$= 98.9\times10^3\ Pa = 98.9\ kPa.$

Q8] Hy and Hx are the vertical and horizontal components of the reaction force.

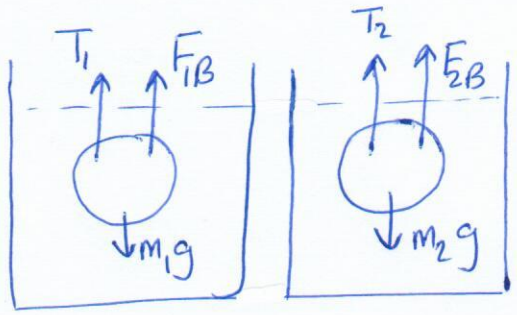


$\Sigma F_y = 0 \Rightarrow +\uparrow \quad Hy - W = 0$

$Hy = W = 431$ Newtons.

Q9] Two balls have the same radius ⇒ they have the same volume (V)

$\rho_1 = 2\rho_L$, $\rho_2 = 4\rho_L$ ⇒ both are totally submerged under liquid.



T_1 : weight of ball 1

T_2 : weight of ball 2

$T_1 + F_{1B} = m_1 g \Rightarrow T_1 = m_1 g - F_{1B}$

$= \rho_1 V g - \rho_L V g$

$= 2\rho_L V g - \rho_L V g = \rho_L V g$

Similarly

$T_2 + F_{2B} = m_2 g \Rightarrow T_2 = m_2 g - F_{2B}$

$= \rho_2 V g - \rho_L V g$

$= 4\rho_L V g - \rho_L V g = 3\rho_L V g$

$\Rightarrow \frac{T_1}{T_2} = \frac{\rho_L V g}{3\rho_L V g} = \frac{1}{3}$.

Q10] A and B have same mass and volume ⇒ $\rho_A = \rho_B = \rho$

C is submerged more than A and B ⇒ $\rho_C > \rho$

Since bolck ~~A~~ and block B have the same mass and volume (same density) ⇒ they must displace the same volume of the liquid.

Q11]

P_1 , $v_1^{air} = 0$ — P_1' , $v_1^{air} = v$ (roof)

use Bernoulli's equation

$P_1 + 0 = P_1' + \frac{1}{2}\rho v^2$ (note height is the same

$\therefore P_1 - P_1' = \Delta P = \frac{1}{2}\rho v^2$

Now, $v \to 3v$

$P_2 + 0 = P_2' + \frac{1}{2}\rho(3v)^2 = P_2' + 9 \times \frac{1}{2}\rho v^2$

$\therefore P_2 - P_2' = 9\left(\frac{1}{2}\rho v^2\right) = 9\Delta P$

12]

$Av \equiv$ volume flow rate

$\therefore \pi(1\times10^{-2})^2 v = \underbrace{2\times10^{-3}}_{\text{volume in } m^3}$

$\Rightarrow v \simeq 6.37$ m/s