The University of Jordan
Faculty of Science
Department of Physics

2nd Semester 2015/2016
Date: 8/12/2015
Physics 105 - Second Exam

Name (In Arabic):
Student Number:

Instructor:
Section:

Constants: g = 9.8 m/s^2, 1 atm=1.013×10^5 Pa, ρ_{water} = 1.0× 10^3 kg/m^3, 1 hp = 746 W

Write the letter corresponding to the correct answer in the table

Q	1	2	3	4	5	6	7	8	9	10
Answer	A	D	B	E	A	E	C	C	B	D

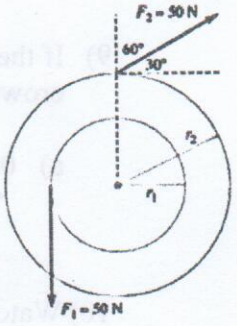
1) A 1.0-kg ball falls to the floor. When it is 0.70m above the floor, its potential energy exactly equals its kinetic energy. How fast is it moving?

a) 3.7 m/s b) 6.9 m/s c) 14 m/s d) 45 m/s e) 28 m/s

2) A 1500-kg car accelerates from 0 to 25 m/s in 7.0 s. What is the average power delivered by the engine?

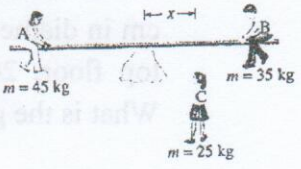
a) 60 hp b) 70 hp c) 80 hp d) 90 hp e) 100 hp

3) Two thin disk-shaped wheels of radii r_1 = 30 cm and r_2 = 45 cm are attached to each other on an axle that passes through the center of each. What is the net torque on this compound wheel due to the two forces shown each of magnitude 50 N?



a) 4.5 N.m counterclockwise b) 4.5 N.m clockwise c) 2.5 N.m clockwise
d) 7N.m counterclockwise e) 7N.m clockwise

4) Three children are trying to balance on a seesaw, which includes a fulcrum rock acting as a pivot at the center, and a very light board 3.6 m long. Boy A (45 kg) is already on the left end while boy B (35 kg) is already on the right end. Where should girl C (25 kg) place herself to the right of the pivot so as to balance the seesaw?

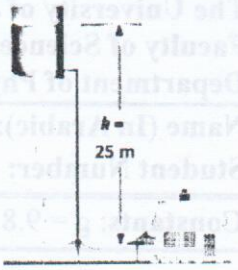


a) 0.8 m b) 0.64 m c) 0.6 m d) 0.76 e) 0.72 m

5) Water is flowing at 3.0 m/s in a section of a circular pipe of radius 2.0 cm. What is the speed of the water in another circular section of the pipe of radius 1.0 cm?

a) 12.0 m/s b) 6.0 m/s c) 8.0 m/s d) 0.5 m/s e) 4.0 m/s

6) The surface of the water in a storage tank is 25 m above a water faucet in the kitchen of a house. What is the difference in water pressure between the faucet and the surface of the water in the tank?



a) 0 b) 1.0 atm c) 3.4 atm
d) 1.8 atm e) 2.4 atm

7) The deltoid muscle (M) in the figure holds up the outstretched arm by exerting the force F_M. If the arm has a total mass of 2.8 kg and its CG is 24 cm from the shoulder joint (J), what is the magnitude of the force F_J exerted by the shoulder joint on the arm?

a) 800 N b) 50 N c) 207 N d) 280 N e) 400 N

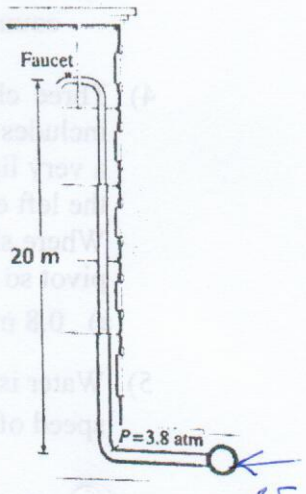
8) It requires 3200J of work to push an 800-N box 4 m up an inclined plane at constant speed during which the elevation of the box increased by 2m. What is the magnitude of the average friction force on the box?

a) 0 b) 260 N c) 400 N d) 500 N e) 680 N

9) If the density of gold is 19.3×10^3 kg/m^3, what buoyant force does a 0.60-kg gold crown experience when it is immersed in water?

a) 0.6 N b) 0.3 N c) 0.9 N d) 1.2 N e) 1.5 N

10) Water at a gauge pressure of 3.8 atm at street level flows into an office building at a speed of 0.6 m/s through a circular pipe 5.0 cm in diameter. The pipe contracts to 2.8 cm in diameter by the top floor, 20 m above, where the faucet has been left open. What is the gauge pressure in the pipe on the top floor?



a) 1.3×10^5 Pa b) 3.8×10^5Pa c) 2.3×10^5Pa
d) 1.9×10^5Pa e) 2.7×10^5Pa

$v_1 = 0.6$ m/s

Physics for Medical Students
2nd Exam / 8/12/2015
Solutions
(Prof. Mahmoud Jaghoub)

Q1] $PE = KE$

$mgh = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{2gh} \simeq 3.7$ m/s

---

Q2] Work done $= \frac{1}{2}m(v_f^2 - v_i^2) = 468750$ J.

$\bar{P} = \frac{\text{Work done}}{\text{time}} \simeq 66964.3$ Watt

$= \frac{66964.3}{746} \simeq 90$ hp

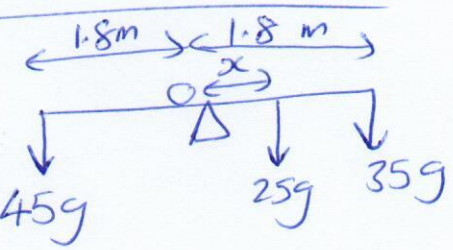
Q3] $+\circlearrowleft$ $50(0.3) - (50\cos 30)(0.45) = -4.48$ N.m

$\simeq -4.5$ Nm

clockwise

Static equilibrium $\Rightarrow \Sigma\vec{\tau} = 0$

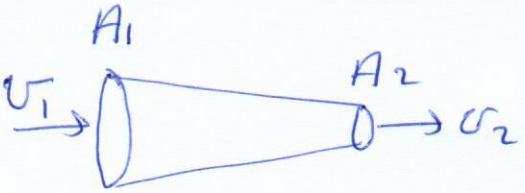
Q4] $+\circlearrowleft$



$45g(1.8) - 25g(x) - 35g(1.8) = 0$

$\Rightarrow x = 0.72$ m.

5] $A_1 v_1 = A_2 v_2$



$\pi (r_1)^2 v_1 = \pi (r_2)^2 v_2$

$\left(\frac{r_1}{r_2}\right)^2 v_1 = v_2$

$\left(\frac{2}{1}\right)^2 v_1 = v_2 \Rightarrow v_2 = 4 v_1 = 4(3) = 12$ m/s

---

Q6] Assuming the tube has a uniform cross section $\Rightarrow$ the speed is constant.

$\Rightarrow \underbrace{P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1}_{\text{tank surface}} = \underbrace{P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2}_{\text{ground level}}$

$v_1 = v_2$ since tube has uniform cross section

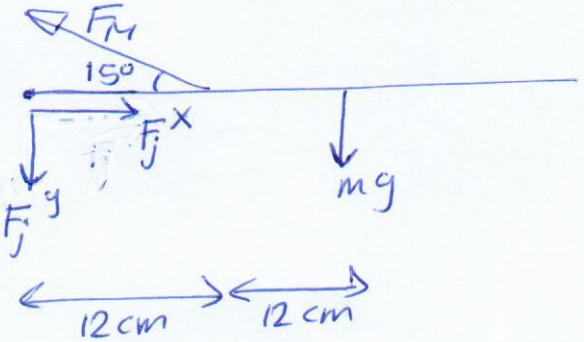
$\Rightarrow P_1 + \rho g (h_1 - h_2) = P_2$

$P_2 - P_1 = \rho g (25) \simeq 2.4$ atm.

Q7] Static equilibrium $\Rightarrow \sum \vec{\tau} = 0$ about joint.

$+\circlearrowleft$ $(F_M \sin 15)(0.12) - mg(0.24) = 0$

$\Rightarrow F_M \simeq 212$ N.



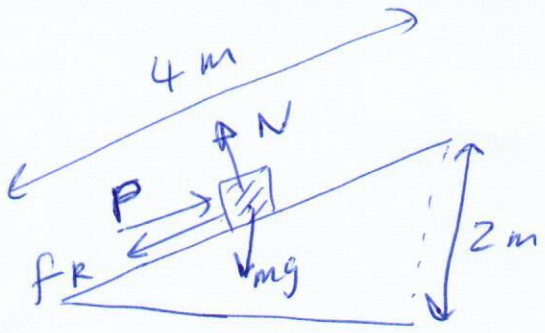
$\sum F_x = 0 \Rightarrow F_j - F_M \cos 15 = 0$

$\Rightarrow F_j \simeq 204.8$ N

$\sum F_y = 0 \Rightarrow F_M \sin 15^\circ - mg - F_j^y = 0 \Rightarrow F_j^y = 27.4$ N

$F_j = \sqrt{(F_j^x)^2 + (F_j^y)^2} \simeq 207$ N

8]



$$W_{nc} = \underbrace{\Delta K}_{0} + \Delta U$$

$$W_p + W_{f_k} = \Delta U \Rightarrow 3200 + W_{f_k} = mg(2)$$

$$\therefore W_{f_k} = 2mg - 3200 = -1600$$

$$W_{f_k} = (f_k)(4)\cos 180^\circ = -1600$$

$$\Rightarrow f_k = 400 \text{ Newton.}$$

9] $V = \frac{m}{\rho} = 3.11 \times 10^{-5}\ m^3$

$$F_B = \rho_F g V = (1000)(9.8)(3.11 \times 10^{-5}) \simeq 0.3 \text{ N.}$$

10] $P_b + \frac{1}{2}\rho v_b^2 + \rho g y_b = P_t + \frac{1}{2}\rho v_t^2 + \rho g y_t$

$\boxed{y_b = 0,\ y_t = 20\ m.}$, $P_g = P - P_0$

$$A_b v_b = A_t v_t \Rightarrow v_t = \left(\frac{r_b}{r_t}\right)^2 v_b \simeq 1.91 \text{ m/s}$$

$$(4.8 \times 1.013 \times 10^5) + \frac{1}{2}\rho(0.6)^2 = P_t + \frac{1}{2}\rho(1.91)^2 + \rho g(20)$$

$$P_t \simeq 288596 \text{ Pascal} = \frac{288596}{1.013 \times 10^5} \simeq 2.85 \text{ atm}$$

$\Rightarrow$ at the top $P_g = 2.85 - 1.00 = 1.85 \simeq 1.9$ atm