THE UNIVERSITY OF JORDAN **PHYSICS DEPARTMENT**

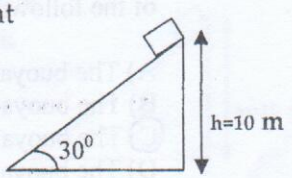
PHYSICS 105 (2nd EXAM) **SECOND SEMESTER (April. 26th, 2018)**

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

Lecturer's Name:..... Section # .....

$g = 9.8$ m/s2, 1 atm $= 1.013 \times 10^5$ Pa, $\rho_{water} = 1000$ kg/m^3

Q1) An object of mass 4 kg slides down a rough 30^0 inclined plane at constant velocity. The value of the coefficient of kinetic friction μ_k between the block and the inclined plane is:

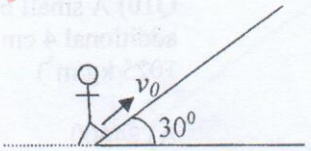


A) 0 B) 0.58 C) 1.73 D) 0.87 E) 0.5

Q2) Two cars of masses M_a and $M_b = 2M_a$ have the same kinetic energy. If the speed of mass M_b is V then the speed of mass M_a is:

A) V B) $2V$ C) $\sqrt{2}V$ D) $\frac{1}{\sqrt{2}}V$ E) $\frac{1}{2}V$

Q3) A skier starts with an initial speed $v_0 = 10$ m/s at the bottom of a rough steady upward 30^0 inclined plane as shown. The skier travels a distance of 6 m along the plane before coming to rest. The value of the coefficient of kinetic friction is:

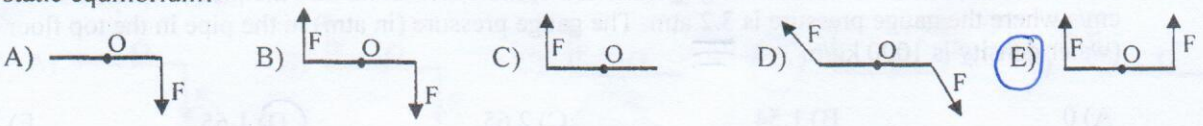


A) 0.17 B) 1.55 C) 0.70 D) 0.40 E) 0.91

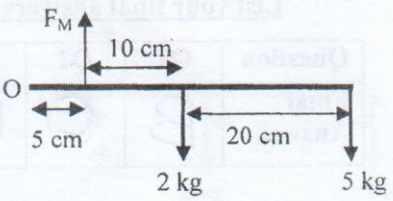
Q4) A 70-kg athlete in basic training climbs a 10-m vertical rope at a constant speed of 1.2 m/s. His power output (in W) is:

A) 823 B) 85.8 C) 840 D) 686 E) 0

Q5) The figure shows a uniform beam fixed at its midpoint O. The beam can only rotate about an axis perpendicular to the page and passes through point O. Which of the following graphs represents static equilibrium?

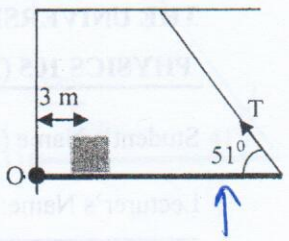


Q6) How much force (F_M in N) must the biceps muscle exert when a 5.0-kg mass is held in the hand with the arm horizontal as in the figure. Assume that the mass of forearm and hand together is 2.0 kg.



A) 803 B) 50 C) 105
D) 201 E) 402

Q7) The figure shows a uniform, horizontal beam (length = 10 m, mass = 25 kg) that is pivoted at the wall at point O, with its far end supported by a cable that makes an angle of 51° with the horizontal. If a load (mass = 60 kg) is placed 3.0 m from the pivot. Determine the horizontal component of the hinge force (in N) acting at point O.



A) 298 B) 189 C) 264 D) 242 E) 150

Q8) A block of iron is completely immersed in water and is sinking below the water surface. Which of the following statements is correct?

A) The buoyant force acting on it increases as the block sinks.
B) The buoyant force acting on it decreases as the block sinks.
C) The buoyant force acting on it is constant as the block sinks.
D) The buoyant force does not depend on the density of the water.
E) All the above statements are wrong.

Q9) A balloon is filled with 100 m^3 of helium gas ($\rho_{He} = 0.179$ kg/m^3, $\rho_{air} = 1.29$ kg/m^3). The weight (in N) of a load that can be lifted using this balloon is: (ignore the mass of the skin of the balloon and the buoyant force on the load)

A) 1089 B) 11 C) 111 D) 1880 E) 1000

Q10) A small boat is 4m wide and 6 m long. When a load is placed on the boat, the boat sinks an additional 4 cm in the river water. What is the weight (in N) of the load? (density of sea water is 1025 kg/m^3)

A) 24600 B) 9643 C) 1025 D) 24108 E) 940

Q11) The cross-sectional area of the aorta is 2 cm^2 and blood flows through it at 40 cm/s. The mass flow rate (in grams/s) of blood through the aorta is: (Assume density of blood to be 1059 kg/m^3)

A) 0.1 B) 100 C) 84.7 D) 8470 E) 1059

Q12) Water flows into the top floor of a 16 m high building through a pipe of constant 2 cm diameter. At the base of the building (ground level) the water flows into the pipe at a speed of 60 cm/s where the gauge pressure is 3.2 atm. The gauge pressure (in atm) in the pipe in the top floor is: (water density is 1000 kg/m^3)

A) 0 B) 1.54 C) 2.65 D) 1.65 E) 3.2

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	B	C	D	A	E	E	D	C	A	B	C	D

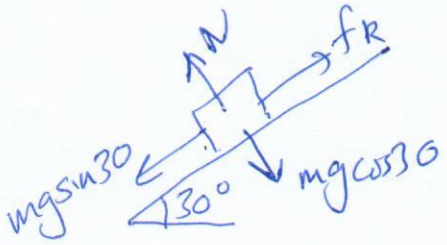
Physics for Medical Students (0342105) / Second Exam Solutions

April / 26 / 2018

Q1] $+\swarrow$ $mg\sin 30 - f_k = ma$

$mg\sin 30 - \mu_k (mg\cos 30) = 0$

$\therefore \mu_k = \tan 30^\circ$



Q2] $K_a = K_b \Rightarrow \frac{1}{2} M_a V_a^2 = \frac{1}{2} M_b V_b^2$

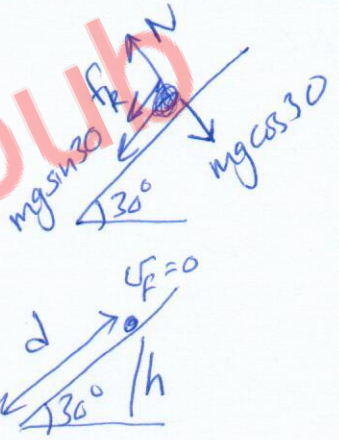
$\therefore M_a V_a^2 = (2M_a) V^2 \Rightarrow V_a^2 = 2V^2 \Rightarrow V_a = \sqrt{2}\, V$

Q3] $W_{nc} = \Delta K + \Delta U$

$f_k (d) \cos 180^\circ = (0 - \frac{1}{2} m (v_0)^2) + mgh$

$-\mu_k (mg\cos 30)(d) = -\frac{1}{2} m v_0^2 + mg(d\sin 30)$

$\therefore \mu_k = \dfrac{gd\sin 30 - v_0^2/2}{-gd\cos 30} = 0.40$



Q4] $\bar{P} = \dfrac{\text{total work done}}{\text{time taken}} = \dfrac{(mg)(h)}{t} = mg\left(\frac{h}{t}\right) = mgv \simeq 823\ W$

Q5] The only graph for which $\Sigma \tau = 0$ and Σ forces $= 0$ is (E)

Q6] $+\circlearrowleft$ (O) $F_M (0.05) - 2g(0.15) - 5g(0.35) = 0$

$F_M = \dfrac{2g(0.15) + 5g(0.35)}{0.05} \simeq 402\ N.$

Q7] $+\circlearrowleft$ $(T\sin 51)(10) - 25g(5) - 60g(3) = 0$

$$T = \frac{g(25\times 5 + 60\times 3)}{10\sin 51} \simeq 384$$

$$T\cos 51 = H_x = 242$$

Q8] Since the block is completely imersed in water
$\Rightarrow$ the buoyant force acting on it is constant.

Remember $F_B = \rho_F V g$, as it sinks
the volume of displaced water is constant $= V$
which is the same as the volume of the block.

Q9] $\uparrow^+ F_B - m_{He}g = W \Rightarrow (\rho_{air} Vg - \rho_{He} Vg) = W$

$W = (\rho_{air} - \rho_{He})Vg = (1.29 - 0.179)(100)\,g$

Q10] W_{load} = weight of displaced fluid

$= \rho_w V g = (1025)(\underbrace{4\times 6\times 0.04}_{\text{volume of disp. fluid}})\times 9.8$

$\simeq 9643$ N

Q11] mass flow rate $= \rho \frac{\Delta V}{\Delta t} = \rho A v = 1059 \times 2\times 10^{-4} \times 0.4$

$\simeq 84.7$ grams/s.

Q12] $A_1 v_1 = A_2 v_2$ since area is constant

$\Rightarrow v_1 = v_2 = 0.6$ m/s.

$$P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$$

$v_1 = v_2$,

$$P_1 + \rho g(y_1 - y_2) = P_2$$

$$P_1 - P_{atm} + \rho g(y_1 - y_2) = P_2 - P_{atm}$$

$$P_g + \rho g(0 - 16) = P_{2g} \Rightarrow P_{2g} = 3.2 + \frac{1000\times 9.8(-16)}{1.013\times 10^5}$$

$$P_{2g} \simeq 1.65 \text{ atm}$$