Dr. Mohammad Hussein PHY 105 Recitation Session - 2nd Exam Chapters 6,8, and 9

Problem One

1) A PHY 105 student is holding a book of mass m. He walks a distance d at a constant speed v. The work the student has done on the book is:

zero +mgd – mgd $+1/2mv^2$ $– 1/2mv^2$

2) Imagine you push a box of mass m a distance d across a floor with constant speed. The coefficient of kinetic friction between the box and the floor is μ_k. You then pick up the box, raise it to a height h, carry it back to the starting point, and put it back down on the floor. How much work have you done on the box?

$\mu_k mgd$ zero $\mu_k mgd + 2mgh$ $\mu_k mgd – 2mgh$ $2\mu_k mgd + 2mgh$

3) When a ball rises vertically to a height 3h and returns to its original position, the work done on it by the gravitational force is

zero – 6mgh – 3mgh + 3mgh + 6mgh

4) A 20 g particle is moving to the left at a speed of 30 m/s. How much total work (in J) must be done on the particle to make it move to the right at a speed of 30 m/s?

zero +9 – 9 +18 – 18

Problem Two

5) The engine of a truck of mass 940 kg can deliver an average power of 104800 W. If the truck accelerates from rest, the speed (in m/s) after 4.5 s is: (Ignore air resistance)

31.7 11.2 15.1 4.8 36.6

6) A 100 kg box is pushed at a constant speed of 5.0 m/s across a horizontal floor by an applied force F directed 37° above the horizontal. If the rate at which F does work on the box is 0.66 hp, the applied force F (in N) is: Hint: 1 hp = 746 W

123 980 98 164 43

7) A motor lifts a 3000 kg elevator 210 m up during a time interval t at constant speed. If the rate at which the motor does work on the elevator is 362 hp, the time interval t (in s) is: Hint: 1 hp = 746 W

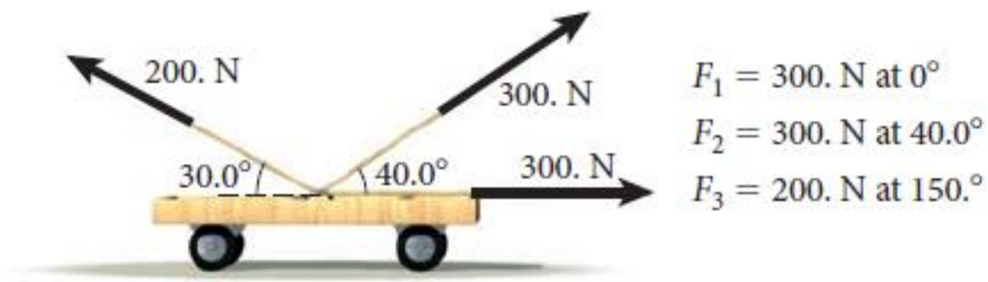
23 1.7 5 14.8 19.9

8) A horse drags a heavy cart (200 kg) horizontally on a rough floor at constant speed. The power delivered by the horse is 1.06 hp. The coefficient of kinetic friction between the cart and the floor is 0.115. The speed (in m/s) with which the cart moves across the floor is:

3.5 0.3 11.7 9.0 2.1

Problem Three

9) A 125 kg cart initially at rest is pulled by three ropes as shown. When the cart moves 100 m horizontally on a frictionless level, it's final speed (in m/s) is:



24 22 19 27 30

10) A box of mass m at a height h above the floor has a speed v. Its total mechanical energy is E. A second box of mass m at a height 4h above the floor has a speed 2v. The total mechanical energy for the second box is:

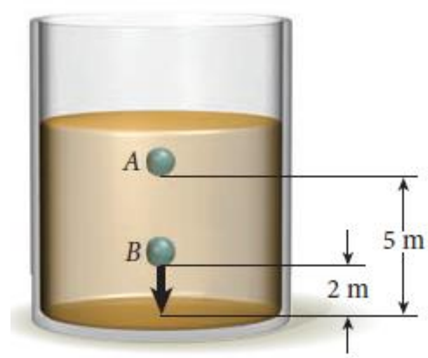
4E 2E $(2)^{½}$E E $(2)^{-½}$E

Problem Four

11) A box of mass m is moving with an initial speed v on a horizontal level, where the coefficient of kinetic friction is μ_k. The box moves a distance d and stops. If the initial speed is doubled, how far will the same box move before it stops?

4d 2d d^2 d $4d^2$

12) As shown, a bead of mass 0.5 kg immersed in a certain liquid is released from rest at point A. At point B, the bead has a speed of 6 m/s. The work done on the bead (in J) by the viscosity (friction force) of the liquid is:



–5.7 +15 +9 –15 –9

Problem Five

13) A 3 kg ball thrown vertically upward has reached a height of 100 m in the presence of air resistance. The air resistance has performed –800 J of work on the ball. Determine the height (in m) the ball would reach if air resistance can be neglected.

127 100 163 196 201

14) A box of mass 18 kg is dropped from rest from a height of 80 m above the floor. The box falls vertically downward and reaches the floor with a speed of 15 m/s. The work (in 10^3 J) exerted by the air resistance force on the box is:

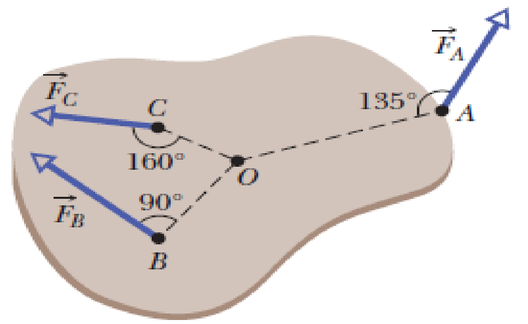
– 12   – 16   + 12   + 16   – 14

15) A 0.5 kg ball thrown vertically upward with an initial speed of 4.00 m/s has reached a maximum height of 0.8 m. What change does air resistance cause in the mechanical energy (in J) of the ball during the upward motion?

0.08   0   16   3.92   4.9

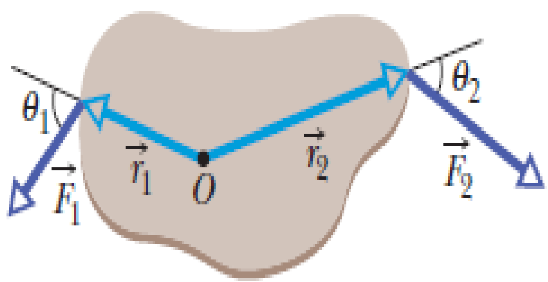
Problem Six

16) The rigid object shown lies in a horizontal plane and is free to rotate about the pivot O. Three forces act on it: F_A = 10 N, F_B = 16 N and F_C = 19 N. If AO = 8 m, BO = 4 m and CO = 3 m, what is the net torque (in N.m) about O?



+12   –21   +101   –27   +140

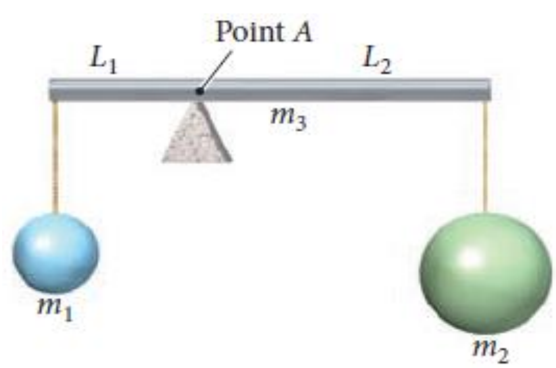
17) The rigid object shown lies in a horizontal plane and is free to rotate about the pivot O. Two forces act on it; F_1= 4.2 N and F_2= 4.9 N. If r_1 =1.3 m, r_2 =2.15 m, θ_1=75°, and θ_2 = 60°, then the net torque (in N.m) about O is:



–3.85   +14.37   –14.37   +5.27   –1.07

Problem Seven

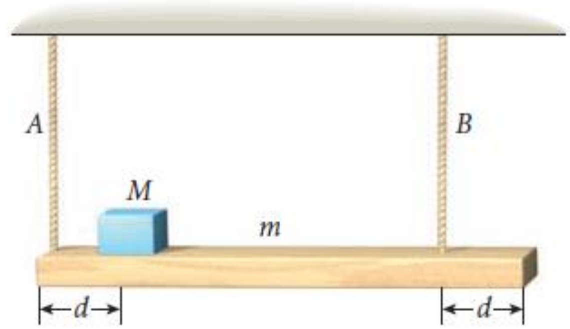
18) As shown, a rigid rod of mass m_3 is pivoted at point A, where two masses (m_1 and m_2) are hanging from it. The hanging mass m_2 is equal to $2m_1$, while the rod's mass m_3 is equal to $3m_1$. The distances L_1 and L_2 are measured from point A to m_1 and m_2, respectively. At static equilibrium, the ratio (L_1/L_2) is:



7/5   5/2   7/2   3/7   2/5

The figure below belongs to Q19 & Q20:

19) As shown, a wooden beam is supported by two vertical ropes, A and B. The weight of the beam is mg = 120 N and its length is 5 m. Rope A is connected to the left end of the beam, while rope B is connected at a distance d = 1 m from the right end. A box with a weight Mg = 20 N is placed on the beam with its center of mass at d = 1 m from rope A. If the whole system is in static equilibrium, the tension (in N) in the rope A is:



60 80 53.3 140 220

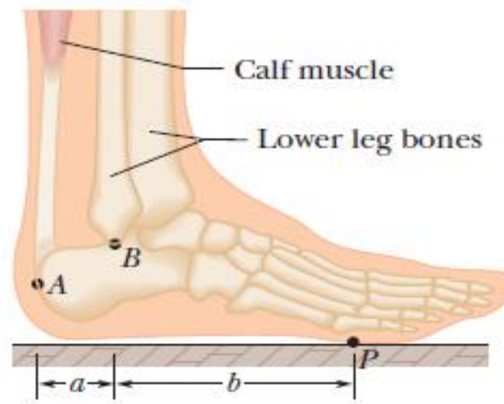
20) As shown, a wooden beam is supported by two vertical ropes, A and B. The weight of the beam is mg = 120 N and its length is 5 m. Rope A is connected to the left end of the beam, while rope B is connected at a distance d = 1 m from the right end. A box with a weight Mg = 20 N is placed on the beam with its center of mass at d = 1 m from rope A. If the whole system is in static equilibrium, the tension (in N) in the rope B is:

80 60 200 140 26.7

The figure below belongs to Q21 & Q22:

Problem Eight

21) A patient's foot shown in the figure does contact the floor only at point P (the heel does not touch the floor). The calf muscle acts on the foot with a force at point A, while the lower leg bones act on the foot with a force at point B. If the patient's weight is 900 N, distance a = 5 cm and distance b = 15 cm, the calf's force (in N) is:



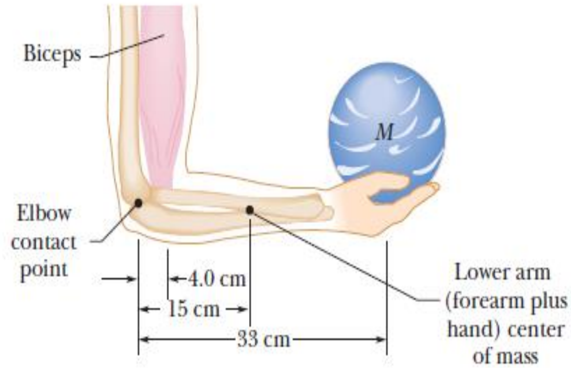
2700 upward 2700 downward 900 downward 4500 upward 4500 downward

22) The foot shown in the figure does contact the floor only at point P (the heel does not touch the floor). The calf muscle acts on the foot with a force at point A, while the lower leg bones act on the foot with a force at point B. If the student's weight is 900 N, distance a = 5 cm and distance b = 15 cm, the lower leg bones' force (in N) is:

3600 downward 3600 downward 900 downward 5400 upward 5400 downward

The figure below belongs to Q23 & Q24:

23) As shown, a PHY 105 student holds a massive ball (M= 7.2 kg) by his hand. The student's upper arm is vertical, while his lower arm (of mass 1.8 kg) is horizontal. Both of the biceps muscle and the bone of the upper arm do act on the lower arm with forces, each at a specific point as shown. The biceps' force (in N) is:



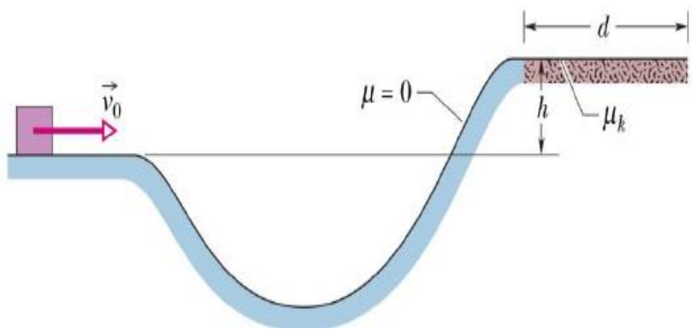
650 upward   650 downward   88 upward
88 downward   450 upward

24) As shown, a PHY 105 student holds a massive ball (M= 7.2 kg) by his hand. The student's upper arm is vertical, while his lower arm (of mass 1.8 kg) is horizontal. Both of the biceps muscle and the bone of the upper arm do act on the lower arm with forces, each at a specific point as shown. The upper arm bone's force (in N) is:

560 downward   560 upward   88 upward   88 downward   320 downward

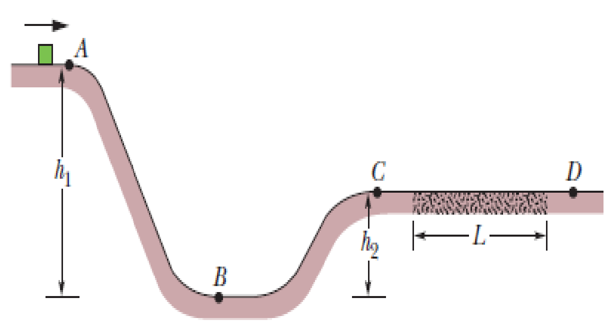
Problem Nine

25) As shown, 2 kg block slides along the track with an initial speed v_o of 6 m/s. The blue section of the track is frictionless (μ=0), while the horizontal brown section is rough (μ_k). On the rough section, a frictional force stops the block in a distance d. If the height difference h is 1.1 m and μ_k is 0.60, what is d (in m)?



1.2   4.5   2.6   3.4   5.7

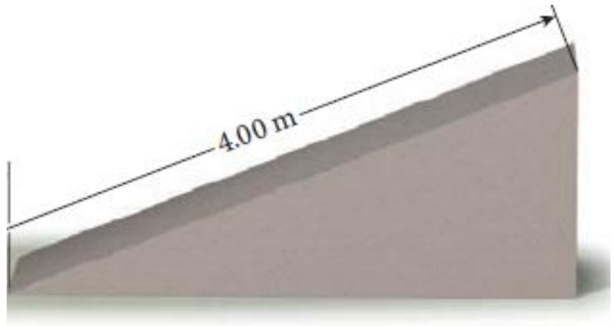
26) As shown, a block slides at point A with an initial speed of 7 m/s along the track. All the sections of the track are frictionless until the block reaches the section L (of length 12 m), where the coefficient of kinetic friction is 0.7. If the height differences h_1 and h_2 are 6 m 2 m respectively, how far (in m) through the section of friction does the block travel before it comes to a complete stop?



9.3   6.3   10.3   12   5.7

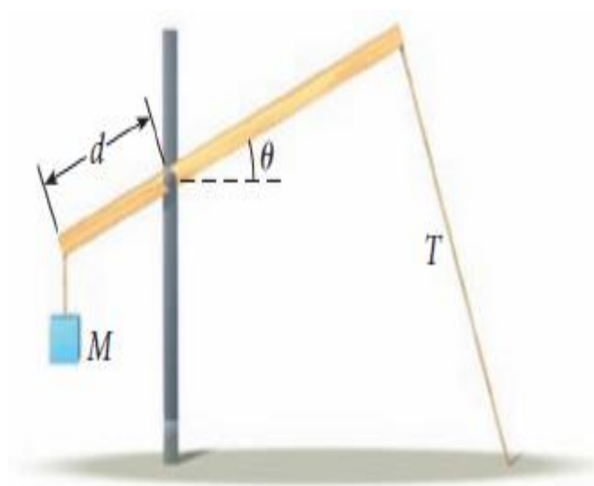
Problem Ten

27) A 1 kg ball is located at the top of a 4 m plane inclined at 45° as shown. The ball begins to slide down the inclined plane from rest. The upper half of the inclined plane is frictionless, while the lower half is rough, with a coefficient of kinetic friction $\mu_k = 0.3$. The speed (in m/s) of the ball at the bottom of the inclined plane is:



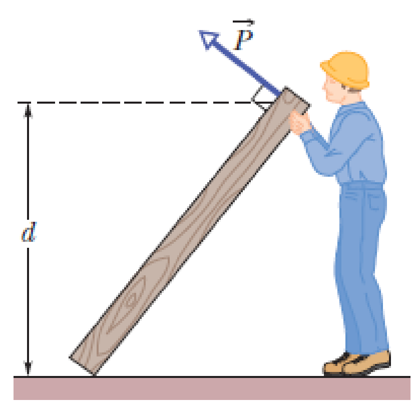
6.9 5.3 7.5 0.3 1.1

28) As shown, a wooden beam with a length of 8 m and a mass of 100 kg is attached by a strong bolt to a vertical steel support at a distance d = 3 m from the left end. The beam makes an angle θ = 30.0° with the horizontal. A huge mass M = 500 kg is attached with a rope to the left end of the beam, and a second rope is attached at a right angle (90°) to the other end of the beam. If the whole system is in static equilibrium, the tension T (in N) in the second rope is approximately:



2380 7950 1190 3004 14070

29) In order to hold a beam (of weight 500 N and length 2.5 m) at rest, a PHY 105 student exerts a force P perpendicular to the beam, as shown. The vertical distance d is 1.5 m. The minimum value the coefficient of static friction between the beam and the floor can have in order for the beam not to slip is:



0.35 0.75 0.67 0.60 0.56

30) A uniform ladder leans against a vertical smooth wall and rests on a rough horizontal ground, as shown. The ladder is 10 m long and weighs 200 N. The height h is 8.0 m. A horizontal force F is applied to the ladder at distance d = 2 m from its bottom base. The coefficient of static friction between the ladder and the ground is 0.38. The minimum value of the force F (in N) by which the bottom base of the ladder will be on the verge of moving toward the vertical wall is:

189 76 45 35 200