Written Homework problems. Spring 2014.
(taken from Giancoli, 4th edition)

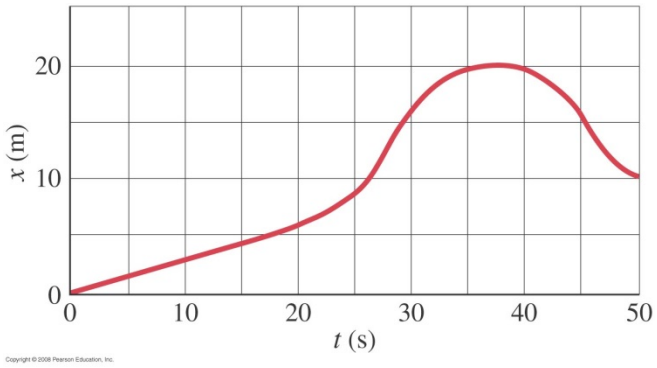
HW1. Ch1. 19, 47

19. Determine the conversion factor between (*a*) km / h and mi / h, (*b*) m / s and ft / s, and (*c*) km / h and m / s.

47. An average family of four uses roughly 1200 L (about 300 gallons) of water per day $\left(1\,\text{L} = 1000\,\text{cm}^3\right)$. How much depth would a lake lose per year if it uniformly covered an area of $50\,\text{km}^2$ and supplied a local town with a population of 40,000 people? Consider only population uses, and neglect evaporation and so on.

HW2. Ch2. 9, 51

9. The position of a rabbit along a straight tunnel as a function of time is plotted in Fig. 2 –36. What is its instantaneous velocity (*a*) at $t = 10.0\,\text{s}$ and (*b*) at $t = 30.0\,\text{s}$? What is its average velocity (*c*) between $t = 0$ and $t = 5.0\,\text{s}$, (*d*) between $t = 25.0\,\text{s}$ and $t = 30.0\,\text{s}$, and (*e*) between $t = 40.0\,\text{s}$ and $t = 50.0\,\text{s}$?



51. A baseball is hit almost straight up into the air with a speed of about 20 m / s. (*a*) How high does it go? (*b*) How long is it in the air?

HW3. Ch3. 9, 80

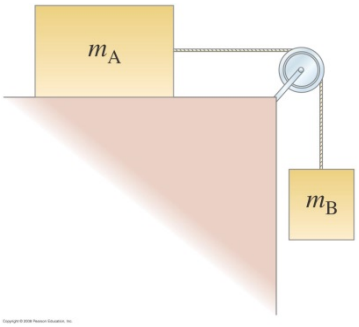
9. (*a*) Determine the magnitude and direction of the sum of the three vectors $\vec{\mathbf{V}}_1 = 4.0\hat{\mathbf{i}} - 8.0\hat{\mathbf{j}}$, $\vec{\mathbf{V}}_2 = \hat{\mathbf{i}} + \hat{\mathbf{j}}$, and $\vec{\mathbf{V}}_3 = 2\ 2.0\hat{\mathbf{i}} + 4.0\hat{\mathbf{j}}$. (*b*) Determine $\vec{\mathbf{V}}_1 - \vec{\mathbf{V}}_2 + \vec{\mathbf{V}}_3$.

80. A hunter aims directly at a target (on the same level) 68.0 m away. (a) If the bullet leaves the gun at a speed of 175 m s, by how much will it miss the target? (b) At what angle should the gun be aimed so the target will be hit?

HW4. Ch4. 33, 51

33. One 3.2-kg paint bucket is hanging by a massless cord from another 3.2-kg paint bucket, also hanging by a massless cord, as shown in Fig. 4–37. (*a*) If the buckets are at rest, what is the tension in each cord? (*b*) If the two buckets are pulled upward with an acceleration of 1.25 m/s^2 by the upper cord, calculate the tension in each cord.

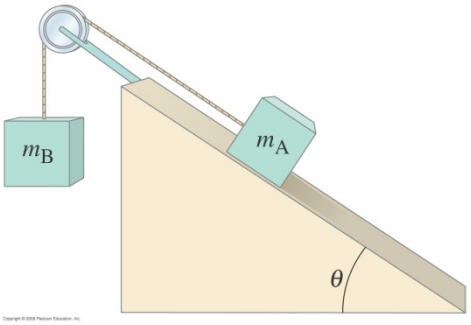
51. Figure shows a block (mass m_A) on a smooth horizontal surface, connected by a thin cord that passes over a pulley to a second block (m_B), which hangs vertically. (*a*) Draw a free-body diagram for each block, showing the force of gravity on each, the force (tension) exerted by the cord, and any normal force. (*b*) Apply Newton's second law to find formulas for the acceleration of the system and for the tension in the cord. Ignore friction and the masses of the pulley and cord.



HW5. Ch5. 10, 30

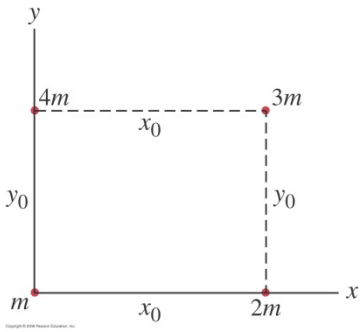
10. A wet bar of soap slides freely down a ramp 9.0 m long inclined at 8.0°. How long does it take to reach the bottom? Assume μ_k=0.060.

30. (*a*) Suppose the coefficient of kinetic friction between m_A and the plane in Fig. 5–38 is μ_k=0.15 and that $m_A = m_B = 2.7$ kg. As m_B moves down, determine the magnitude of the acceleration of m_A and m_B, given θ=34°. (*b*) What smallest value of μ_k will keep the system from accelerating?



HW6. Ch6. 11, 28

11. (II) Four masses are arranged as shown in Fig. 6–25. Determine the *x* and *y* components of the gravitational force on the mass at the origin (*m*). Write the force in vector notation $(\hat{\mathbf{i}}, \hat{\mathbf{j}})$.



28. (II) Two satellites orbit Earth at altitudes of 5000 km and 15,000 km. Which satellite is faster, and by what factor?

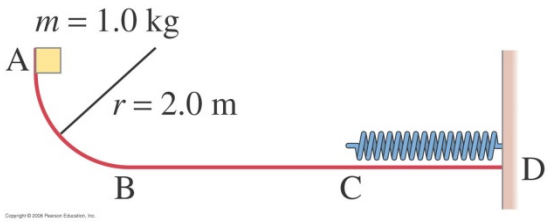
HW7. Ch7. 15, 75

15. A grocery cart with mass of 16 kg is being pushed at constant speed up a flat 12° ramp by a force F_P which acts at an angle of 17° below the horizontal. Find the work done by each of the forces $\left(m\vec{\mathbf{g}}, \vec{\mathbf{F}}_N, \vec{\mathbf{F}}_P\right)$ on the cart if the ramp is 15 m long.

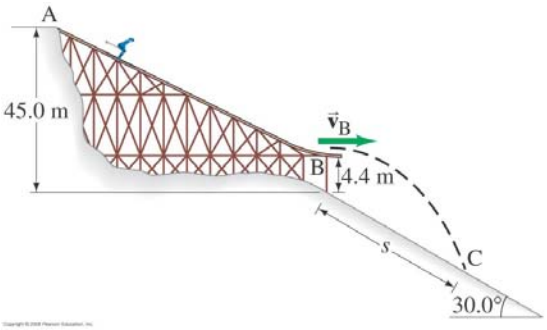
75. Two forces, $\vec{\mathbf{F}}_1 = \left(1.50\hat{\mathbf{i}} - 0.80\hat{\mathbf{j}} + 0.70\hat{\mathbf{k}}\right)$ N and $\vec{\mathbf{F}}_2$ @ $\left(2\ 0.70\hat{\mathbf{i}} + 1.20\hat{\mathbf{j}}\right)$ N, are applied on a moving object of mass 0.20 kg. The displacement vector produced by the two forces is $\vec{\mathbf{d}} = \left(8.0\hat{\mathbf{i}} + 6.0\hat{\mathbf{j}} + 5.0\hat{\mathbf{k}}\right)$ m. What is the work done by the two forces?

HW8. Ch8. 36, 83

36. Consider the track shown in Fig. 8–37. The section AB is one quadrant of a circle of radius 2.0 m and is frictionless. B to C is a horizontal span 3.0 m long with a coefficient of kinetic friction $\mu_k = 0.25$. The section CD under the spring is frictionless. A block of mass 1.0 kg is released from rest at A. After sliding on the track, it compresses the spring by 0.20 m. Determine: (*a*) the velocity of the block at point B; (*b*) the thermal energy produced as the block slides from B to C; (*c*) the velocity of the block at point C; (*d*) the stiffness constant *k* for the spring.



83. A 62-kg skier starts from rest at the top of a ski jump, point A in Fig. 8–41, and travels down the ramp. If friction and air resistance can be neglected, (*a*) determine her speed v_B when she reaches the horizontal end of the ramp at B. (*b*) Determine the distance *s* to where she strikes the ground at C.



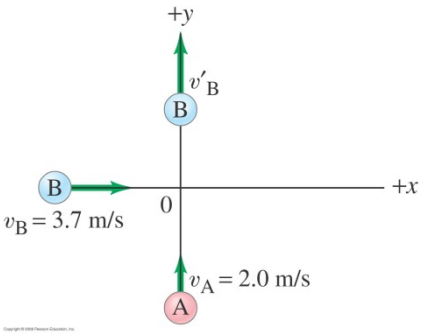
HW9. Ch9. 17, 52

17. A rocket of mass *m* traveling with speed v_0 along the *x* axis suddenly shoots out fuel equal to one-third its mass, perpendicular to the *x* axis (along the *y* axis) with speed $2v_0$ * Express the final velocity of the rocket in $\hat{\mathbf{i}}, \hat{\mathbf{j}}, \hat{\mathbf{k}}$ notation.

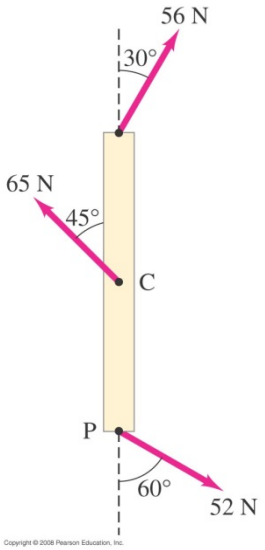
52. A 144-g baseball moving 28.0 m/s strikes a stationary 5.25-kg brick resting on small rollers so it moves without significant friction. After hitting the brick, the baseball bounces straight back, and the brick moves forward at 1.10 m/s. (*a*) What is the baseball's speed after the collision? (*b*) Find the total kinetic energy before and after the collision.

HW10. Ch9.#56; Ch10.#30

56. (Ch9) Two billiard balls of equal mass move at right angles and meet at the origin of an *xy* coordinate system. Initially ball A is moving upward along the *y* axis at 2.0 m/s, and ball B is moving to the right along the *x* axis with speed 3.7 m/s. After the collision (assumed elastic), the second ball is moving along the positive *y* axis (Fig. 9–43). What is the final direction of ball A, and what are the speeds of the two balls?

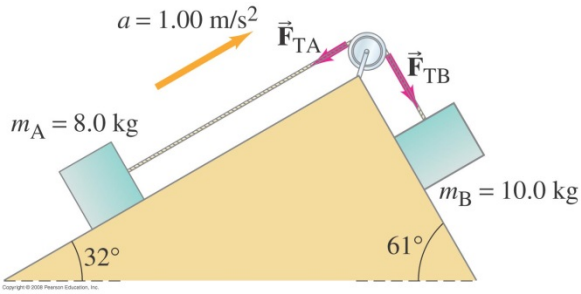


30. (Ch10) Determine the net torque on the 2.0-m-long uniform beam shown in Fig. 10–50. Calculate about (*a*) point C, the CM, and (*b*) point P at one end.

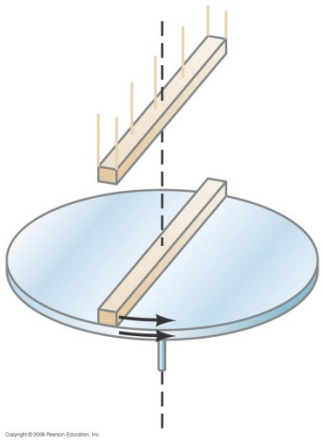


HW11. Ch10.#46; Ch11.#10

46. (Ch10) Two blocks are connected by a light string passing over a pulley of radius 0.15 m and moment of inertia I. The blocks move (towards the right) with an acceleration of $1.00\ \text{m/s}^2$ along their frictionless inclines (see Fig. 10–54). (*a*) Draw free-body diagrams for each of the two blocks and the pulley. (*b*) Determine F_{TA} and F_{TB}, the tensions in the two parts of the string. (*c*) Find the net torque acting on the pulley, and determine its moment of inertia, I.

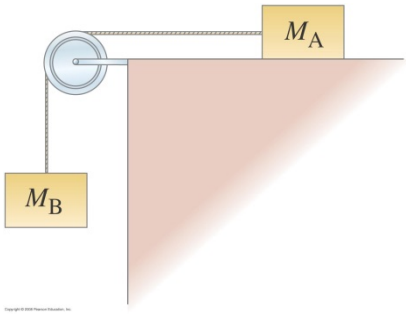


10. (Ch11) A uniform disk turns at 3.7 rev/s around a frictionless spindle. A nonrotating rod, of the same mass as the disk and length equal to the disk's diameter, is dropped onto the freely spinning disk, Fig. 11–31. They then turn together around the spindle with their centers superposed. What is the angular frequency in rev/s of the combination?



HW12. Ch11.#41; Ch12.#24

41. (Ch11) Figure 11–35 shows two masses connected by a cord passing over a pulley of radius R_0 and moment of inertia I. Mass M_A slides on a frictionless surface, and M_B hangs freely. Determine a formula for (*a*) the angular momentum of the system about the pulley axis, as a function of the speed y of mass M_A or M_B, and (*b*) the acceleration of the masses.



24. (Ch12) A large 62.0-kg board is propped at a 45° angle against the edge of a barn door that is 2.6 m wide. How great a horizontal force must a person behind the door exert (at the edge) in order to open it? Assume that there is negligible friction between the door and the board but that the board is firmly set against the ground.