ME 2210 Dynamics Handout #2: Homework: 12.6, 12.8, 12.10, 12.12, 12.37, 12.46, 12.56, 12.68, 12.76, 12.79

12.5 A hockey player hits a puck so that it comes to rest in 9 s after sliding 30 m on the ice. Determine (*a*) the initial velocity of the puck, (*b*) the coefficient of friction between the puck and the ice.

12.6 Determine the maximum theoretical speed that an automobile starting from rest can reach after traveling 400 m. Assume that the coefficient of static friction is 0.80 between the tires and the pavement and that (*a*) the automobile has front-wheel drive and the front wheels support 62 percent of the automobile's weight, (*b*) the automobile has rear-wheel drive and the rear wheels support 43 percent of the automobile's weight.

12.7 In anticipation of a long 7° upgrade, a bus driver accelerates at a constant rate of 3 ft/s^2 while still on a level section of the highway. Knowing that the speed of the bus is 60 mi/h as it begins to climb the grade and that the driver does not change the setting of his throttle or shift gears, determine the distance traveled by the bus up the grade when its speed has decreased to 50 mi/h.

12.8 If an automobile's braking distance from 60 mph is 150 ft on level pavement, determine the automobile's braking distance from 60 mph when it is (*a*) going up a 5° incline, (*b*) going down a 3-percent incline. Assume the braking force is independent of grade.

12.9 A 20-kg package is at rest on an incline when a force **P** is applied to it. Determine the magnitude of **P** if 10 s is required for the package to travel 5 m up the incline. The static and kinetic coefficients of friction between the package and the incline are both equal to 0.3.

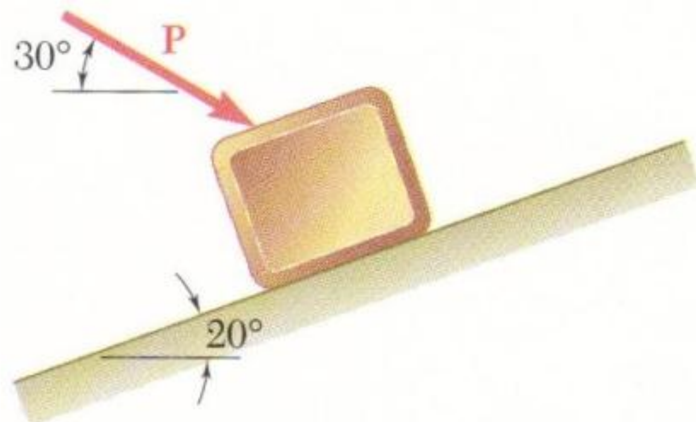

Fig. P12.9

12.10 The acceleration of a package sliding at point A is 3 m/s^2. Assuming that the coefficient of kinetic friction is the same for each section, determine the acceleration of the package at point B.

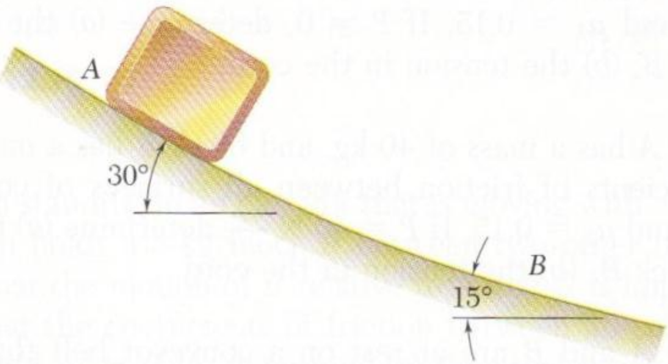

Fig. P12.10

12.11 The two blocks shown are originally at rest. Neglecting the masses of the pulleys and the effect of friction in the pulleys and between block A and the horizontal surface, determine (*a*) the acceleration of each block, (*b*) the tension in the cable.

12.12 The two blocks shown are originally at rest. Neglecting the masses of the pulleys and the effect of friction in the pulleys and assuming that the coefficients of friction between block A and the horizontal surface are $\mu_s = 0.25$ and $\mu_k = 0.20$, determine (*a*) the acceleration of each block, (*b*) the tension in the cable.

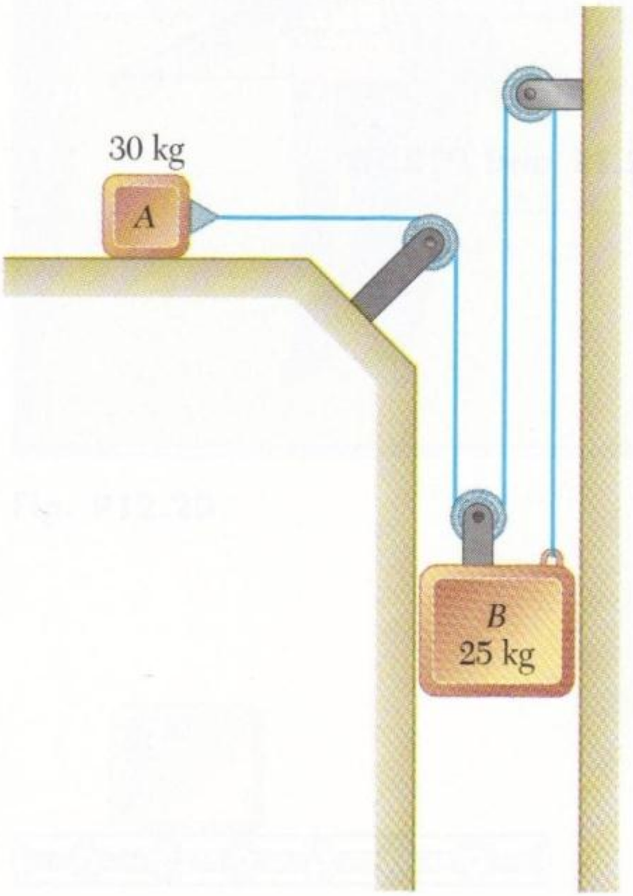

Fig. P12.11 and P12.12

12.15 Block A has a mass of 40 kg, and block B has a mass of 8 kg. The coefficients of friction between all surfaces of contact are $\mu_s = 0.20$ and $\mu_k = 0.15$. If $P = 0$, determine (*a*) the acceleration of block B, (*b*) the tension in the cord.

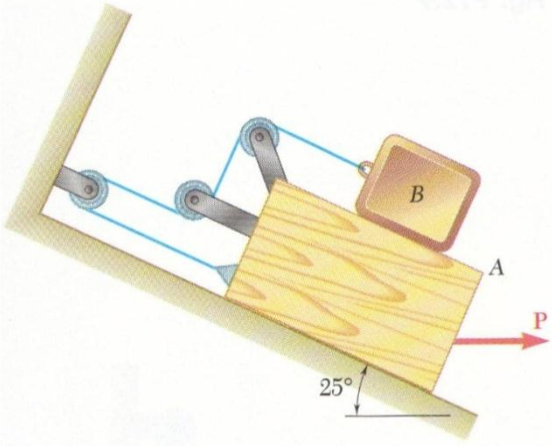

Fig. P12.15 and P12.16

12.36 During a hammer thrower's practice swings, the 7.1-kg head A of the hammer revolves at a constant speed v in a horizontal circle as shown. If $\rho = 0.93$ m and $\theta = 60°$, determine (*a*) the tension in wire BC, (*b*) the speed of the hammer's head.

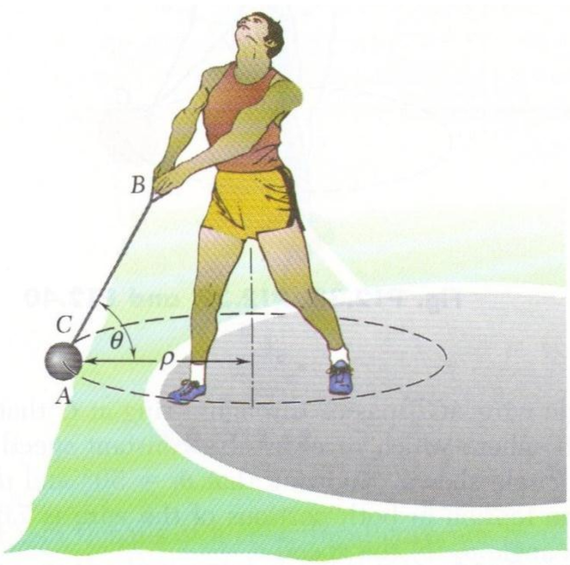

Fig. P12.36

12.37 A 450-g tetherball A is moving along a horizontal circular path at a constant speed of 4 m/s. Determine (*a*) the angle θ that the cord forms with pole BC, (*b*) the tension in the cord.

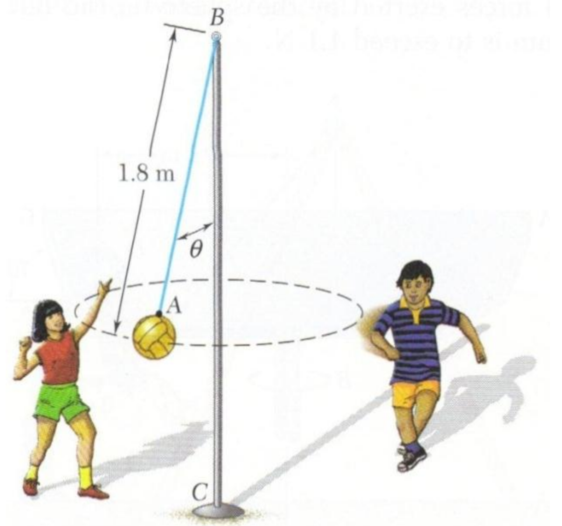

Fig. P12.37

12.45 A 60-kg wrecking ball B is attached to a 15-m-long steel cable AB and swings in the vertical arc shown. Determine the tension in the cable (*a*) at the top C of the swing, (*b*) at the bottom D of the swing, where the speed of B is 4.2 m/s.

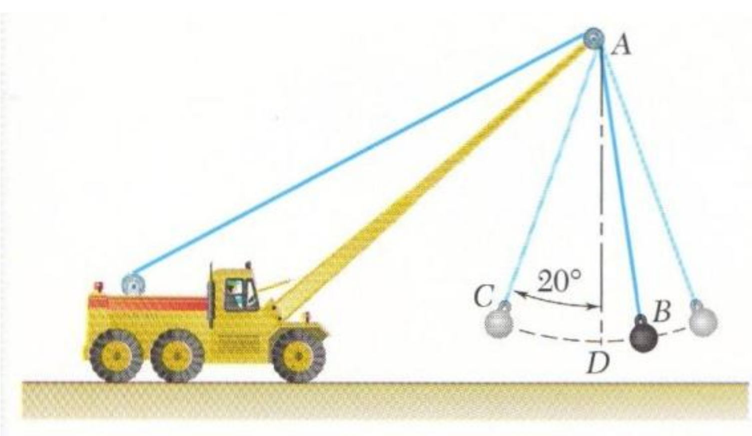

Fig. P12.45

12.46 During a high-speed chase, a 2400-lb sports car traveling at a speed of 100 mi/h just loses contact with the road as it reaches the crest A of a hill. (*a*) Determine the radius of curvature ρ of the vertical profile of the road at A. (*b*) Using the value of ρ found in part *a*, determine the force exerted on a 160-lb driver by the seat of his 3100-lb car as the car, traveling at a constant speed of 50 mi/h, passes through A.

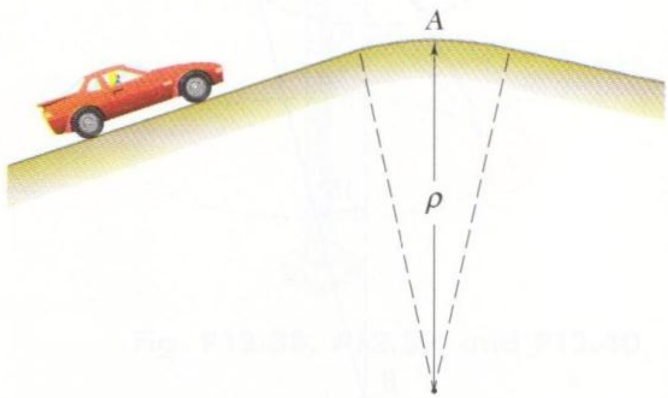

Fig. P12.46

12.55 A small, 300-g collar D can slide on portion AB of a rod which is bent as shown. Knowing that $\alpha = 40°$ and that the rod rotates about the vertical AC at a constant rate of 5 rad/s, determine the value of r for which the collar will not slide on the rod if the effect of friction between the rod and the collar is neglected.

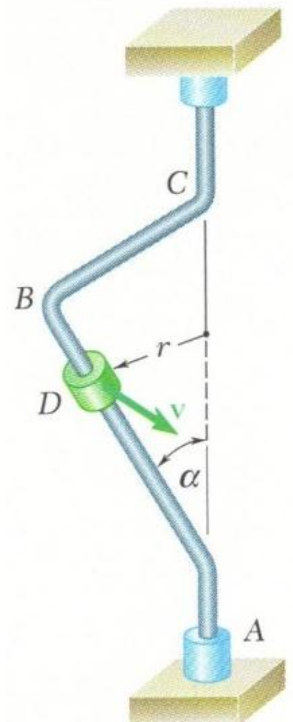

Fig. P12.55, P12.56

12.56 A small, 200-g collar D can slide on portion AB of a rod which is bent as shown. Knowing that the rod rotates about the vertical AC at a constant rate and that $\alpha = 30°$ and $r = 600$ mm, determine the range of values of the speed v for which the collar will not slide on the rod if the coefficient of static friction between the rod and the collar is 0.30.

12.66 Rod OA rotates about O in a horizontal plane. The motion of the 300-g collar B is defined by the relations $r = 300 + 100 \cos (0.5\, \pi t)$ and $\theta = \pi(t^2 - 3t)$, where r is expressed in millimeters, t in seconds, and θ in radians. Determine the radial and transverse components of the force exerted on the collar when (*a*) $t = 0$, (*b*) $t = 0.5$ s.

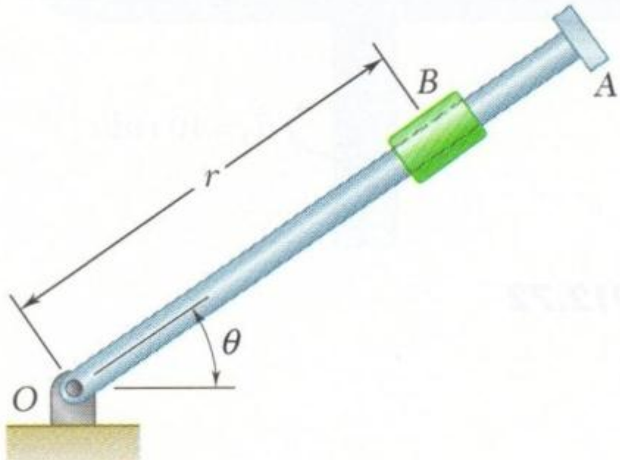

Fig. P12.66 and P12.68

12.68 Rod OA oscillates about O in a horizontal plane. The motion of the 5-lb collar B is defined by the relations $r = 10/(t + 4)$ and $\theta = (2/\pi) \sin \pi t$, where r is expressed in feet, t in seconds, and θ in radians. Determine the radial and transverse components of the force exerted on the collar when (*a*) $t = 1$ s, (*b*) $t = 6$ s.

12.74 A particle of mass m is projected from point A with an initial velocity $\mathbf{v}_0$ perpendicular to line OA and moves under a central force $\mathbf{F}$ along a semicircular path of diameter OA. Observing that $r = r_0 \cos \theta$ and using Eq. (12.27), show that the speed of the particle is $v = v_0/\cos^2 \theta$.

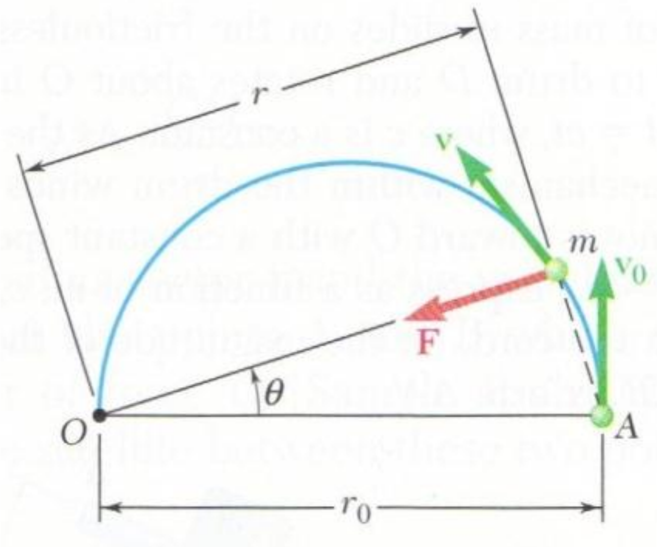

Fig. P12.74

12.76 A particle of mass m is projected from point A with an initial velocity $\mathbf{v}_0$ perpendicular to line OA and moves under a central force $\mathbf{F}$ directed away from the center of force O. Knowing that the particle follows a path defined by the equation $r = r_0/\sqrt{\cos 2\theta}$ and using Eq. (12.27), express the radial and transverse components of the velocity $\mathbf{v}$ of the particle as functions of θ.

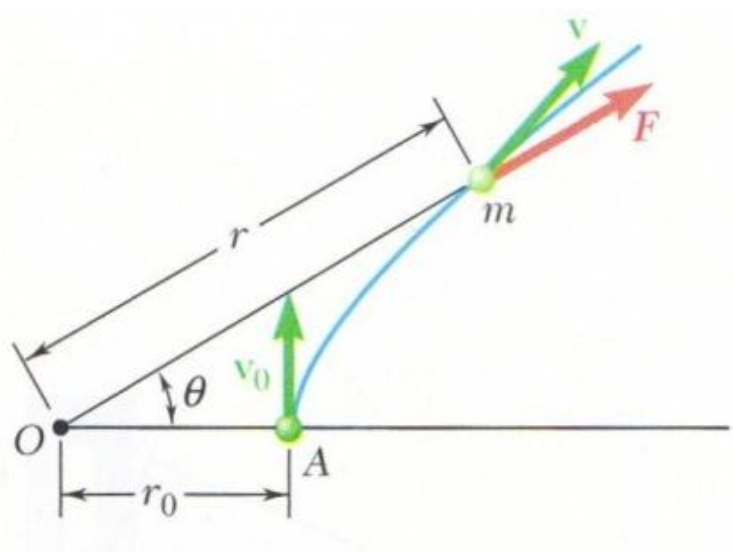

Fig. P12.76

12.78 The radius of the orbit of a moon of a given planet is equal to twice the radius of that planet. Denoting by ρ the mean density of the planet, show that the time required by the moon to complete one full revolution about the planet is $(24\pi/G\rho)^{1/2}$, where G is the constant of gravitation.

12.79 Show that the radius r of the orbit of a moon of a given planet can be determined from the radius R of the planet, the acceleration of gravity at the surface of the planet, and the time τ required by the moon to complete one full revolution about the planet. Determine the acceleration of gravity at the surface of the planet Jupiter knowing that $R = 71\ 492$ km and that $\tau = 3.551$ days and $r = 670.9 \times 10^3$ km for its moon Europa.