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Assignment 2 Assigned: Jan 27 Due Feb 8 (WED) 6:00 PM sharp!

Total Points: 58 (4 points for each correctly solved problem+10 points for presentation).

For full marks the solution should be clear and neat with clear diagram if needed. In the case of longer problems the main arguments should be presented in the space provided, while detailed calculations should be presented on the back of the page.

1 A crate of weight F_g is pushed by a force \mathbf{P} on a horizontal floor. (a) If the coefficient of static friction is μ_s and \mathbf{P} is directed at angle θ below the horizontal, show that the minimum value of P that will move the crate is given by

$$P = \frac{\mu_s F_g \sec \theta}{1 - \mu_s \tan \theta}$$

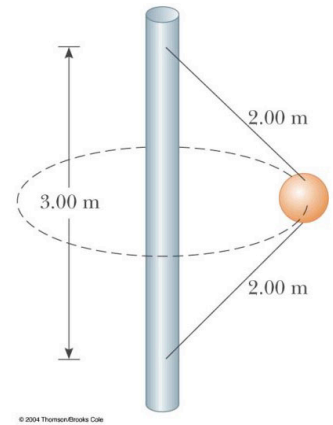
(b) Find the minimum value of P that can produce motion when $\mu_s = 0.400$, $F_g = 100$ N, and $\theta = 0^\circ, 15.0^\circ, 30.0^\circ, 45.0^\circ$, and 60.0° .

2 A 1.30-kg toaster is not plugged in. The coefficient of static friction between the toaster and a horizontal countertop is 0.350. To make the toaster start moving, you carelessly pull on its electric cord. (a) For the cord tension to be as small as possible, you should pull at what angle above the horizontal? (b) With this angle, how large must the tension be?

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3 A coin placed 30.0 cm from the center of a rotating, horizontal turntable slips when its speed is 50.0 cm/s. (a) What force causes the centripetal acceleration when the coin is stationary relative to the turntable? (b) What is the coefficient of static friction between coin and turntable?

4 A 4.00-kg object is attached to a vertical rod by two strings, as in Figure P6.11. The object rotates in a horizontal circle at constant speed 6.00 m/s. Find the tension in (a) the upper string and (b) the lower string.

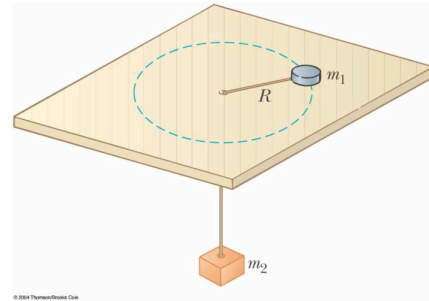


5 An amusement park ride consists of a large vertical cylinder that spins about its axis fast enough that any person inside is held up against the wall when the floor drops away (Fig. P6.65). The coefficient of static friction between person and wall is μ_s , and the radius of the cylinder is R . (a) Show that the maximum period of revolution necessary to keep the person from falling is $T = (4\pi^2 R \mu_s / g)^{1/2}$. (b) Obtain a numerical value for T if $R = 4.00$ m and $\mu_s = 0.400$. How many revolutions per minute does the cylinder make?



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6 An air puck of mass m_1 is tied to a string and allowed to revolve in a circle of radius R on a frictionless horizontal table. The end of the string passes through a hole in the center of the table, and counterweight of mass m_2 is tied to it (Fig. P6.58). The suspended object remains in equilibrium while the puck on the tabletop revolves. What is (a) the tension in the string? (b) the radial force acting on the puck? (c) the speed of the puck?



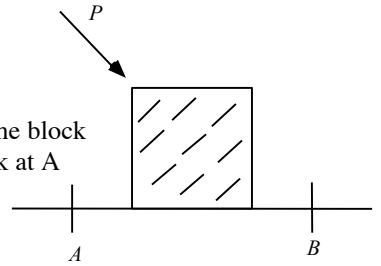
other
a

7 A crate of eggs is located in the middle of the flat bed of a pickup truck as the truck negotiates an unbanked curve in the road. The curve may be regarded as an arc of a circle of radius 35.0 m. If the coefficient of static friction between crate and truck is 0.600, how fast can the truck be moving without the crate sliding?

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8. A skier of mass 70.0 kg is pulled up a slope by a motor-driven cable. (a) How much work is required to pull him a distance of 60.0 m up a 30.0° slope (assumed frictionless) at a constant speed of 2.00 m/s? (b) A motor of what power is required to perform this task?

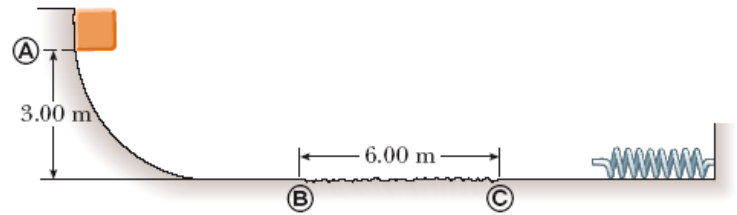
9. A block is pushed across a rough horizontal surface from point A to point B by a force (magnitude $P = 5.4$ N) as shown in the figure. The magnitude of the force of friction acting on the block between A and B is 1.2 N and points A and B are 0.5 m apart. If the kinetic energies of the block at A and B are 4.0 J and 5.6 J, respectively, how much work in J is done on the block by the force P between A and B?



10. On Oct 31 2015 massive asteroid TB145 nicknamed "Spooky" passed near the Earth vicinity. Given the measured diameter of the asteroid (450 meters) and its speed relative to the Sun: 125000 km/h, find the total maximum and minimum energy released in the completely inelastic collision of this object with Earth. (NOTE you are not given the parameters of collision so they become important part of the "worst case – best case scenario.") Treat the asteroid as spherical object with the density of between 3g/cm^3 to 6g/cm^3 . Earth orbit around the sun has radius $= 150 \times 10^6$ km. State your answers in Jules and in mega-tons of TNT. (1 megaton of TNT = 4.184×10^{15})

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- 11 10.0-kg block is released from point A with speed of initial speed 1m/s. (Block is given a push). The track is frictionless except for the portion between points B and C which has a length of 6.00 m. The block travels down the track, hits a spring of force constant 2000 N/m, and compresses the spring 0.300 m from its equilibrium position before coming to rest momentarily. Determine the coefficient of kinetic friction between the block and the rough surface between B and C.



12. A 50.0-kg block and 100-kg block are connected by a string. The pulley is frictionless and of negligible mass. The coefficient of kinetic friction between the 50-kg block and incline is 0.250. Determine the change in the kinetic energy of the 50-kg block as it moves from A to B, a distance of 20.0 m

