Exam 2 Practice Problems

(hr05-049) In the figure to the right, a block of mass \( m = 5.00 \text{ kg} \) is pulled along a horizontal frictionless floor by a cord that exerts a force of magnitude \( F = 12.0 \text{ N} \) at an angle \( \theta = 25.0^\circ \). (a) What is the magnitude of the block’s acceleration? (b) The force magnitude \( F \) is slowly increased. What is its value just before the block is lifted (completely) off the floor? (c) What is the magnitude of the block’s acceleration just before it is lifted (completely) off the floor?

Answer: (a) 2.18 m/s\(^2\)  (b) 116 N  (c) 21.0 m/s\(^2\)

(hr05-073) In the figure to the right, a tin of antioxidants (\( m_1 = 1.0 \text{ kg} \)) on a frictionless inclined surface is connected to a tin of corned beef (\( m_2 = 2.0 \text{ kg} \)). The pulley is massless and frictionless. An applied upward force of magnitude \( F = 6.0 \text{ N} \) acts on the corned beef tin, which has a downward acceleration of 5.5 m/s\(^2\). What are (a) the tension in the connecting cord and (b) angle \( \beta \)?

Answer: (a) 2.6 N  (b) 17\(^\circ\)

(hr06-029) In the figure to the right, blocks A and B have weights of 44 N and 22 N, respectively. The coefficient of static friction \( \mu_s \) between block A and the table is 0.20. (a) If block C has weight of 121 N, find the magnitude of the friction force between block A and the table. (b) Determine the minimum weight of block C to keep A from sliding on the table. (b) Block C suddenly is lifted off A. What is the acceleration of block A if \( \mu_k \) between A and the table is 0.15?

Answer: (a) 22 N  (b) 66 N  (c) 2.3 m/s\(^2\)

(hr06-059) In the figure to the right, a 1.34 kg ball is connected by means of two massless strings, each of length \( L = 1.70 \text{ m} \), to a vertical, rotating rod. The strings are tied to the rod with separation \( d = 1.70 \text{ m} \) and are taut. The tension in the upper string is 35 N. What are the (a) tension in the lower string, (b) magnitude of the net force \( \vec{F}_{net} \) on the ball, and (c) speed of the ball? (d) What is the direction of \( \vec{F}_{net} \)?

Answer: (a) 8.74 N  (b) 37.9 N  (c) 6.45 m/s  (d) radially inward
4. (yf04-037) Two adults and a child want to push a wheeled cart in the direction marked $x$ in the figure to the right. The two adults push with horizontal forces $F_1$ and $F_2$ as shown in the figure. (a) Find the magnitude and direction of the smallest force that the child should exert. You can ignore the effects of friction. (b) If the child exerts the minimum force found in part (a), the cart accelerates at $2.0 \text{ m/s}^2$ in the $+x$-direction. What is the weight of the cart?

Answer (a) 17 N, at $90^\circ$ clock-wise from the $+x$ axis  (b) 840 N

(yf05-059) A solid uniform 45.0-kg ball of diameter 32.0 cm is supported against a vertical, frictionless wall using a thin 30.0-cm wire of negligible mass, as shown in Fig. P5.59. (a) (With the help of a free-body diagram) Find the tension in the wire. (b) How hard does the ball push against the wall?

Answer (a) 470 N  (b) 163 N

(yf05-127) A ball is held at rest at position A, in the figure to the right, by two light strings. The horizontal string is cut and the ball starts swinging as a pendulum. Point B is the farthest to the right the ball goes as it swings back and forth. You are given that the angle $\beta = 37^\circ$. What is the ratio of the tension in the supporting string at position B to its value at A before the horizontal string was cut?

Answer: $\cos^2 \beta = 0.64$

(hr07-019) In the figure to the right, a block of ice slides down a frictionless ramp at angle $\theta = 50^\circ$ while an ice worker pulls on the block (via a rope) with a force $F_r$ that has a magnitude of 50 N and is directed up the ramp. As the block slides through distance $d = 0.50 \text{ m}$ along the ramp, its kinetic energy increases by 80J. How much greater would its kinetic energy have been if the rope had not been attached to the block?

Answer: 25 J
(hr07-057) A 230 kg crate hangs from the end of a rope of length $L = 12.0$ m. You push horizontally on the crate with a varying force $\vec{F}$ to move it distance $d = 4.00$ m to the side, as shown in the figure to the right. (a) What is the magnitude of $\vec{F}$ when the crate is in this final position? During the crate’s displacement, what are (b) the total work done on it, (c) the work done by the gravitational force on the crate, and (d) the work done by the pull on the crate from the rope? (e) Knowing that the crate is at rest at the start and end of its displacement, use the answers to (b), (c), and (d) to find the work your force $\vec{F}$ does on the crate. (f) Why is the work of your force not equal to the product of the horizontal displacement and the answer to (a)?

Answer: (a) 797 N; (b) 0; (c) $-1.55$ kJ; (d) 0; (e) $+1.55$ kJ; (f) (the product would be 3.19 kJ) $F$ varies during displacement

(hr08-031) A block with mass $m = 2.00$ kg is placed against a spring on a frictionless incline with angle $\theta = 30.0^\circ$ (see attached figure). (The block is not attached to the spring.) The spring, with spring constant $k = 19.6$ N/cm, is compressed 20.0 cm and then released. (a) What is the elastic potential energy of the compressed spring? (b) What is the change in the gravitational potential energy of the block–Earth system as the block moves from the release point to its highest point on the incline? (c) How far along the incline is the highest point from the release point?

Answer: (a) 39.2 J; (b) 39.2 J; (c) 4.00 m

(hr08-093) A playground slide is in the form of an arc of a circle that has a radius of 12 m. The maximum height of the slide is $h = 4.0$ m, and the ground is tangent to the circle (see figure). A 25 kg child starts from rest at the top of the slide and has a speed of 6.2 m/s at the bottom. (a) What is the length of the slide? (b) What average frictional force acts on the child over this distance? If, instead of the ground, a vertical line through the top of the slide is tangent to the circle, what are (c) the length of the slide and (d) the average frictional force on the child?

Answer: (a) 10 m; (b) 49 N; (c) 4.1 m; (d) $1.2 \times 10^2$ N
(yf06-087) Consider the system shown in the figure. The rope and pulley have negligible mass, and the pulley is frictionless. Initially the 6.00-kg block is moving downward and the 8.00-kg block is moving to the right, both with a speed of 0.900 m/s. The blocks come to rest after moving 2.00 m. Use the work–energy theorem to calculate the coefficient of kinetic friction between the 8.00-kg block and the tabletop.

Answer: 0.786

(yf07-041) At a construction site, a 65.0-kg bucket of concrete hangs from a light (but strong) cable that passes over a light, friction-free pulley and is connected to an 80.0-kg box on a horizontal roof (see figure). The cable pulls horizontally on the box, and a 50.0-kg bag of gravel rests on top of the box. The coefficients of friction between the box and roof are shown. (a) Find the friction force on the bag of gravel and on the box. (b) Suddenly a worker picks up the bag of gravel. Use the concepts of work, kinetic and potential energy to find the speed of the bucket after it has descended 2.00 m from rest. (You can check your answer by solving this problem using Newton’s laws.)

Answer: (a) zero on the bag of gravel, 637 N on the box  (b) 2.99 m/s

(yf07-077) A small block with mass 0.0500 kg slides in a vertical circle of radius $R = 0.800$ m on the inside of a (vertical) circular track. There is no friction between the track and the block. At the bottom of the path of the block, the normal force the track exerts on the block has magnitude 3.40 N. What is the magnitude of the normal force that the track exerts on the block when it is at the top of the path of the block?

Answer: 0.456 N