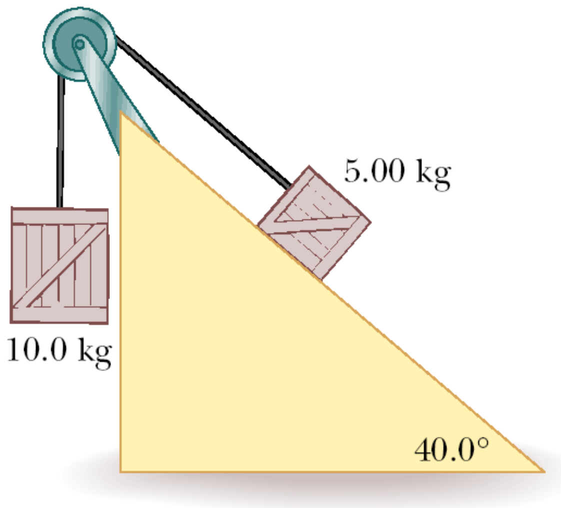
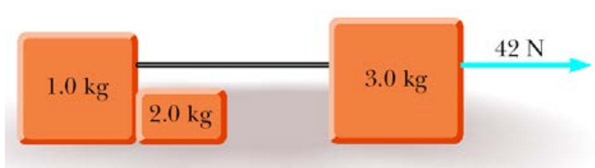
1. Two packing crates of masses 10.0 kg and 5.00 kg are connected by a light string that passes over a frictionless pulley as in the diagram below. The 5.00-kg crate lies on a smooth incline of angle 40.0°. Find the acceleration of the 5.00-kg crate and the tension in the string.

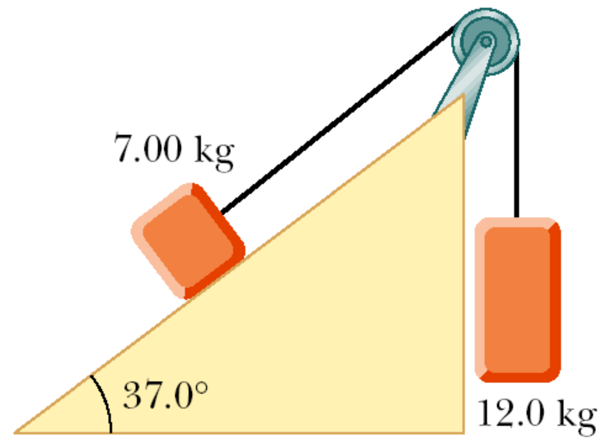


2. Assume that the three blocks portrayed in figure below move on a frictionless surface and that a 42-N force acts as shown on the 3.0-kg block. Determine (a) the acceleration given this system, (b) the tension in the cord connecting the 3.0-kg and the 1.0-kg blocks, and (c) the force exerted by the 1.0-kg block on the 2.0-kg block.

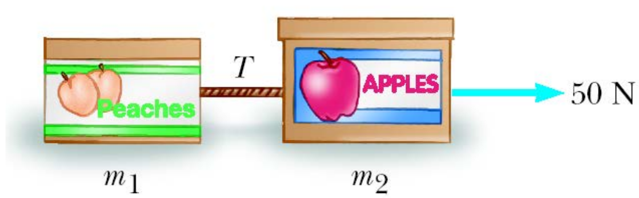


3. A 1,000-kg car is pulling a 300-kg trailer. Together, the car and trailer have an acceleration of 2.15 m/s^2 in the forward direction. Neglecting frictional forces on the trailer, determine (a) the net force on the car, (b) the net force on the trailer, (c) the force exerted by the trailer on the car, and (d) the magnitude of the resultant force exerted by the car on the road.

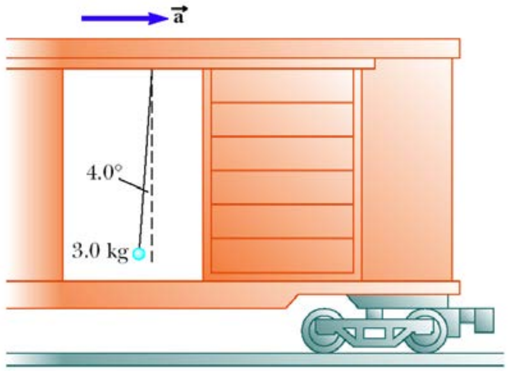
4. Find the acceleration reached by each of the two objects shown in the figure below if the coefficient of kinetic friction between the 7.00-kg object and the plane is 0.250.



5. Two boxes of fruit on a frictionless horizontal surface are connected by a light string as in Figure P4.69, where m_1 = 10 kg and m_2 = 20 kg. A force of 50 N is applied to the 20-kg box. Determine the acceleration of each box and the tension in the string.



6. A 3.0-kg object hangs at one end of a rope that is attached to a support on a railroad car. When the car accelerates to the right, the rope makes an angle of 4.0° with the vertical, as shown in the figure below. Find the acceleration of the car.



7. A fire helicopter carries a 620 kg bucket of water at the end of a 20 m long cable. Flying back from a fire at a constant speed of 40 m/s, the cable makes an angle of 40° with respect to the vertical. Determine the force exerted by air resistance on the bucket.

8. On an airplane's takeoff, the combined action of the air around the engines and wings of an airplane exerts an 8 000-N force on the plane, directed upward at an angle of 65.0° above the horizontal. The plane rises with constant velocity in the vertical direction while continuing to accelerate in the horizontal direction. (a) What is the weight of the plane? (b) What is its horizontal acceleration?

9. A hockey puck struck by a hockey stick is given an initial speed v_o in the positive x - direction. The coefficient of kinetic friction between the ice and the puck is μ_k. (a) Obtain an expression for the acceleration of the puck. (b) Use the result of part (a) to obtain an expression for the distance d the puck slides. The answer should be in terms of the variables v_o, μ_k, and g only.

10. A hockey puck is hit on a frozen lake and starts moving with a speed of 12.0 m/s. Five seconds later, its speed is 6.00 m/s. (a) What is its average acceleration during the five seconds? (b) What is the average value of the coefficient of kinetic friction between puck and ice? (c) How far does the puck travel during the 5.00-s interval?

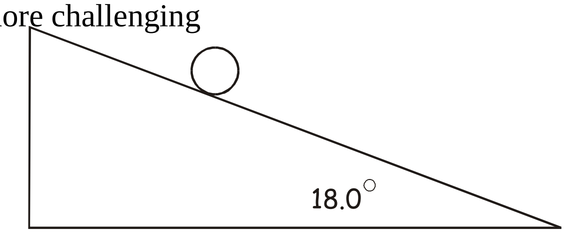
11. A frictionless plane is 10.0 m long and inclined at 35.0°. A sled starts at the bottom with an initial speed of 5.00 m/s up the incline. When the sled reaches the point at which it momentarily stops, a second sled is released from the **top** of the incline with an initial speed v_i. Both sleds reach the bottom of the incline at the same moment. (a) Determine the distance that the first sled traveled up the incline. (b) Determine the initial speed of the second sled.

12. Consider a large truck carrying a heavy load, such as steel beams. A significant hazard for the driver is that the load may slide forward, crushing the cab, if the truck stops suddenly in an accident or even in braking. Assume, for example, that a load or M sits on the flat bed of a 20 000-kg truck moving at 12.0 m/s. Assume the load is not tied down to the truck and has a coefficient of static friction of 0.500 with the truck bed. Calculate the minimum stopping distance for which the load will not slide forward relative to the truck.

13. A box of mass m is released from rest and accelerates down an incline. The box takes 0.89 s to reach the bottom of the incline which is 1.7 m long. What is the angle of the incline?

Unit 3 – Additional Problems that are more challenging

1. A ball of mass M slides down a $18.0°$ ramp. (a) What is the acceleration of the ball? Ignore friction. (b) If the ramp is 2.00 m long, how much time to reach the bottom?



FBD:

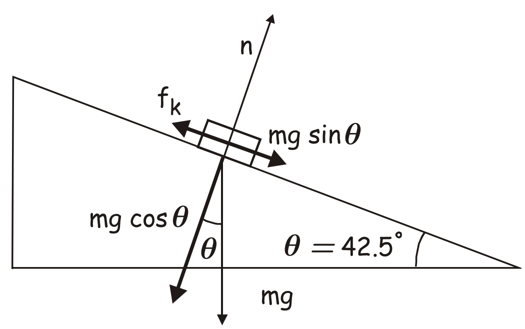
We'll let the direction down the ramp be the positive ***x*** direction; the ***y*** direction will be perpendicular to the surface of the ramp.

(a) First we look at the sum of the forces in the ***x*** direction (up and down the ramp).

There is only one force acting in this direction, the component of the weight that is down the slope:

(b) Since we know the acceleration and the distance it goes down the ramp, it's a simple matter to calculate the time it takes to do this.

2. A block of mass ***m*** slides down a ramp at constant speed. The elevation angle is $42.5°$. What is the coefficient of kinetic friction?



If the block moves at constant velocity, then the net force down the ramp is zero. This means that the kinetic force of friction must equal the force component down the surface of the ramp.

We know that the force of friction is also: $\boldsymbol{f_k = \mu_k F_N}$ **&** $\boldsymbol{F_N = w_y = mg\cos\theta}$