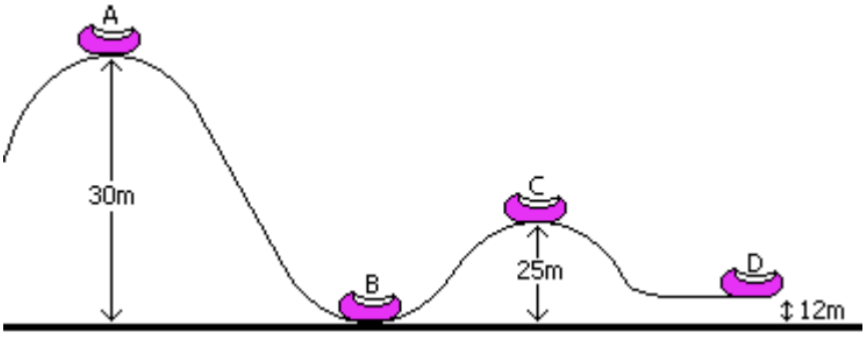
Physics 1 Exam 2 Test Prep

Kinetics

In screeching to a halt, a car leaves skid marks that are 65m long. The coefficient of kinetic friction between the tires and the road is k = 0.71. How fast was the car going before the driver applied the brakes? Show your work and explain your reasoning.

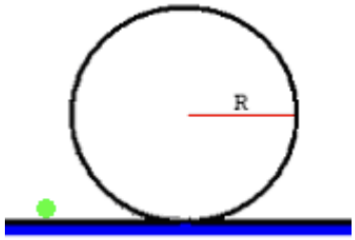
Consider the diagram below.



a) The roller coaster is pulled up to point A, where it and its screaming occupants are released from rest. Assuming no friction, calculate the speed of the coaster at points B, C, and D. Show your work.

b) Now, suppose the roller coaster passes point A with a speed of 1.70m/s. If the work done by friction is 45,000J, with what speed will it reach B? The mass of the coaster is 1000kg. Show your work.

The picture below shows a ball going around a loop. If the initial speed of the ball just before it enters the loop is 4.00m/s, what is the largest value that the radius of the loop, R, can have, if the ball is to remain in contact with the track? You may assume that friction is negligible. Show your work and explain your reasoning.



A 500 kg hot air balloon begins at rest and rises. The wind and lift forces combined do 97,000 J of work on the balloon. At what height above the surface of Earth is the speed of the balloon 8.00m/s?

Energy and momentum

A 9300 kg boxcar traveling at 11.0 m/s strikes a second boxcar at rest. The two stick together and move off with a speed of 4.5 m/s. What is the mass of the second car?

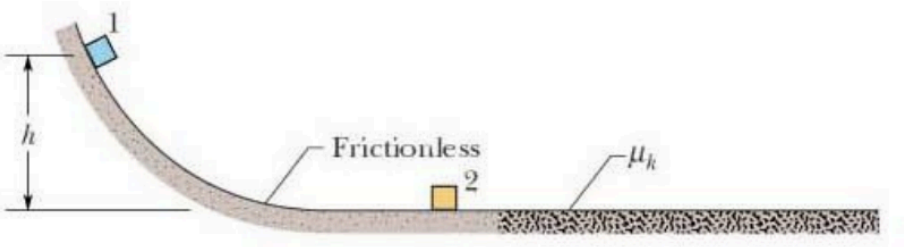
A 0.40 kg ball is thrown with a speed of 12 m/s at an angle of 25º. What is its speed at its highest point, and how high does it go? Use conservation of energy and ignore air resistance.

A 21.7 kg child descends a slide 3.5 m high and reaches the bottom with a speed of 2.2 m/s. How much thermal energy due to friction was generated in this process?

An internal explosion breaks an object, initially at rest, into two pieces, one of which has 1.5 times the mass of the other. If 7500 J were released in the explosion, how much kinetic energy did each piece acquire?

A 23 g bullet traveling 230 m/s penetrates a 2.0 kg block of wood and emerges cleanly at 170 m/s. If the block is stationary on a frictionless surface when hit, how fast does it move after the bullet emerges?

In the figure below, block 1 of mass m1 slides from rest along a frictionless ramp from height h and then collides with stationary block 2, which has mass m2 = 2m1. The collision is completely inelastic (the blocks stick together). After the collisions, block 2 slides into a region where the coefficient of kinetic friction is μk and comes to a stop in distance d within that region. Derive expressions for a) the speed of block 1 at the bottom of the ramp, b) the speed of the blocks after the collision, and c) the distance d the block travels on the rough surface. Express all your answers as functions of the height h.

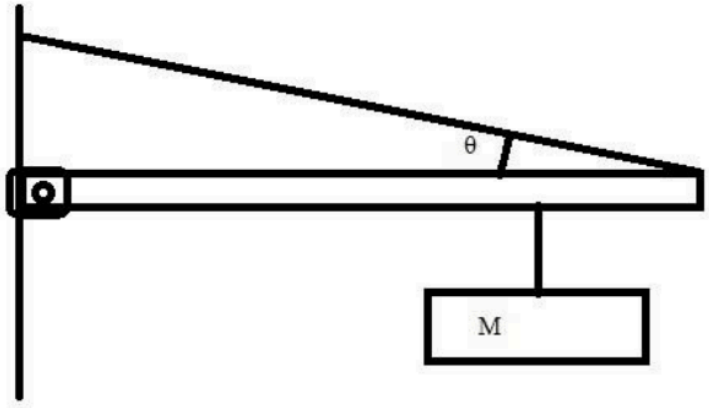


In the figure above, height h = 2.50 m, and the coefficient of kinetic friction μk is 0.500. What is the value of d?

A 70.0-kg ice hockey goalie, originally at rest, catches a 0.150-kg hockey puck slapped at him at a velocity of 35.0 m/s. Suppose the goalie and the ice puck have an elastic collision, and the puck is reflected back in the direction from which it came. What would their final velocities be in this case?

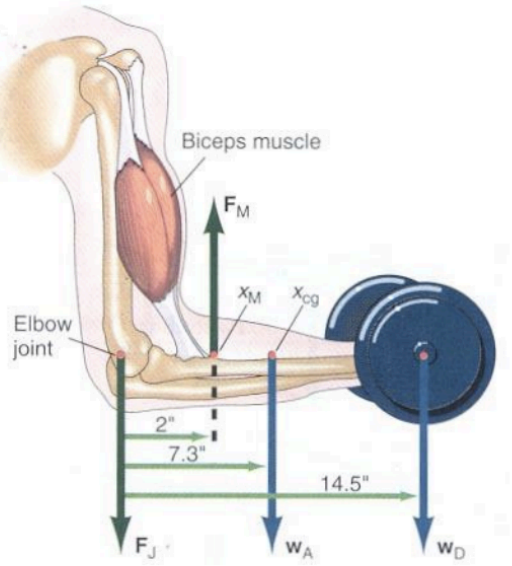
Statics and torques

In the figure below, a sign is suspended near, but not at the end, of a long horizontal bar. The bar is held in place by a brace and pin at the wall and by a cord attached at the right end of the bar and the wall. The cord is at an angle θ with respect to the horizontal. Draw the free body diagram for the bar and write the 2nd Law equations. Draw the torque diagram and write the torque equation.



For the previous problem, consider the following values. The mass of the bar is 25 kg, the mass M of the sign is 10 kg, θ = 15°, the length of the bar is 2.0 m, and the sign is hung 1.7 m from the left end of the bar. Calculate the torque on the bar due to the cord. To keep things simple, consider the brace and pivot to act exactly on the left end of the bar.

The figure below shows a weightlifter holding a dumbbell in place. The biceps muscle exerts a force on the forearm. The upper arm exerts a force on the elbow joint. Gravity exerts a force at the center of mass of the forearm, and the barbell exerts a force at the hand. Draw the free-body diagram and torque diagram for the situation below.



In the above problem, the dumbbell weighs 60 lbs. The forearm weighs 15 lbs. The biceps is attached to the forearm 2.0 in. from the elbow joint; the center of mass of the forearm is 7.30 in. from the elbow joint. (Note: these units are English rather than metric. Pounds are a unit of force in this system, and the unit of torque for this problem is inch-pounds.) Find the force exerted by the biceps to lift the dumbbell. What is the magnitude of the force exerted by the elbow joint? Show your work and explain your reasoning.