8-Series Problem

8.2) The *modified conservation of energy relationship* looks like:

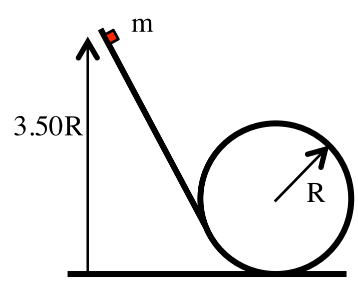
$$\sum KE_1 + \sum U_1 + \sum W_{ext} = \sum KE_2 + \sum U_2$$

a.) Assume a ball of mass m free falls from rest a distance h without the effects of friction. If we take *the system* to be the ball and the earth, how would you use the *modified conservation of energy relationship* to determine the ball's velocity at the end of its fall? (That is, start by reproducing the relationship, then do the problem!)

b.) Now assume we take *the system* to be just the ball. How would you use the *modified conservation of energy relationship* to determine the ball's velocity at the end of its fall? (Again, do it!)

c.) How do the two velocity values compare? Is your comparison expected? Explain very briefly what's different in the two approaches.

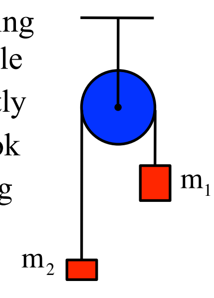
8.3.) A spring whose spring constant is 5000 N/m sits upright on a table in the vertical. A 0.250 kg mass is placed on the spring and the spring/mass system is forced to compress a distance 0.100 meters. The mass is released, flying upward. How high above the release point does the mass go?



8.5) A small block of mass m sits 3.50R units above the bottom of a loop of radius R (as shown). Assuming the system is frictionless:

a.) Assuming it's released from rest, what is the block's speed as it passes through the top of the loop?

b.) What is the normal force acting on the block at the top of the loop?



8.7) An Atwood Machine is a pulley with masses attached to each of the ends of a string threaded over the pulley (see sketch). In the original problem, m_2 is sitting on the table with a distance of 4.00 meters between it and m_1. (Clearly, the set-up shown is slightly different with m_2 *not* on the table's top—the reason for this will be evident if you look at the solutions.) If the pulley is ideal (super-light and frictionless) and if $m_1 = 5.00\text{kg}$ and $m_2 = 3.00\text{kg}$:

a.) How fast will m_1 be traveling just as it changes positions with m_2? (That is, after it has fallen a distance equal to 4.00 meters).

b.) Assume m_2 did start on the tabletop. After dropping 4.00 meters, m_1 would hit the tabletop and stop dead. How high would m_2 fly upward, maximum, after that happened?

8.12) A box is observed to be moving with velocity 2.00 m/s over an otherwise frictionless floor. At some point, the box runs into a frictional patch with a *coefficient of kinetic friction* of 0.100. Use *energy considerations* to determine how far the box will move over this patch before coming to rest.

8.14) A constant, 130 newton force is applied in the horizontal to a box of mass 40.0 kg that is initially at rest. If the push is applied over 5.00 meters, and if the *coefficient of kinetic friction* between the box and floor is 0.300:

a.) How much work is done by the *applied force*?

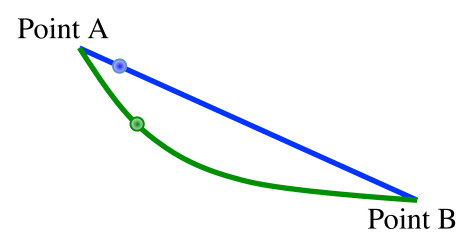
b.) Friction will essentially remove energy from the body's motion, heating the surroundings (the floor) in the process. This is sometimes referred to as *increasing the internal energy* of the system. By how much was the internal energy of the system increased (translation: how much work did friction do during the motion)?

c.) How much work did the *normal force* do?

d.) How much work was done by the *gravitational force*?

e.) What was the box's *change of kinetic energy*?

f.) What was the box's final, resulting speed?



8.18) A 0.600 meter long blue wire has a 0.025 kg bead released at *Point A* from rest. It slides down the wire under the influence of gravity and a constant frictional force of 0.0250 N. If *Point A* is .200 meters above *Point B*:

a.) What is the blue bead's speed at the end of the run?

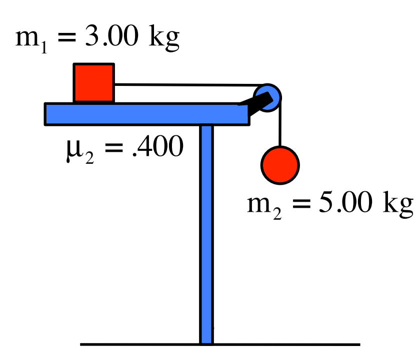
b.) A second wire (green) has an identical bead (though it's green) slide from *Point A* from rest down its curved length. If the frictional force is the same in both cases, which bead has the greater speed at the end of the run? Explain your reasoning.

8.21) A spring whose spring constant is 1.40 KN/m is secured on a 60° incline. A 200 gram mass is shoved down against the spring until the spring is compressed a distance 0.10 meters. Using energy considerations, how far does the mass move up the incline upon release (relative to its initial position) if:

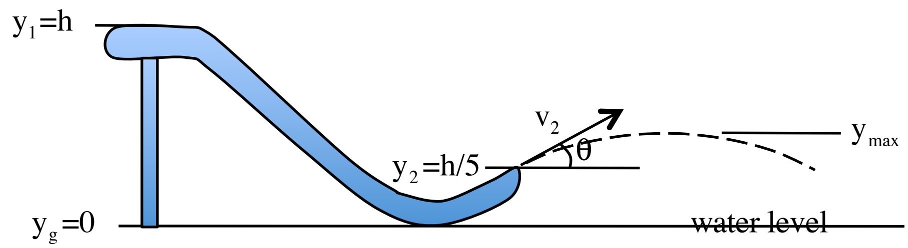
a.) There is no friction in the system?

b.) The *coefficient of kinetic friction* between the mass and the incline is 0.400?

8.22) If the *coefficient of kinetic friction* between the tabletop and m_1 is 0.400, how fast will the ball be moving after having fallen 1.50 meters?



8.27) A child of mass *m* climbs to the top of the *water slide* of height *h* shown to the right (sketch is without child), begins her slide more or less from rest, and proceeds down the essentially frictionless water slide into a pool.



a.) If we take the earth and child to be *the system*, is the system isolated or non-isolated? Explain briefly.

b.) Are there any non-conservative forces acting within *the system*?

c.) Assuming the *zero gravitational potential energy level* is at water's level, how much *mechanical energy*, total, exists in the system when the girl is at the top of the slide?

d.) How much *mechanical energy* exists in the system at the point where the child leaves the slide?

e.) How much *mechanical energy* exists in the system at the top of the child's free fall motion?

f.) In terms of *g* and *h,* determine the magnitude of the child's velocity v_2 (i.e., her velocity at the point of departure from the slide).

g.) In terms of *g* and θ, determine the girl's maximum height of flight.

h.) How would your answers to this problem have been different if the system had been frictional? Explain.

8.29) Climbing a 12.0 meter high vertical rope in 8.00 seconds is no mean feat. A strong, fit woman who weights 820 N does the deed with constant speed. How much power output did she generate?

8.30) Over a 21.0 millisecond period, a toy train accelerates from rest to 0.620 m/s using an electric motor. The train's mass is 875 grams.

a.) Power is transferred to the train by electrical transmission from the metal tracks. Determine the minimum power delivered to the train by this transmission.

b.) Why is this value a minimum?

8.37) A pulley system attached to the roof of a building allows three workers to lift a 3.50 KN stove 25.0 meters from the street to an apartment landing. 25% of the energy in the system is lost to friction, etc. (that means the system is only 75% efficient), and each worker is only able to deliver 165 W of power in the effort. Ignoring the mass of the pulley, how long will it take to lift the stove to the landing?