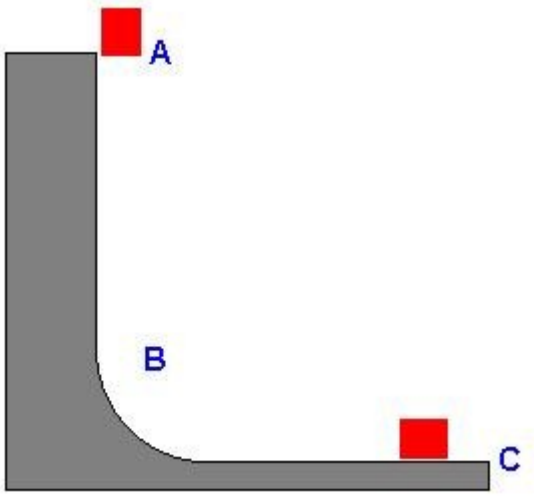
DAY 6

Homework Assignment (see syllabus for homework collection information)

1. A marble is placed on the lip of a cereal bowl and released. It rolls down into the bowl, up the other side, rolls back down, etc. Describe the marble's motion in detail. What types of energy are present in this system? Discuss the role of heat in the problem.

2. Refer to the figure at right. In an amusement park ride, people in a car are dropped some horrible distance, screaming for their lives. The car rounds a curved track and is brought to a halt by a braking force on a horizontal piece of track.



   The car has mass of 1100 kg. Point A is 50 m off the ground. Point B is 20 m off the ground. Point C is 5 m off the ground. The track is frictionless until you get to the horizontal braking section. The braking force is 2500 lb.

   Find the velocity of the car at B and when it reaches the horizontal track. How far will the car move on the horizontal track?

3. Re-work the above problem, with the braking force kicking in at point B rather than at the horizontal track.

4. A 5 gram bullet is moving at 400 m/s. It passes through a 2" thick piece of wood and comes out moving at 300 m/s. How much heat energy could have been generated? What was the average force on the bullet?

5. What is the KE of a 200 lb man on a 35 lb bicycle moving at 20 mph? If it took him 10 seconds to get to 20 mph, what was his power output?

6. According to the 1967 *Journal of Experimental Biology* paper "The Jump of the Flea: A Study of the energetics and a model of the mechanism" by Bennet-Clark and Lucey, when a flea (mass 0.45 mg) jumps it accelerates from 0 to 1 m/s in approximately 0.85 ms. Determine its acceleration and power.

7. A 2000 kg car moving at 20 mph plows into the back of a 10,000 kg truck that is standing still. The wreckage sticks together after the crash. How fast is it moving?

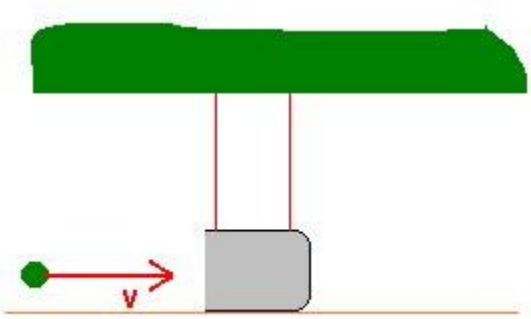
8. Re-work the above problem, this time with the car standing still and the truck moving at 20 mph.

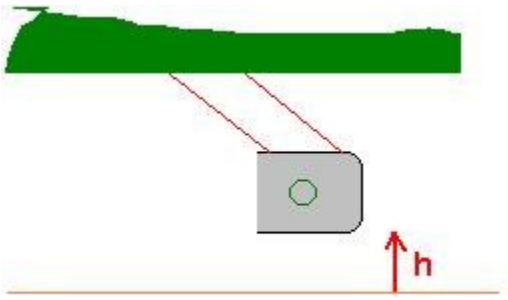
9. A swimmer dives off the stern of a pontoon boat that is at rest. What will the boat do? What if there are five other adults on the boat?

10. In the above problem, what if the boat is a huge coal barge? Is momentum still conserved in this case?

11. In movies there are frequently scenes where the one person shoots another. The "shooter" is standing, but the person getting hit goes flying backwards from the impact. Use conservation of momentum to argue that such a scene is "pure Hollywood", and not realistic at all.

12. To measure pitching speed without a radar gun, a little league coach has his pitchers throw baseballs into a bucket that hangs from a couple of ropes. The bucket swings up, and the height "h" the bucket reaches indicates the speed with which the ball was moving (see figures at right).





A baseball weighs 5 oz. The bucket has a mass of 2 kg. How high will the bucket swing when a baseball enters it at 50 mph? If it swings to twice the 50 mph height how fast is the pitch?

13. A small mass sets atop a larger, sloped mass as shown in the figure below. The two masses together have a mass of 100 kg. All surfaces are well-lubricated (no significant friction).

The small mass slides down the slope where it is measured to be moving at 1.25 m/s to the left and to have a mass of 20 kg. The large mass is moving to the right. What is the height of the large mass?