NYU Engineering Physics 1—Problem set 6

Due Thursday 2004 March 4 by 4:30pm at Irene Port’s office in Meyer 605.

**Problem 1:** Give estimated values (in SI units) for (a) the kinetic energies, and (b) the momenta of: (1) a bullet fired from a rifle, (2) a soccer ball kicked hard, and (3) a three-year-old riding slowly on a tricycle. You will have to make estimates of the masses and speeds of all three. Clearly state your assumptions and estimates.

**Problem 2:** A block of mass 5 kg moving initially at speed 7 m s\(^{-1}\) in the positive \(x\) direction collides elastically with another block of mass 2 kg moving initially at speed 2 m s\(^{-1}\) in the negative \(x\) direction. If the blocks recoil in the \(x\) direction (ie, if the problem remains one-dimensional), what are the final velocities of the blocks? Assume that there is no friction, drag or any other external force.

**Problem 3:** Two blocks of mass \(M\) are placed on an inclined plane, inclined at an angle \(\theta\) to the horizontal. One has a small coefficient of sliding friction \(\mu_k\) that is insufficient to keep it from accelerating down the plane. Compute the magnitude of the frictional force \(f_k\) and the magnitude of the block’s acceleration \(a\). The other block has a large coefficient of static friction \(\mu_s\) that is sufficient to keep it from sliding. Compute the magnitude of the frictional force \(f_s\) acting on this static block. If your answer is correct, the coefficient \(\mu_s\) does not appear in the expression. Explain why not.

**Problem 4—optional (not for credit):** Consider again the blocks-and-pulleys machine of Problem Set 5, Problem 1. Because of the configuration of strings and pulleys, if mass \(m_2\) falls, mass \(m_1\) rises, although not at the same rate, as you found (I hope) in solving that problem. Compute the change in potential energy \(\Delta U\) for the system if mass \(m_2\) falls by a distance \(\Delta h\), in terms of \(m_1, m_2, \Delta h\) and \(g\). For what ratio of masses \(m_1/m_2\) will this change \(\Delta U\) be exactly zero? Now imagine that the masses have exactly this specific ratio; what are the accelerations of the two blocks? Treat the strings and pulleys as massless and frictionless.