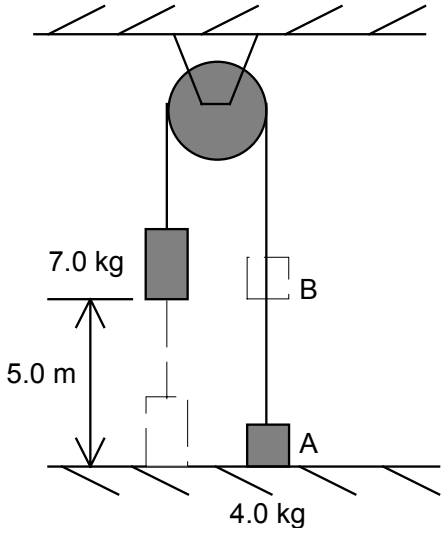
PHY 140Y – FOUNDATIONS OF PHYSICS
2001-2002
Tutorial Questions #8
November 5/6

Note: Answers are given in brackets. Try getting full solutions before the tutorials!

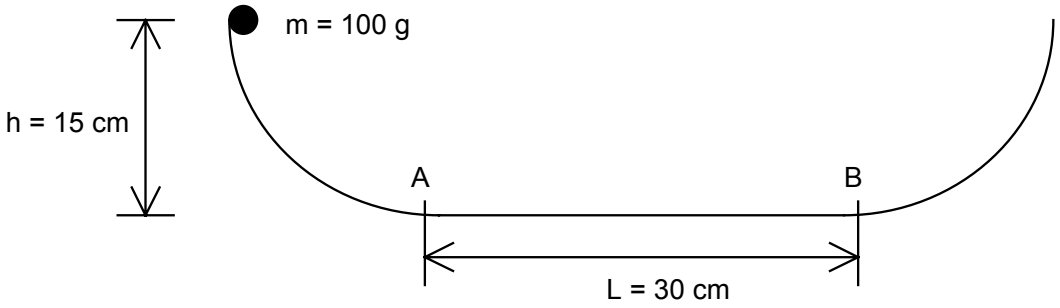
Conservation of Energy

1. The masses shown below are connected by a massless string over a frictionless, massless pulley and are released from rest. Use energy conservation to find
(a) the velocity of the 7.0-kg mass just before it hits the floor, [5.2 m/s]
(b) the maximum height reached by the 4.0-kg mass, and [6.4 m]
(c) the fraction of the system's initial mechanical energy lost when the 7.0 kg mass comes to rest on the floor. [27%]



2. A biologist uses a spring-loaded dart gun to shoot a 50-g tranquilizing dart into an elephant 21 m away. The gun's spring has spring constant k = 690 N/m and is pulled back 14 cm to launch the dart. The dart embeds itself 2.2 cm in the elephant. Assume that the dart's trajectory is nearly horizontal.
(a) What is the average stopping force exerted on the dart by the elephant's flesh? [310 N]
(b) How long does it take the dart to reach the elephant? [1.3 s]

3. A ball of mass m = 100 g slides inside a bowl whose cross section has circular arcs at each side and a flat horizontal central portion between points A and B of length L = 30 cm, as shown below. The curved sides of the bowl are frictionless, and for the flat bottom, the coefficient of kinetic friction is $\mu_k = 0.15$. The ball is released from rest at the rim, which is 15 cm above the flat part of the bowl.
(a) What is the speed of the ball at A? [1.7 m/s]
(b) What is the speed of the ball at B? [1.4 m/s]
(c) Where does the ball finally come to rest? [10 cm to the left of B]



Force and Potential Energy

4. (a) Derive an expression for the potential energy of an object subject to a force $F_x = ax - bx^3$, where a = 5.0 N/m and b = 2.0 N/m^3, taking U = 0 at x = 0. [an eqn]
(b) Graph the potential energy curve for x > 0 and use it to find the turning points for an object whose total energy is –1.0 Joule. [a graph, 0.66 m, 2.1 m]