Problem set 5

- Dynamics of Circular Motion

1. *Duffy* swings in a swing (Fig 5.1) supported by two chains, each 3.00 m long. The tension in each chain at the lowest point is 350 N. Find

   a) Duffy's speed at the lowest point and

   b) The force exerted by the seat on Duffy at the lowest point. (Find Duffy's mass in *Problem set 4-1*)

2. A dog toy consists of a small wedge (Fig 5.2) that has an acute angle θ. The sloping side of the wedge is frictionless, and an object of mass m on it remains at constant height if the wedge is spun at a certain constant speed. The wedge is spun by rotating, as an axis, a vertical rod that is firmly attached to the wedge at the bottom end. Show that, when the object sits at rest at a point at distance L up along the wedge, the speed of the object must be $v = \sqrt{gLsin\theta}$.

3. A ball is held at rest at position A by two light strings (Fig 5.3). The horizontal string is cut, and the ball starts swinging as a pendulum. Position B is the farthest to the right that the ball can go as it swings back and forth. What is the ratio of the tension in the supporting string at B to its value at A before the string was cut?

4. One problem for cool dogs like Duffy living in outer space is that they are apparently weightless. One way around this problem is to design a space station that spins about its center at a constant rate. This creates "artificial gravity" at the outside rim of the station.

   a) If the diameter of the space station is 800 m, how many revolutions per minute are needed for the "artificial gravity" acceleration to be 9.80 m/s^2?

   b) If the space station is a waiting area for dogs going to Mars, it might be desirable to simulate the acceleration due to gravity on the Martian surface (3.70 m/s^2). How many revolutions per minute are needed in this case?

Fig 5.1

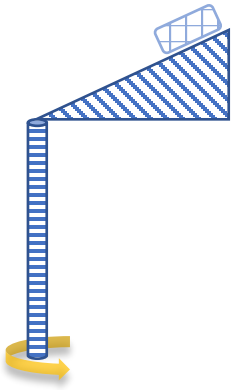

Fig 5.2

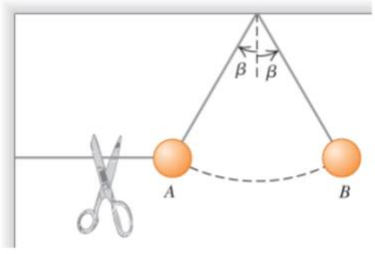

Fig 5.3