

# ***PHYSICS FOR ENGINEERING I***

***(PHYS 1210)***

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*Chapter 6:*

**Circular Motion:  
Applications of Newton's Laws**

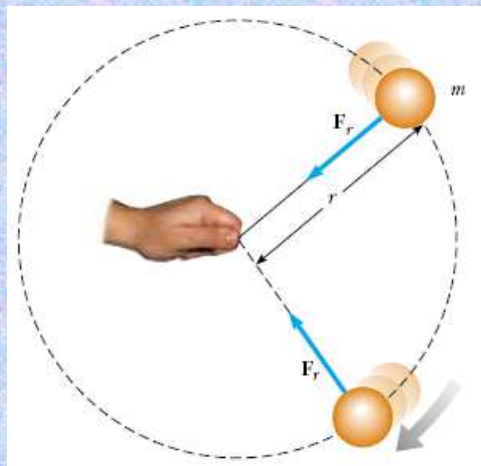
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*Chapter 6*

**CIRCULAR MOTION**

*Circular Motion*



$$a_c = \frac{v^2}{r}$$

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*Chapter 6*

**CIRCULAR MOTION**

### Example:

A small object of mass  $m$  is suspended from a string of length  $L$ . The object revolves with constant speed  $v$  in a horizontal circle of radius  $r$ , as shown in Figure 6.4. (Because the string sweeps out the surface of a cone, the system is known as a *conical pendulum*.) Find an expression for  $v$ .

### Solution:

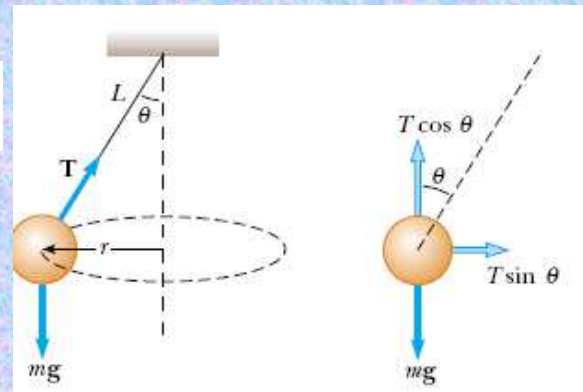
$$(1) \quad T \cos \theta = mg$$

$$(2) \quad \sum F = T \sin \theta = ma_c = \frac{mv^2}{r}$$

$$\tan \theta = \frac{v^2}{rg}$$

$$v = \sqrt{rg \tan \theta}$$

$$v = \sqrt{Lg \sin \theta \tan \theta}$$

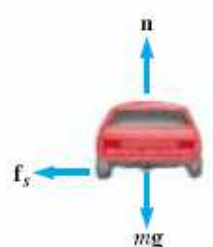
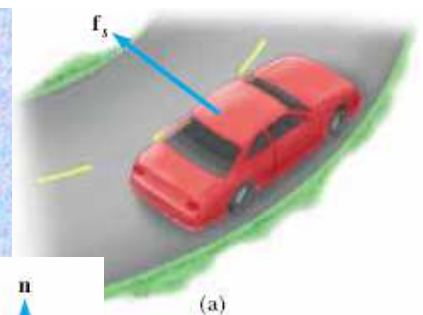


### Example:

A 1 500-kg car moving on a flat, horizontal road negotiates a curve, as shown in Figure 6.5. If the radius of the curve is 35.0 m and the coefficient of static friction between the tires and dry pavement is 0.500, find the maximum speed the car can have and still make the turn successfully.

### Solution:

$$\begin{aligned} v_{\max} &= \sqrt{\frac{f_{s, \max} r}{m}} = \sqrt{\frac{\mu_s m g r}{m}} = \sqrt{\mu_s g r} \\ &= \sqrt{(0.500)(9.80 \text{ m/s}^2)(35.0 \text{ m})} \\ &= 13.1 \text{ m/s} \end{aligned}$$



### *Example:*

A small sphere of mass  $m$  is attached to the end of a cord of length  $R$  and set into motion in a *vertical* circle about a fixed point  $O$ , as illustrated in Figure 6.10a. Determine the tension in the cord at any instant when the speed of the sphere is  $v$  and the cord makes an angle  $\theta$  with the vertical.

### *Solution:*

$$\sum F_t = mg \sin \theta = ma_t$$

$$a_t = g \sin \theta$$

$$\sum F_r = T - mg \cos \theta = \frac{mv^2}{R}$$

$$T = m \left( \frac{v^2}{R} + g \cos \theta \right)$$

