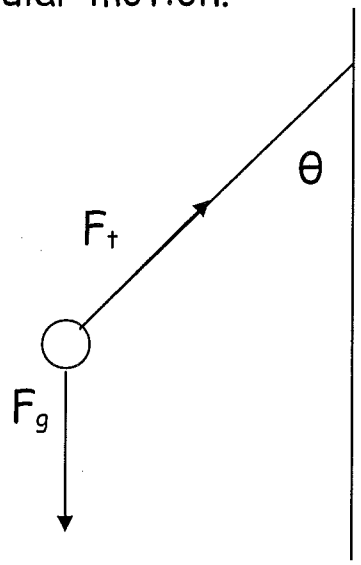
Physics 12 Section 5.2 Continued
The Tether Ball and the Car Rounding a Corner

1. There are two forces acting on a tether ball as it rotates in uniform circular motion.



2. The force of tension acts along the rope while the weight acts straight down. The force of tension provides the center seeking force and is the horizontal component of the F_t.

$$F_t \sin\theta = F_h$$

3. The vertical component of the F_t is equal to the weight of the object.

$$F_t \cos\theta = F_g$$

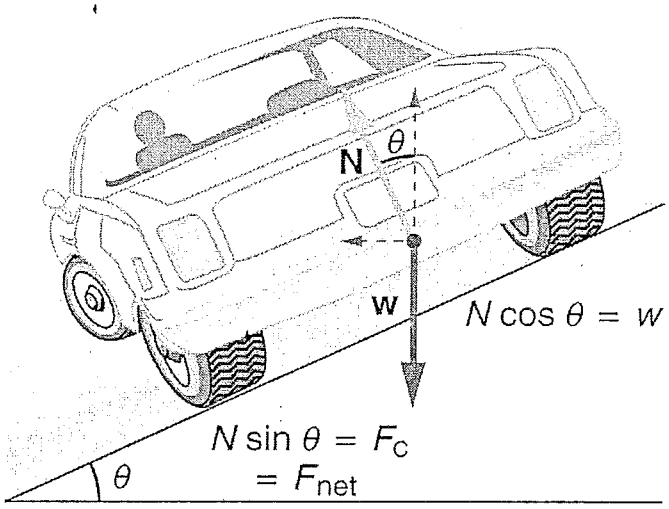
4. The sum of the forces statement for the x direction is:

$$\Sigma F_c = mv^2/r$$
$$F_t \sin\theta = mv^2/r$$

5. The sum of the forces statement for the y direction is:

$$\Sigma F_y = ma$$
$$F_t \cos\theta - mg = 0$$

6. A car going around a corner:



For a car going around a curve with radius r travelling at speed v, determine the formula for the angle at which a road should be banked so that no friction is required. What is the angle for a curve of radius 50m at a designated speed of 50km/h?

For the centre seeking forces:

$$\Sigma F_c = mv^2/r$$

$$F_n \sin \Theta = mv^2/r \qquad 1.$$

For the forces in the y direction:

$$\Sigma F = ma$$

$$F_n \cos \Theta - mg = ma$$

since "a" is zero

$$F_n \cos \Theta - mg = 0$$

$$F_n = \frac{mg}{\cos \Theta} \qquad 2.$$

combine 1. and 2.

$$\frac{mg \sin\Theta}{\cos\Theta} = \frac{mv^2}{r}$$

$$\tan \Theta = \frac{v^2}{gr}$$

$$\Theta = \tan^{-1} (v^2/gr)$$

The above formula can be used to solve for Θ.

$$\Theta = \tan^{-1} (v^2/gr)$$

$$\Theta = \tan^{-1} (14^2/(9.8 \times 50))$$

$$\Theta = 22°$$