Physics 151 Class Exercise: Centripetal Acceleration 2 - KEY

1.   A car goes around a curve on a road that is banked at an angle of 31.5°. Even though the road is slick, the car will stay on the road without any friction between its tires and the road when its speed is 22.7 m/s. What is the radius of the curve?

Since friction comes and goes with the weather and tire condition, we want to design a road so that friction is not needed to keep the car on the road at a reasonable "design speed".
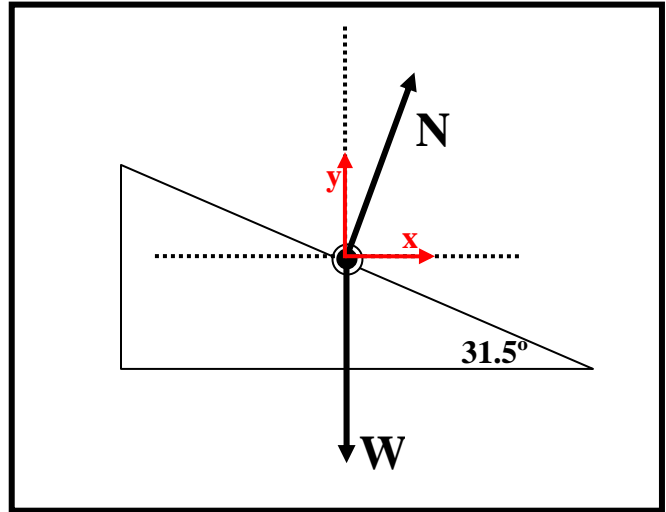
Free Body Diagram w/Coordinate System

$$\Sigma F_y = N\cos\theta - mg = 0$$

$$N = \frac{mg}{\cos\theta}$$

$$\Sigma F_x = N\sin\theta = m\frac{v^2}{R}$$

$$\frac{mg}{\cos\theta}\sin\theta = m\frac{v^2}{R}$$

$$R = \frac{v^2}{g\tan\theta} = \frac{\left(22.7\frac{m}{s}\right)^2}{\left(9.81\frac{m}{s^2}\right)(\tan 31.5°)} = 85.7m$$