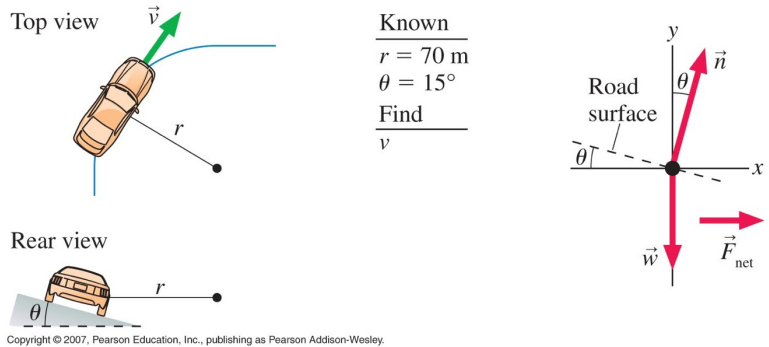


Banked road (KJF example 6.6)

A curve of radius 70m is banked at a 15° angle. At what speed can a car take this curve without assistance from friction?



Known
$r = 70 \text{ m}$
$\theta = 15^\circ$
Find
v

Solution: From the FBD, there is no net force in the vertical direction, so

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

while in the horizontal direction, with no friction acting, there is a net force provided by the x-component of the normal force which is providing the centripetal force:

$$F_{\text{net}} = N \sin \theta = mv^2/r$$

So, since $N = mg/\cos \theta$, we have

$$v^2 = mg/\cos \theta \times \sin \theta \times r/m = rg \tan \theta$$

so

$$v = \sqrt{rg \tan \theta} = \sqrt{70 \times 9.8 \times \tan 15^\circ} \\ = 14 \text{ ms}^{-1} = 50 \text{ kmh}^{-1}$$

At this speed, no assistance from friction is needed to make the car go in a circle, so it will do so even on a slippery road or with bald tyres.