# Circular Motion Worksheet II

*(Additional notes related to problems 1 & 2 can be found below.)*

1. What is the ideal, or critical, speed *(the speed for which no friction is required between the car's tires and the surface)* for a car on a curve that has a radius of 50 meters and a banking angle of 15°?
   *11 m/s*

2. Talladega Motor Speedway in Alabama has turns with radii of 1100 ft that are banked at extreme angles. If a car going 100.0 mph could negotiate the turns at Talladega without any friction between the tires and the pavement, at what angle would the turns have to be banked? (By the way, during races, cars have gone through the turns at about twice that speed.) *33°*

3. A looping roller coaster ride at an amusement park has a radius of curvature of 7.50 m. At what minimum speed must the coaster be traveling at the top of the curve so the passengers will not fall out? (8.57 m/s)

4. A physics student is twirling a 50.0 g rubber stopper attached to a 0.950 m length of cord at a uniform speed in a vertical circle. If its speed is 3.50 m/s, what is the tension in the cord at

   (A) the top of the circle (0.155 N)
   (B) the bottom of the circle (1.13 N)

5. A pilot pulls her jet out a dive by swing up in an arc of radius 3.80 km at a speed of 450.0 m/s.

   (A) What is the plane's centripetal acceleration? (53.3 m/s$^2$)
   (B) How many *g*'s does the pilot experience? *Hint: what is 1 g? 9.81 m/s$^2$?* (5.44 *g*)

## Additional Notes Regarding Circular Motion

We've talked about friction providing the centripetal force necessary to keep a car moving in a circular path, but what if the curve that the car is rounding is banked? By that, I mean, what if the curve isn't flat? Think about it, they often aren't, and that's on purpose!

When the road isn't flat, you have to consider the angle of the "bank," and not only the horizontal component of the force of friction, but also the horizontal component of the weight of the car. See – that's why they do the banked thing on purpose; even if there is no friction or reduced friction, given the right speed, a car could still make a curve since the horizontal component of the weight of the car provides a centripetal force that keeps the car on its circular path.

Bottom line, you can calculate the maximum speed (ideal or critical speed) that a car could successfully round the curve without any friction between the tires and the road. $v_{max} = \sqrt{r\mu g \tan\theta}$

Source: BHS Physics
[http://www.batesville.k12.in.us/physics/phynet/mechanics/circular%20motion/banked_no_friction.htm](http://www.batesville.k12.in.us/physics/phynet/mechanics/circular%20motion/banked_no_friction.htm)