More Circular Motion

Let's continue looking at how Newton's Laws can be applied to circular motion.

An object of mass $m = 0.50$ kg is tied to a string and whirled in a vertical circle of radius $r = 1.0$ m at constant speed v. If we use $g = 10\ \text{m/s}^2$, then the weight of the ball is 5.0 N. This is less than the tension required to break the string, which is 13 N, but the string breaks anyway. Why does it break? What is the minimum speed of the ball required to break the string?

Hint: Draw an appropriate free-body diagram and apply Newton's Second Law.

A water bucket of mass m is being whirled in a vertical circle of radius r at constant speed v. What is the minimum speed required so that the water remains in the bucket without falling out?

Hint: Draw an appropriate free-body diagram and apply Newton's Second Law.

You're on a roller coaster traveling very fast at the bottom of the loop-the-loop, and you feel pressed into your seat. Effectively you feel like you have an apparent weight that is larger than usual. Why?

Hint: Draw an appropriate free-body diagram and apply Newton's Second Law.

You're driving on a hilly road. As you drive at relatively high speed v over the top of a hill curved in an arc of radius r, you feel almost weightless and your car comes close to losing contact with the road. Explain why this is.

Hint: Draw an appropriate free-body diagram and apply Newton's Second Law.