Uniform Circular Motion

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1. What is the speed, in m/s, of the roller coaster at the top of the loop if the radius of curvature there is 18.0 m and the downward acceleration of the char is 1.50g?

$$a_c = \frac{mv^2}{r}.$$

$$14.7 = \frac{v^2}{18}.$$

$$\boxed{v = 16.3 \ \frac{m}{s}} \tag{1}$$

2. A stunt pilot in an air show performs a loop-the-loop in a vertical circle of radius 3.18×10^3 m. During this performance the pilot, whose weight is 685 N, maintains a constant speed of 2.10×10^2 m.

   (a) When the pilot is at the highest point of the loop, determine his apparent weight.

   You can calculate the apparent weight at the top of the loop with the equation
   $$\frac{mv^2}{r} - mg.$$

   Plugging all the answers in, you get $\boxed{284 \text{ N}}$.

   (b) At what speed will the pilot experience weightlessness?

   You can get this speed with the equation
   $$mg = \frac{mv^2}{r}.$$

   Plugging all the values in, you get $\boxed{177 \text{ m/s}}$.

   (c) When the pilot is at the lowest point of the loop determine his apparent weight.

   $$mg + \frac{mv^2}{r} = N.$$