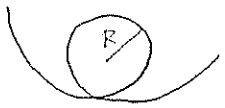
3. 8-64



a) at the top of the loop,  FBD of rider (upside down)
if rider feels weightless,

$n = 0 \rightarrow \Sigma F = mg$

and $a_c = v^2/R \Rightarrow mg = m\frac{v^2}{R} \rightarrow v^2 = gR$

to have this speed at the top of the loop, which is $y = 2R$ above the bottom, car needs to start from rest at height given by

$E_i = mgh$

$E_f = \frac{1}{2}mv^2 + mg(2R)$

$\Rightarrow mgh = \frac{1}{2}mv^2 + mg(2R)$

and $v^2 = gR$

so $mgh = \frac{1}{2}m(gR) + mg(2R) = \frac{5}{2}mgR$

$\Rightarrow h = \frac{5}{2}R$

b) if $h = \frac{5}{2}R$, at bottom of loop ($y = 0$) $mg(\frac{5}{2}R) = \frac{1}{2}mv_b^2 + 0$

so $v_b = \sqrt{5gR}$

then looking at forces 

$\Sigma F = n - mg = m\frac{v_b^2}{R}$

so $n = mg + m\frac{v_b^2}{R} = mg + \frac{m}{R}(5gR) = 6mg = 6 * \text{weight}$

if $h > \frac{5}{2}R$, v_b^2 is even bigger, so $n \geq 6 * \text{weight}$