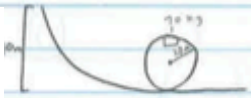
#2



a) $PE_i = (70\,kg)(10\,m/s^2)(40\,m) = 28000\,J$

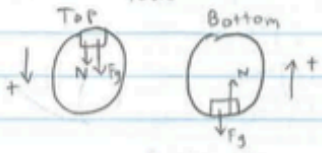
$PE_{Top\ of\ Loop} = (70\,kg)(10\,m/s)(20\,m) = 14000$

$28000\,J = \frac{1}{2}mv^2$, $V_{bottom} = 28.28\,m/s$

$14000\,J = \frac{1}{2}mv^2$, $V_{top} = 20\,m/s$

$a_{c\,bottom} = \frac{(28.28\,m/s)^2}{10m} = 80\,m/s^2$

$a_{c\,top} = \frac{(20\,m/s)^2}{10m} = 40\,m/s^2$



$\Sigma F_c = ma_c$

$N + F_g = ma_c$

$N = ma_c - F_g$

$N = (70kg)(40\,m/s^2) - (70kg)(10\,m/s^2) = \boxed{2100\,N}$

$\Sigma F_c = ma_c$

$N - F_g = ma_c$

$N = ma_c + F_g$

$N = (70kg)(80\,m/s^2) + (70kg)(10\,m/s^2) = \boxed{6300\,N}$

→ As you round the bottom of the loop, you feel more force pushing down on you. This is not a good ride for a pregnant woman!

b) If you start at the height as the top of the loop, you won't have enough velocity to make it around the top of the loop, because if energy is conserved, then KE will be 0 as you approach the top of the loop

c) $PE_i = PE_f + KE_f$

$mgh = mg(20m) + \frac{1}{2}mv^2$

$gh = g(20m) + \frac{1}{2}v^2$

$(10\,m/s)h = (10\,m/s)(20m) + \frac{1}{2}(10.01\,m/s)^2$

$\boxed{h > 25\,m}$

$\Sigma F = ma_c$

$F_g < ma_c$

$mg < ma_c$

$a_c > g$

$\frac{v^2}{r} > g$

$v > \sqrt{gr}$

$v > 10\,m/s$

Here we have neglected to identify the lenses. We can see this is a combination of energy and dynamics: Energy because we are finding velocity by recognizing that the height lost will translate to PE => KE. Dynamics because in a circle we know that we undergo centripetal acceleration and recognize the sum of the forces (in this case gravity and normal force) = ma. Also notice that this student chose to calculate the energy in Joules. This is not necessary. You could skip this step by setting PE=KE and just solving for V^2, which is what you need for centripetal acceleration. In any case, we see that a "9g" force at the bottom is more than a pregnant woman (and many other people) should experience.