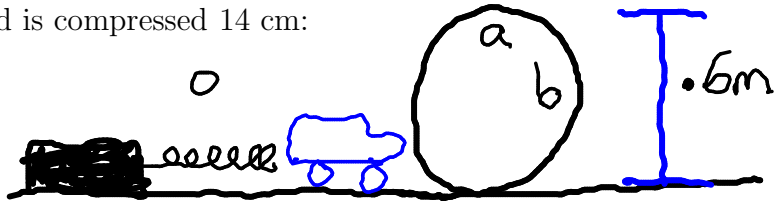


$\vec{g} = 9.81 \text{ m/s}^2$  downward, for a constant force  $W = \vec{F} \cdot \vec{d}$   
 $K = .5mv^2$     $U_g = mgh$     $E = K + U$     $f_k = \mu_k F_N$     $\vec{F} = m\vec{a}$   
 $\Delta E = W_{ext} + W_{friction}$     $\Delta K = W_{Net}$     $F_{circle} = \frac{mv^2}{r}$     $U_s = \frac{1}{2} kx^2$

A spring loaded piston is used to release a matchbox car of mass .095 kg so it can travel along a track and through an upside down loop. The system is assumed frictionless. If the spring has a spring constant of 85 N/m and is compressed 14 cm:

(A) what is the velocity at a and b?

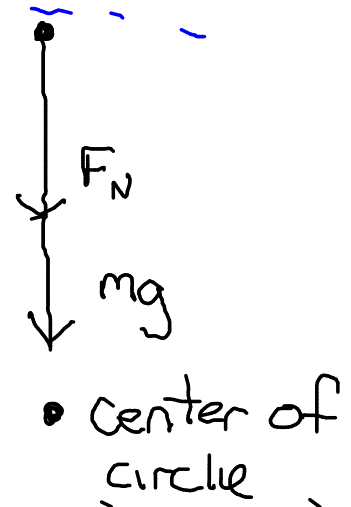
(B) What is the normal force at point a?



Energy is conserved!

$E_0 \Rightarrow \text{spring}$     $E_0 = \frac{1}{2} (85 \text{ N/m}) (.14 \text{ m})^2$   
 $= .833 \text{ J}$

True always!



so at point a

$.833 \text{ J} = \frac{1}{2} m v_a^2 + m g y_a$

$.833 \text{ J} = \frac{1}{2} (.095 \text{ kg}) v_a^2 + (.095 \text{ kg}) (9.81 \text{ m/s}^2) (.6 \text{ m})$

$v_a^2 = 5.76 \text{ m}^2/\text{s}^2$    so  $v_a = 2.4 \text{ m/s}$

part b)  $.833 \text{ J} = \frac{1}{2} (.095 \text{ kg}) v_b^2 + (.095 \text{ kg}) (9.81 \text{ m/s}^2) (.3 \text{ m})$

$v_b^2 = 11.65 \text{ m}^2/\text{s}^2$    so  $v_b = 3.4 \text{ m/s}$

B) By diagram  $\frac{mv^2}{r} = F_N + mg$

so  $F_N = \frac{mv^2}{r} - mg = .89 \text{ N}$