$F(x) = Cx^3$

$$W = \int \vec{F}(x) \cdot d\vec{x} = \int_{x=0}^{x=L} -|F(x)||dx| = \int_0^L -Cx^3\,dx = -\frac{1}{4}Cx^4\Big|_0^L$$

$$= -\frac{1}{4}CL^4$$

a) $\frac{1}{2}mv_1^2 = \frac{1}{2}mv_A^2 + \frac{1}{4}CL^4 \Rightarrow \frac{1}{2}mv_A^2 = \frac{1}{2}mv_1^2 - \frac{1}{4}CL^4$

$$\Rightarrow \boxed{v_A = \sqrt{\frac{\frac{1}{2}mv_1^2 - \frac{1}{4}CL^4}{\frac{1}{2}m}} = \sqrt{v_1^2 - \frac{1}{2}\frac{CL^4}{m}}}$$

+8

+ 2pt deduct

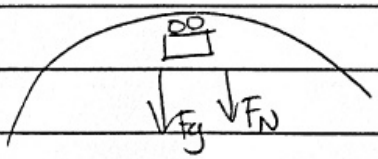
b) At point B

$$\frac{1}{2}mv_A^2 = \frac{1}{2}mv_B^2 + 2mgR$$

$$\Rightarrow \frac{1}{2}mv_B^2 = \frac{1}{2}mv_A^2 - 2mgR$$

+6

$$\Rightarrow v_B = \sqrt{\frac{\frac{1}{2}mv_A^2 - 2mgR}{\frac{1}{2}m}} = \sqrt{v_A^2 - 4gR}$$



$$|F_g + F_N| = |mv_B^2/R|$$

$$mg + F_N = m\left(\frac{v_A^2 - 4gR}{R}\right)$$

$$\Rightarrow \boxed{F_N = m\left(\frac{v_A^2 - 4gR}{R}\right) - mg}$$

$$= \frac{mv_A^2}{R} - 4mg - mg$$

+6

$$\boxed{F_N = \frac{mv_A^2}{R} - 5mg}$$