A block of mass $m$ is launched in the frictionless circular loop—the loop shown. Given that the spring constant is $k$, the radius $R$, and the mass $m$, find the distance the spring must be compressed before launch, if the normal force on the block at the top of the loop is to be $2mg$.

$$E_A = \frac{1}{2} k x^2$$

$$E_B = \frac{1}{2} m v_B^2 + mg(2R)$$

$$a_n = \frac{v_B^2}{R} = \frac{F}{m} = \frac{N + mg}{m} = 3g$$

$$\Rightarrow v_B^2 = 3gR$$

**Conservation of Energy**

$$\frac{1}{2} k x^2 = \frac{1}{2} m v_B^2 + 2mgR$$

$$= \frac{1}{2} m (3gR) + 2mgR$$

dividing by $k/2$

$$x^2 = \frac{3mgR + 4mgR}{k} = \frac{7mgR}{k}$$

$$x = \sqrt{\frac{7mgR}{k}}$$

- 9 pts
- 7 pts answer & algebra