A small bead B of mass m is threaded on a smooth wire fixed in a vertical plane. The wire forms a circle of radius a and centre O. The highest point of the circle is A. The bead is slightly displaced from rest at A. When angle $AOB = \theta$, where $\theta < \cos^{-1}\left(\frac{2}{3}\right)$, the force exerted on the bead by the wire has magnitude R_1. When angle $AOB = \pi + \theta$, the force exerted on the bead by the wire has magnitude R_2. Show that $R_2 - R_1 = 4mg$.

Solution:

$$\tfrac{1}{2}mv_1^2 = mga(1 - \cos\theta)$$

$$\tfrac{1}{2}mv_2^2 = mga(1 + \cos\theta)$$

$$R_1 = mg\cos\theta - mv_1^2/a$$

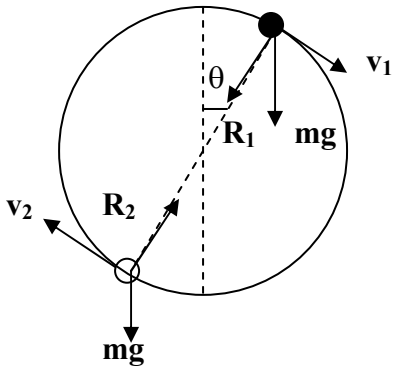
$$R_2 = mg\cos\theta + mv_2^2/a$$

$$R_1 = 3mg\cos\theta - 2mg$$

$$R_2 = 3mg\cos\theta + 2mg$$

$$R_2 - R_1 = 4mg$$

My calculation:



$$\frac{1}{2}mv_1^2 = mga(1-\cos\theta)$$

$$\frac{1}{2}mv_2^2 = mga(1+\cos\theta)$$

$$R_1 + mg\cos\theta = \frac{mv_1^2}{a}$$

$$R_2 - mg\cos\theta = \frac{mv_2^2}{a}$$

$$R_2 - R_1 = 6mg\cos\theta$$