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A *D* cm long uniform rod is sitting in equilibrium is a round bowl with radius *R* cm. It weighs *M* kg and is resting at an angle of θ degrees. How many reaction forces are there in this situation? What is the normal force at the connection between the bowl and the rod?

ANSWER:

There are four reaction forces: A_x, A_y, B_x, and B_y.

First, we must find the length of rod between A and B.

$$l = 2 \cdot \sqrt{\left(\frac{r}{100}\right)^2 - d^2} = 2 \cdot \frac{R}{100} \cdot \sqrt{(1 - \sin^2(\theta))}$$

Then, we take the sum of moments around A.

$$M_A = 0 = -\frac{D}{200} M \cdot g \cdot (\cos(\theta) + \sin(\theta)) + l \cdot N_B$$

$$N_B = \frac{\frac{D}{200} \cdot M \cdot g \cdot (\cos(\theta) + \sin(\theta))}{l}$$