

Call the pivot point "O".

The moment of inertia of the sphere about its center is  $I = \frac{2}{5} M_s R^2$

Then using the parallel axis theorem, its moment of inertia about an axis through O pointing out of the paper is

$$I_s^{(O)} = \frac{2}{5} M_s R^2 + M_s L^2. \quad \text{Similarly, for}$$

the cube

$$I_c^{(O)} = \frac{1}{6} M_c (2R)^2 + M_c L^2. \quad \text{So the total}$$

moment of inertia is

$$I = \left( \frac{2}{5} M_s + \frac{2}{3} M_c \right) R^2 + (M_s + M_c) L^2$$

Let us next compute the potential energy. Suppose the pendulum makes an angle  $\theta$  with the vertical. Then  $V_{\text{cube}} = -M_c g L \cos \theta$

$$V_{\text{sphere}} = M_s g L \cos \theta \Rightarrow V = (M_s - M_c) g L \cos \theta$$