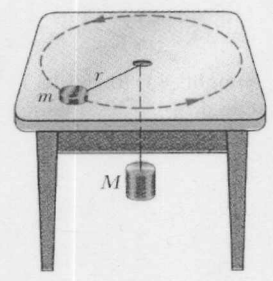# More Force Problems

A mass m on a frictionless table is attached to a hanging mass M by a cord through a hole in the table. Find an expression for the speed with which m must move in order for M to stay at rest. Your expression should be in terms of m, M, and r.

Let the surface of the table be perpendicular to the y-axis

Then, the line connecting the mass m to the central hole will always be perpendicular to the y axis.

FBD
m

$$N \uparrow \quad \xrightarrow{T}$$
$$\downarrow mg$$

M

$$\uparrow T$$
$$\downarrow Mg$$
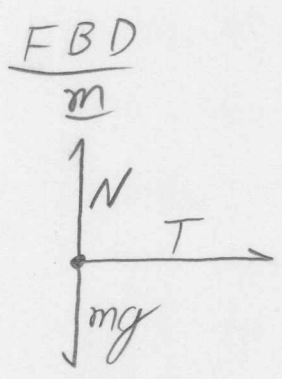
NSL

$$x: \ T = ma$$

↗ To remain in uniform circular motion, $a = \dfrac{v^2}{r} = r\omega^2$

① $\boxed{T = m\dfrac{v^2}{r}}$

$y: \ N - mg = 0$

$x: \ T - Mg = 0 \ \leftarrow \text{remains stationary}$

$\boxed{T = Mg}$ ②

Combine ① and ②

$$m\dfrac{v^2}{r} = Mg$$

$$\boxed{v = \left[\dfrac{rMg}{m}\right]^{1/2}}$$