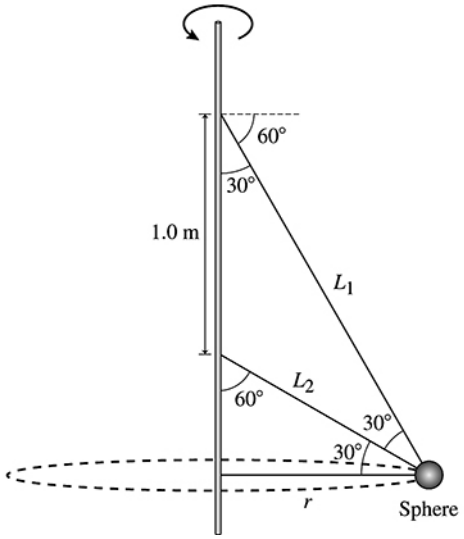
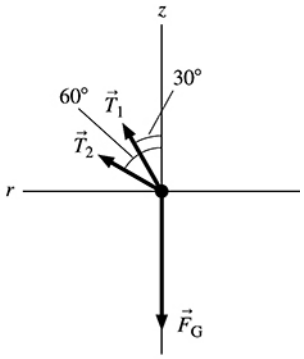
8.60. Model: Assume the particle model for a sphere in circular motion at constant speed.
Visualize:

Pictorial representation

Known
$m = 2.0$ kg

Find
v_t
$T_1 = T_2 = T$





Solve: **(a)** Newton's second law along the r and z axes is:

$$\sum F_r = T_1 \sin 30° + T_2 \sin 60° = \frac{mv_t^2}{r} \quad \sum F_z = T_1 \cos 30° + T_2 \cos 60° - F_G = 0 \text{ N}$$

Since we want $T_1 = T_2 = T$, these two equations become

$$T(\sin 30° + \sin 60°) = \frac{mv_t^2}{r} \quad T(\cos 30° + \cos 60°) = mg$$

Since $\sin 30° + \sin 60° = \cos 30° + \cos 60°$,

$$mg = \frac{mv_t^2}{r} \Rightarrow v_t = \sqrt{rg}$$

The triangle with sides L_1, L_2, and 1.0 m is isosceles, so $L_2 = 1.0$ m and $r = L_2 \cos 30°$. Thus

$$\sqrt{L_2 \cos 30° g} = \sqrt{(1.0 \text{ m}) \cos 30° g} = \sqrt{(0.866 \text{ m})(9.8 \text{ m/s}^2)} = 2.9 \text{ m/s}$$

(b) The tension is

$$T = \frac{mg}{\cos 30° + \cos 60°} = \frac{(2.0 \text{ kg})(9.8 \text{ m/s}^2)}{0.866 + 0.5} = 14.3 \text{ N}$$