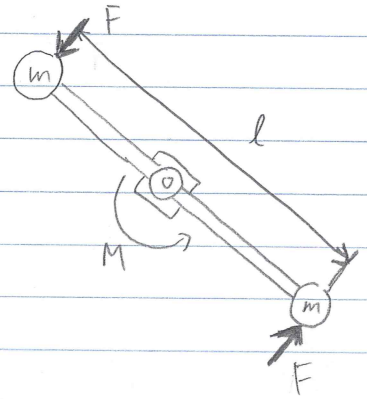
20-P-MOM-DY-20

Two $m = 2\,kg$ spheres are attached to a $2\,m$ long rod with negligible mass. The rod rotates, in the horizontal plane, around a pivot located at the midpoint of the rod. The couple moment $M = 6t^2\ Nm$ is applied to the rod and the spheres are subject to the force $F = 10\ N$. Determine the speed of the spheres when the time $t = 2s$.



Solution:

$$(H_O)_1 + \sum \int_{t_1}^{t_2} M\,dt = (H_O)_2$$

$$2\,r\,m v_1 + \int_{t_1}^{t_2} M\,dt + \int_{t_1}^{t_2} F\,r\,dt = 2\,r\,m v_2 \qquad r = \frac{l}{2} = 1$$

$$2(1)(2)(0) + \int_0^2 6t^2\,dt + \int_0^2 F\,r\,dt = 2\,r\,m v_2$$

$$2t^3\Big|_0^2 + F\,r\,t\Big|_0^2 = 2\,r\,m v_2$$

$$v_2 = \frac{2(2)^3 + F\,r\,(2)}{2\,r\,m} = 9\ m/s$$