

**177. Stabpendel mit Kugeln**

$$\begin{array}{lll} L = 0.3 \text{ m}; & r_1 = 0.02 \text{ m}; & r_2 = 0.03 \text{ m} \\ m_0 = 0.1 \text{ kg}; & m_1 = 0.1 \text{ kg}; & m_2 = 0.3 \text{ kg} \end{array}$$

a)  $I_{ges} = I_{Stab} + I_{Kugel1} + I_{Kugel2}$

$$\begin{aligned} I_{Stab} &= \frac{1}{12} m_0 L^2 = 7.5 * 10^{-4} \text{ kg m}^2 \\ I_{Kugel1} &= \frac{2}{5} m_1 r_1^2 + m_1 \left( \frac{L}{2} + r_1 \right)^2 = 2.9 * 10^{-3} \text{ kg m}^2 \\ I_{Kugel2} &= \frac{2}{5} m_2 r_2^2 + m_2 \left( \frac{L}{2} + r_2 \right)^2 = 9.8 * 10^{-3} \text{ kg m}^2 \\ \Rightarrow I_{ges} &= \underline{\underline{1.3 * 10^{-2} \text{ kg m}^2}} \end{aligned}$$

b)

$$\begin{aligned} x_{Stab_{sp}} &= 0 \text{ m} \\ x_{Kugeln_{sp}} &= \frac{m_1 \left( -\frac{2r_1+L}{2} \right) + m_2 \left( \frac{2r_2+L}{2} \right)}{m_1+m_2} = 0.0925 \text{ m} \\ x_{sp} &= \frac{x_{Stab_{sp}} * m_0 + x_{Kugeln_{sp}} * (m_1+m_2)}{m_0+m_1+m_2} = \underline{\underline{0.074 \text{ m}}} \end{aligned}$$

c)  $T = 2\pi \sqrt{\frac{I}{Mgl}}$

$$\begin{aligned} T &= 2\pi \sqrt{\frac{I}{(m_0+m_1+m_2) g \left( \frac{2r_2+L}{2} \right)}} \\ &= \underline{\underline{0.77 \text{ s}}} \end{aligned}$$