$$\dot{\vec{r}}^2 = \dot\phi^2 \ell^2 - \frac{3}{4}\ell^2\dot\phi^2\cos^2\phi$$

$$\vec{r}^2 = \ell^2\cos^2(\phi) + \frac{1}{4}\ell^2\sin^2(\phi) + \frac{3}{4}\ell^2\sin^2(\phi) - \frac{3}{4}\ell^2\sin^2(\phi)$$

$$= \ell^2 - \frac{3}{4}\ell^2\sin^2(\phi)$$

$$\vec{r}^2 \cdot \dot\phi^2 = \ell^2\dot\phi^2 - \frac{3}{4}\ell^2\dot\phi^2\sin^2(\phi)$$

c) Gesamt:

$$\Rightarrow \mathcal{L} = \frac{2m}{2}\left[\ell^2\dot\phi^2 + \ell^2\dot\phi^2 - \frac{3}{4}\ell^2\dot\phi^2\right] - \ell mg\sin\phi$$

$$= m\frac{5}{4}\ell^2\dot\phi^2 - \ell mg\sin\phi$$

$$\frac{d}{dt}\frac{\partial L}{\partial\dot\phi} - \frac{\partial L}{\partial\phi} = 0 = \frac{5}{2}m\ell^2\ddot\phi + \ell mg\cos\phi = \frac{5}{2}\ell\ddot\phi + g\cos\phi = 0$$

$$\frac{\partial L}{\partial\phi} = -\ell mg\cos\phi$$

$$\frac{\partial L}{\partial\dot\phi} = \frac{5}{2}m\ell^2\dot\phi$$

$$\frac{d}{dt}\frac{\partial L}{\partial\dot\phi} = \frac{5}{2}m\ell\ddot\phi$$

(✓)

d) gen. Impuls: $\frac{\partial L}{\partial\dot\phi} = \frac{5}{2}m\ell^2\dot\phi$ ff.

Die dazugehörige Variable ist nicht zyklisch, da $\frac{\partial L}{\partial\phi} \neq 0$. ✓

2.5/5