ICP 16

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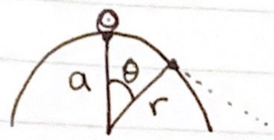

$L = T - U$

$T = T_{tr} + T_{rot}$

$T = \frac{1}{2} m(\dot{r}^2 + r^2\dot{\theta}^2)$

$U = mgr\cos\theta$

$f = a - r = 0$

$\ddot{r} = 0$ (1)

$\dot{r} = 0$ (2)

$L = \frac{1}{2} m(\dot{r}^2 + r^2\dot{\theta}^2) - mgr\cos\theta$

r

$$\frac{\partial L}{\partial r} - \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{r}}\right) + \lambda \frac{\partial f}{\partial r} = 0$$

$$\frac{\partial L}{\partial r} = \frac{1}{2} m 2 r \dot{\theta}^2 - mg\cos\theta$$

$$\frac{\partial L}{\partial \dot{r}} = \frac{1}{2} m 2 \dot{r} = m\dot{r}$$

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{r}}\right) = m\ddot{r}$$

$$\lambda \frac{\partial f}{\partial r} = -\lambda$$

$$mr\dot{\theta}^2 - mg\cos\theta - \cancel{m\ddot{r}}^{\,0} - \lambda = 0$$

$$mr\dot{\theta}^2 - mg\cos\theta = \lambda$$

θ

$$\frac{\partial L}{\partial \theta} - \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\theta}}\right) + \lambda \frac{\partial f}{\partial \theta} = 0$$

$$\frac{\partial L}{\partial \theta} = mgr\sin\theta$$

$$\frac{\partial L}{\partial \dot{\theta}} = mr^2\dot{\theta}$$

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\theta}}\right) = 2mr\dot{r}\dot{\theta} + mr^2\ddot{\theta}$$

$$\frac{\partial f}{\partial \theta} = 0$$

$$mgr\sin\theta - \cancel{2m\dot{r}r\dot{\theta}}^{\,0} - mr^2\ddot{\theta} = 0$$

from (1) & (2)

$$\int \cancel{m}g\sin\theta - \cancel{m}r\ddot{\theta} = 0$$

$$\frac{d\theta}{dt} = \dot\theta$$

$$d\theta = \dot\theta\, dt$$

$$\frac{d\theta}{\dot\theta} = dt$$

$$\frac{mgr\sin\theta}{\dot\theta}\, d\theta = mr^2\dot\theta$$

$$\int mg\sin\theta\, d\theta = \int mr\,\dot\theta^2$$

$$-mg\cos\theta = mr\dot\theta^2\theta$$

$$mr\dot\theta^2 + mr\dot\theta^2\theta = \lambda$$

$$\lambda = mr\dot\theta^2(1+\theta)$$

$$\lambda\frac{\partial f}{\partial r} = -mr\dot\theta^2(1+\theta)$$

$$= -mr\dot\theta^2(1+\theta)$$

$$\boxed{0 \text{ when } \theta = -1}$$