广义坐标和广义动量

$L = T - U$

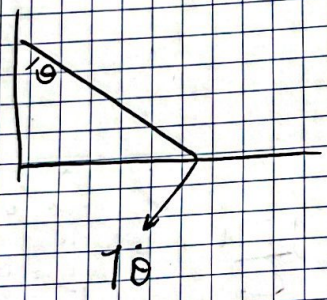
广义坐标 q_α 广义动量 $\dot{q}_\alpha$

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_\alpha}\right) = \frac{\partial L}{\partial q_\alpha}$$

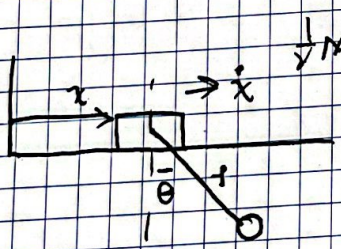
两体运动和散射

微振动

广义坐标 → 非线性运动 | 2阶 角动量 $m\ddot{r} = -\frac{\partial U_{eff}}{\partial r}$ | 一般无法求解 → 微振动



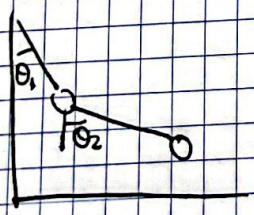
$$T = \frac{1}{2}ml^2\dot{\theta}^2 = \frac{I}{2}\dot{\theta}^2$$



$\frac{1}{2}M\dot{x}^2$

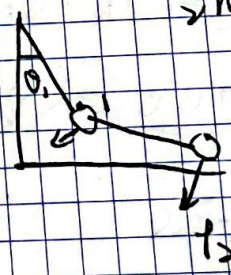
$\parallel \quad \dot{x} - l\dot{\theta}\cos\theta$

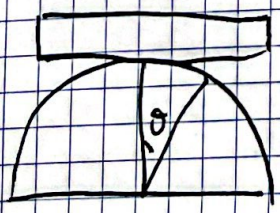
$\perp \quad l\dot{\theta}\sin\theta$

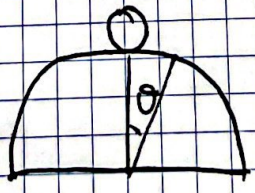


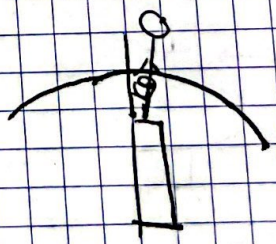
方法 | $\vec{x}_1, \vec{x}_2$ | $\vec{x}_1 \cdot \vec{x}_2$

$\frac{1}{2}m_1 l^2\dot{\theta}_1^2$

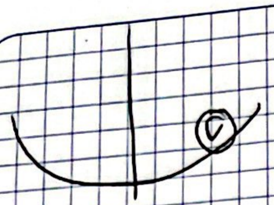








运动周期?

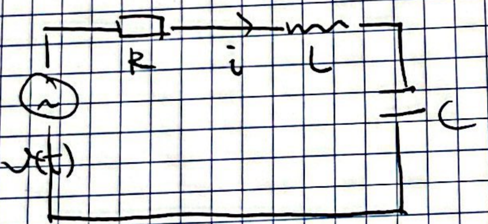


$T=\frac{I}{2}\dot{\theta}^2$

$U=U(\theta)=U(0)+\frac{k}{2}\theta^2$

$m\ddot{r}=-\frac{\partial U_{eff}}{\partial r}$ 　U_{eff}两部分　吸引+排斥 ⇒ 用动量^2

RLC电路



电阻电压 iR

电感 $L\frac{di}{dt}$

电容 $\frac{Q}{C}=\frac{\int i\,dt}{C}$

$\dot{Q}=i$

$\ddot{Q}=\frac{di}{dt}$

$$U(t)=iR+L\frac{di}{dt}+\frac{\int i\,dt}{C}$$

$$=\dot{Q}R+L\ddot{Q}+\frac{Q}{C}$$

$$L\ddot{Q}+\frac{Q}{C}+\dot{Q}R=V\cos(\omega t)$$

$$m\ddot{x}+m\omega_0^2x+\lambda\dot{x}=\int\cos(\omega t)$$

$(+\alpha x^2+\beta x^3)$

$x \leftrightarrow Q$

$m \leftrightarrow L$

$m\omega_0^2 \leftrightarrow \frac{1}{C}$

$\omega_0^2 \leftrightarrow \frac{1}{LC}$

$\lambda \leftrightarrow R$

(LLG eq) $\vec{M}$

$$\frac{d\vec{M}}{dt} = -|\gamma|\vec{M} \times \vec{H}(t) + \frac{\alpha}{M_s}\vec{M} \times \frac{d\vec{M}}{dt}$$

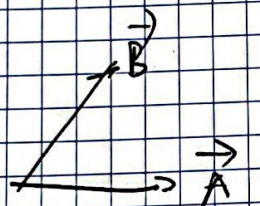
$$\vec{H} = \vec{H}_0 + \delta\vec{H}(\omega t)$$

$$\vec{M} = \begin{pmatrix} m_x \\ m_y \\ m_z \end{pmatrix}$$

二次法 (1) $\vec{M}(0) = \vec{M}_0 + \delta\vec{M}(t)$

(2) 线性展开

(3) 求解



(1) $\vec{A}\cdot\vec{B}$ 标量

(2) $\vec{A}\times\vec{B} = -\vec{B}\times\vec{A}$ 反对

(3) $(\vec{A}\times\vec{B})\cdot\vec{C}$ 混积

(4) $\vec{A}\times(\vec{B}\times\vec{C}) = x_1\vec{A} + y_1\vec{B} + z_1\vec{C}$

$y_1(\vec{A},\vec{C})$ $z_1(\vec{A},\vec{B})$

推出两个是构成 $y_1 = \vec{A}\cdot\vec{C}$, $z_1 = \vec{A}\cdot\vec{B}$

$$-\vec{A}\cdot\vec{C}\,\vec{B} + \vec{A}\cdot\vec{B}\,\vec{C}$$

(5) $(\vec{A}\times\vec{B})^2$ 标量 构成标量 $\vec{A}\cdot\vec{A}$, $\vec{B}\cdot\vec{B}$, $\vec{A}\cdot\vec{B}$, $\vec{A}\cdot\vec{B}$

猜 $(\vec{A}\times\vec{B})^2 = (\vec{A}\cdot\vec{A})(\vec{B}\cdot\vec{B}) + (\vec{A}\cdot\vec{B})^2$

不对 $\vec{A}=\vec{B}$ 左=0

$$(\vec{A}\times\vec{B})^2 = (\vec{A}\cdot\vec{A})(\vec{B}\cdot\vec{B}) - (\vec{A}\cdot\vec{B})^2$$