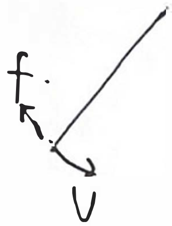
一、 $\underline{-kv}$ $-kv^2$ 浸渐 浸渐

λ $\underline{\frac{-d\lambda}{dt}\cdot T \ll \lambda}$

$$r=\frac{p}{1+e\cos\theta}$$



$$\overline{dE} = -f\cdot ds = -k\underline{v}\cdot \underline{ds}$$

$$ds=\sqrt{(dr)^2+(rd\theta)^2}=p\sqrt{\frac{1}{(1+e\cos\theta)^2}+\frac{e^2\sin^2\theta}{(1+e\cos\theta)^4}}\,d\theta$$

$$\frac{1}{2}mv^2-\frac{GMm}{r}=-\frac{GMm}{2a}$$

$$\Rightarrow\quad v=\sqrt{\frac{GM}{p}}\sqrt{2(1+e\cos\theta)-(1-e^2)}$$

$$=\sqrt{\frac{GM}{p}}\sqrt{e^2+2e\cos\theta+1}$$

✕. $dE = d\left(-\frac{GMm}{2a}\right) = \underline{-kv\cdot ds}$

$$W=\int_0^T kv\cdot v\,dt = \frac{2kT}{m}\left(\frac{1}{T}\int_0^T \underline{\frac{1}{2}mv^2\cdot dt}\right) = -\frac{2kT}{m}\langle E_k\rangle$$

$$\langle E_k\rangle = -\frac{1}{2}\langle V\rangle$$

$$\langle E_k\rangle = -E = \frac{GMm}{2a} \qquad a=\frac{p}{1-e^2}$$

代入: $W=-2\pi k\sqrt{GM}\sqrt{\frac{p}{1-e^2}}$

$$\frac{1}{2}kA^2$$

$$\int -k\underline{v}\cdot\underline{ds} = -W$$

$$-kv\cdot$$

1 m

二.

(1). $4mgl\sin\theta = \frac{1}{2}\cdot 4m(\omega l\cos\theta)^2 + \frac{1}{2}\cdot 4\cdot\frac{1}{3}ml^2\omega^2$

$$\Rightarrow \omega^2 = \frac{6g\sin\theta}{(3\cos^2\theta+1)l} = \frac{6\sqrt{2}}{5}\frac{g}{l}$$

$$V_{中} = \omega\cdot l = \sqrt{\frac{6\sqrt{2}}{5}gl}$$

$$V_{下} = \sqrt{2}V_{中} = \sqrt{\frac{12\sqrt{2}gl}{5}}$$

(2). $4mgl\cos\theta\,\dot\theta = 2ml^2[2\dot\theta\ddot\theta\cos^2\theta - \dot\theta^2\sin 2\theta\,\dot\theta]$

$$+\ \frac{2}{3}ml^2\cdot 2\dot\theta\ddot\theta$$

$$\beta = \frac{3\cos\theta(4+3\sin^2\theta)}{(3\cos^2\theta+1)^2}\frac{g}{l} = \frac{33\sqrt{2}}{25}\frac{g}{l}$$

上杆: $\frac{1}{3}ml^2\cdot\beta = \frac{1}{2}mgl\cos\theta + F_\perp l\cos\theta + F_\parallel l\sin\theta$

下杆: $\frac{1}{12}ml^2\cdot\beta = N\cdot\frac{l}{2}\sin\theta + F_\perp\cdot\frac{l}{2}\cos\theta - F_\parallel\cdot\frac{l}{2}\sin\theta$

$$\underline{m a_{cx}} = -F_\parallel - N$$

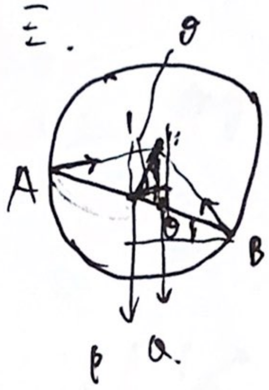
$$a_{cx} = \beta\cdot\frac{l}{2}\sin\theta + \omega^2\cdot\frac{l}{2}\cos\theta$$

$\Rightarrow F = \sqrt{F_\parallel^2 + F_\perp^2} = 0.93mg$. 右杆

下杆.

$N = 0.82mg$

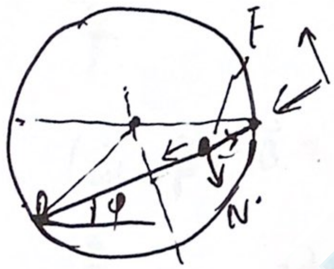
三.



$$P\cdot\frac{R}{2}\cdot\sin\theta = Q\cdot\left[\left(d-\frac{\sqrt{3}}{2}R\right)\cos\theta-\frac{1}{2}R\sin\theta\right]$$

$$\tan\theta = \frac{2d-\sqrt{3}R}{3R}.$$

(2). $d=0.$ $\tan\theta = -\frac{\sqrt{3}}{3}$ $\theta=-30^\circ$



$$N = Q\cdot\cos30^\circ$$

$$F + Q\sin30^\circ = \frac{Q}{g}a.$$

$$N\cdot\left(\frac{\sqrt{3}}{2}R-x\right) = F\cdot\frac{1}{2}R.$$

$$\ddot{x}+\frac{\sqrt{3}g}{R}x-2g=0$$

令 $\xi = x-\frac{2R}{\sqrt{3}}$ $\ddot{\xi}+\frac{\sqrt{3}g}{R}\xi=0$

初始: $x=0,\ \dot{x}=0.$

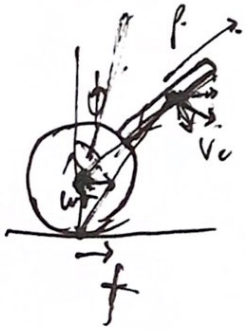
$$x=\frac{2\sqrt{3}R}{3}\left[1-\cos\sqrt{\frac{\sqrt{3}g}{R}}t\right]$$

$N\sim t.$

四.

(1). $$mg\cdot 2r(1-\cos\phi)=\frac{1}{2}\left[\frac{3}{2}mr^2+\frac{1}{3}mr^2+mr^2(5+4\cos\phi)\right]\omega^2$$

$$\omega=\sqrt{\frac{2g(1-\cos\phi)}{r\left(\frac{41}{12}+2\cos\phi\right)}}$$



$$\vec{F}_m=\int_{-\rho}^{\rho}\lambda d\rho\cdot(\vec{v}_c+\vec{\omega}\times\vec{\rho})\times\vec{B}$$

$$=2\lambda r\,\vec{v}_c\times\vec{B}+\int_{-\rho}^{\rho}\lambda d\rho\cdot\omega B\cdot\rho$$

$$(\vec{\omega}\times\vec{\rho})\times\vec{B}=\vec{\rho}(\vec{B}\cdot\vec{\omega})-\underbrace{\vec{\omega}(\vec{B}\cdot\vec{\rho})}_{90}$$

$$\hat{F}_{m\perp}=2\lambda rB(\omega r+2\omega r\cdot\cos\phi)$$

$$F_{m\parallel}=2\lambda rB\cdot 2\omega r\sin\phi$$

$$\begin{cases} f+F_{m\parallel}=2m\cdot a_{cx} \\ N+F_{m\perp}-2mg=2m\cdot a_{cy}\end{cases}$$

$$\beta=\frac{g\sin\phi}{r}\frac{65/12}{\left(\frac{41}{12}+2\cos\phi\right)^2}$$

$$a_{cx}=\frac{1}{2m}\left[m\cdot\beta r+m\left(\beta r+2r\beta\cos\phi-\omega^2\cdot 2r\sin\phi\right)\right]$$

$$=\beta r(1+\cos\phi)-\omega^2 r\sin\phi$$

$$a_{cy}=\frac{1}{2m}\left[m\cdot(-2r\beta\sin\phi-\omega^2\cdot 2r\cdot\cos\phi)\right]$$

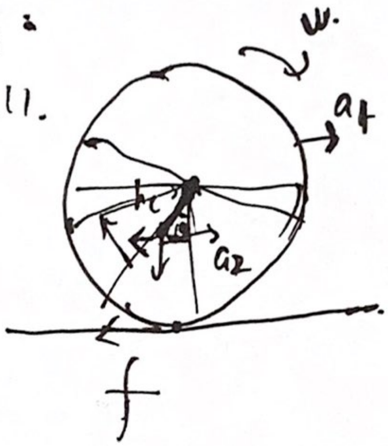
$$=-\beta r\sin\phi-\omega^2 r\cos\phi$$

(1) $N=0$

(2) $\mu>\frac{f}{N}$

五：

(1).



$$-Mgh_c\cdot\theta = I\cdot\ddot{\theta}$$

$$I = \frac{1}{2}MR^2$$

$$h_c = \frac{4R}{3\pi}$$

$$f_1 = \frac{1}{2\pi}\sqrt{\frac{Mgh_c}{I}} = \frac{1}{2\pi}\sqrt{\frac{8g}{3\pi R}}$$

(2).

$$R\cdot f = \cancel{\tfrac{1}{2}}\cdot mR^2\cdot\left(\frac{d\omega}{dt}\right) = mR^2\cdot\frac{a_1}{R} = mRa_1$$

$$-f = \cancel{Ma_1}\ ma_1 + Ma_2 = -ma_1$$

$$\Rightarrow \cancel{Ma_1}\ 2ma_1 + Ma_2 = 0$$

$$a_2 = a_1 - h_c\cdot\ddot{\theta}$$

$$-Mgh_c\theta + M\cdot a_1 h_c = I\ddot{\theta}$$

$$a_1 = \frac{Mh_c\ddot{\theta}}{M+2m}$$

$$\left(\frac{1}{2}MR^2 - \frac{M^2h_c^2}{2m+M}\right)\ddot{\theta} + Mgh_c\theta = 0$$

$$f_2 = \frac{1}{2\pi}\sqrt{\frac{(48\pi m + 24\pi M)g}{(18\pi^2 m + (9\pi^2-32)M)R}}$$