Date. /

运动与力.

运动与力

位矢 位移

$\vec{r}=\vec{r}(t)=x\vec{i}+y\vec{j}+z\vec{k}$

$\vec{v}=\frac{d\vec{r}}{dt}=\frac{dx}{dt}\vec{i}+\frac{dy}{dt}\vec{j}+\frac{dz}{dt}\vec{k}$

$\vec{a}=\frac{d\vec{v}}{dt}=\frac{d^2\vec{r}}{dt^2}$

$\vec{a}=\vec{a_n}+\vec{a_t}=\frac{v^2}{R}\vec{n}+\frac{dv}{dt}\vec{\tau}$

$\theta=\theta(t)$.

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

$\beta=\frac{d\omega}{dt}=\frac{d^2\theta}{dt^2}$

$v=\omega R$.

$a_t=\beta R$

$a_n=\omega^2 R$

质点动力学.

牛顿三定律.

第一定律(惯性定律)

第二定律 $\vec{F}=m\vec{a}=m\frac{d\vec{v}}{dt}=m\frac{d^2\vec{r}}{dt^2}$

第三定律 作用力=反作用力

几种常见的力:

万有引力. 引力场

$F=G\frac{m_1m_2}{r^2}$ 引力常量

重力 mg

$mg=G\frac{Mm}{R^2}\Rightarrow g=G\frac{M}{R^2}=9.8\,m\,s^{-2}$

deli得力

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弹性力.

摩擦力. (滑动摩擦, 静摩擦).

$f_k = \mu_k N$.

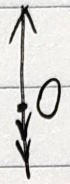
惯性系 非惯性系 恒星系 地心系 地面系.

$-mg - mkv = m\frac{dv}{dt}$

$\int_{v_0}^{v} \frac{dv}{g+kv} = \int_0^t -dt$

$v = (v_0 + \frac{g}{k})e^{-kt} - \frac{g}{k}$

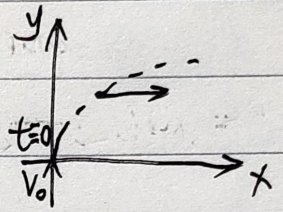
当 $t \to \infty$ $v = -\frac{g}{k}$



$mg = mkv$ $v = \frac{g}{k}$

$v = (v_0 + \frac{g}{k})e^{-kt} - \frac{g}{k} = \frac{dx}{dt}$

$\int_0^x dx = \int_0^t ((v_0 + \frac{g}{k})e^{-kt} - \frac{g}{k})dt$.



$F = f_0 t$

$F_x = f_0 t = m\frac{dv_x}{dt}$

$\int_0^{v_x} dv_x = \int_0^t \frac{f_0 t}{m} dt$

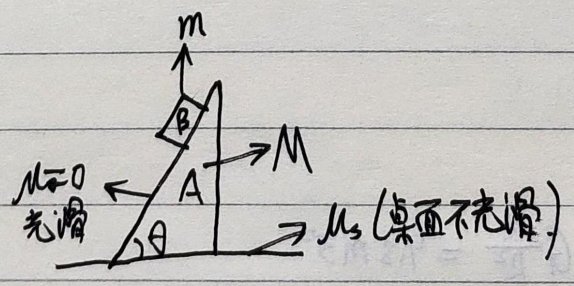
$v_x = \frac{f_0 t^2}{2m} = \frac{dx}{dt}$

$\int_0^x dx = \int_0^t \frac{f_0 t^2}{2m} dt$

$x = \frac{f_0 t^3}{6m}$, $y = v_0 t$

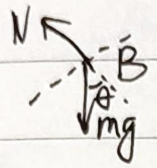
$\therefore x = \frac{f_0}{6mv_0^3} y^3$.

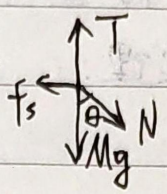
连体问题.



物体B从斜面滑下, 使A不动, 则 μ_s 至少要多大.

隔离B分析A.

对B: 

对A. 

对A: $\begin{cases} N\sin\theta - f_s = 0 & ① \\ T - Mg - N\cos\theta = 0 & ② \end{cases}$

对B: $mg\cos\theta - N = 0$ ③.

$N = mg\cos\theta$

代入①式: $T = Mg + mg\cos^2\theta$

$f_s = mg\sin\theta\cos\theta$.

$|f_s| \le \mu_s T = \mu_s(Mg + mg\cos^2\theta)$

$mg\cos\theta \le \mu_s(Mg + mg\cos^2\theta)$

$\therefore \mu_s \ge \dfrac{m\cos\theta}{M + m\cos^2\theta}$