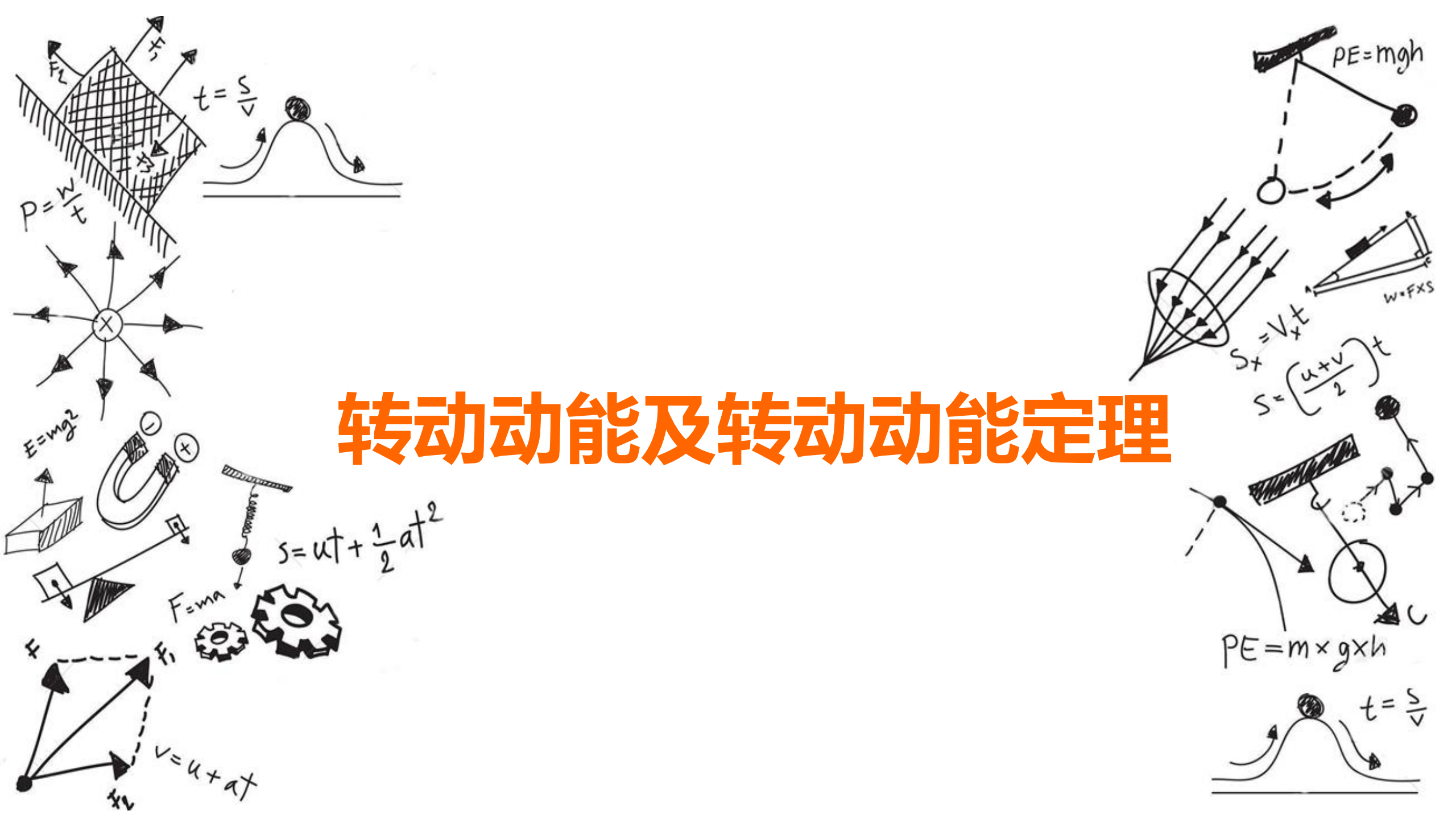



# 转动动能及转动动能定理

# 质点转动动能及刚体定轴转动动能

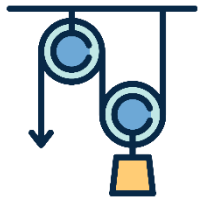
**质点转动动能：** $E_k = \sum_i \frac{1}{2}\Delta m_i v_i^2 = \frac{1}{2}(\sum_i \Delta m_i r_i^2)\omega^2 = \frac{1}{2}J\omega^2$

**刚体定轴转动动能：**

$$W = \int_{\theta_1}^{\theta_2} M\mathrm{d}\theta = \int_{\theta_1}^{\theta_2} J\frac{\mathrm{d}\omega}{\mathrm{d}t}\mathrm{d}\theta = \int_{\omega_1}^{\omega_2} J\omega\mathrm{d}\omega$$

$$W = \int_{\theta_1}^{\theta_2} M\mathrm{d}\theta = \frac{1}{2}J\omega_2^2 - \frac{1}{2}J\omega_1^2$$

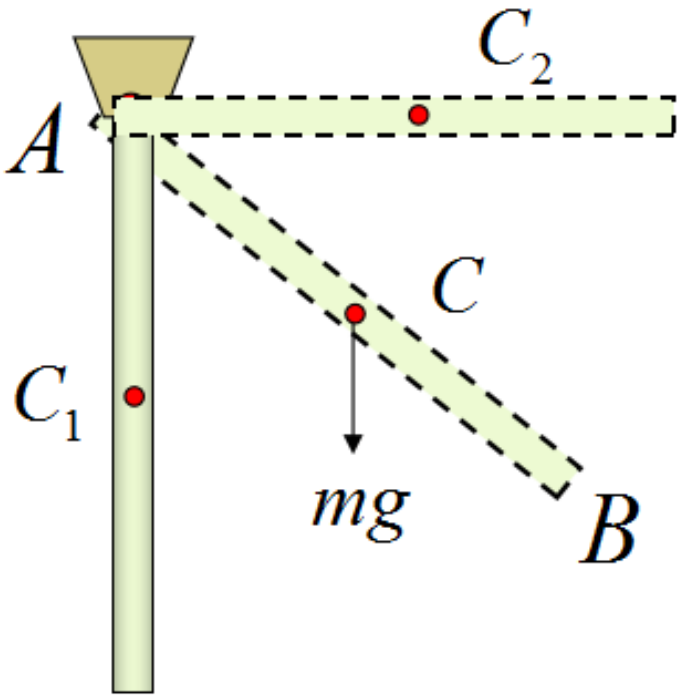
**合外力矩对绕定轴转动的刚体所作的功等于刚体转动动能的增加量。**



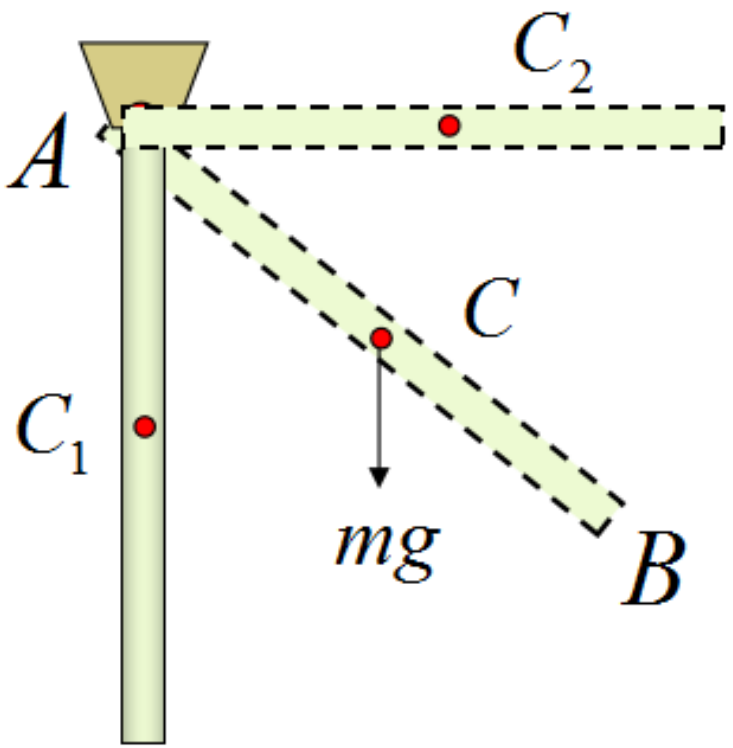
# 【例1】

**已知：一长为 $l$，质量为 $m$ 的均匀细杆，用摩擦可忽略的柱铰链悬挂于 A 处，欲使静止的杆AB自竖直位置恰好能转至水平位置，**

**求：必须给杆的最小初角速度。**



# 【例1】




**解：**设必须给杆的最小初角速度为 $\omega_0$

则杆的**初动能**为：$E_{k1}=\frac{1}{2}J\omega_0^2$

达到水平位置杆的**末动能**为：$E_{k1}=0$

初末过程中重力矩做的**功**为：$W=-mg\frac{l}{2}$

$$-mg\frac{l}{2}=0-\frac{1}{2}J\omega_0^2$$

$$J=\frac{1}{3}ml^2$$

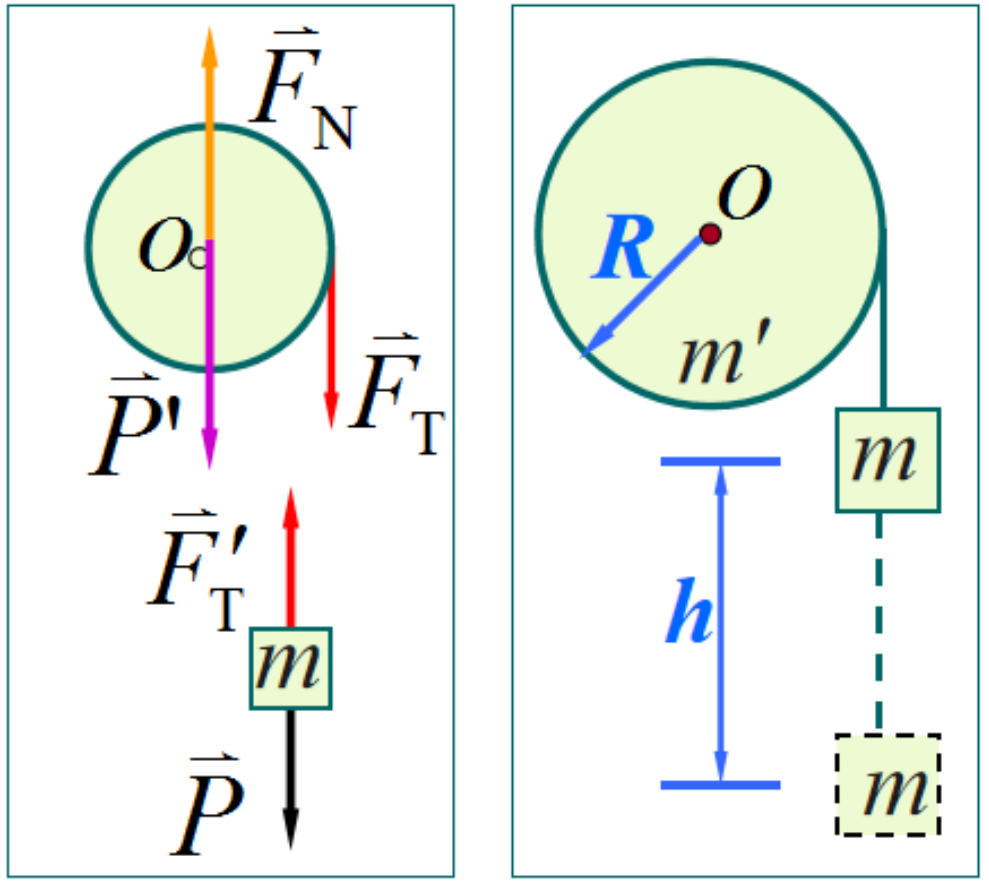
$$\Longrightarrow \omega_0=\sqrt{\frac{3g}{l}}$$

# 【例2】

**已知：**一质量为 $m'$，半径为 $R$ 的圆盘，可绕一垂直通过盘心的无摩擦的水平轴转动。圆盘上绕有轻绳，一端挂质量为 $m$ 的物体。

**问：**物体在静止下落高度 $h$ 时，其速度的大小为多少?

**设绳的质量忽略不计。**

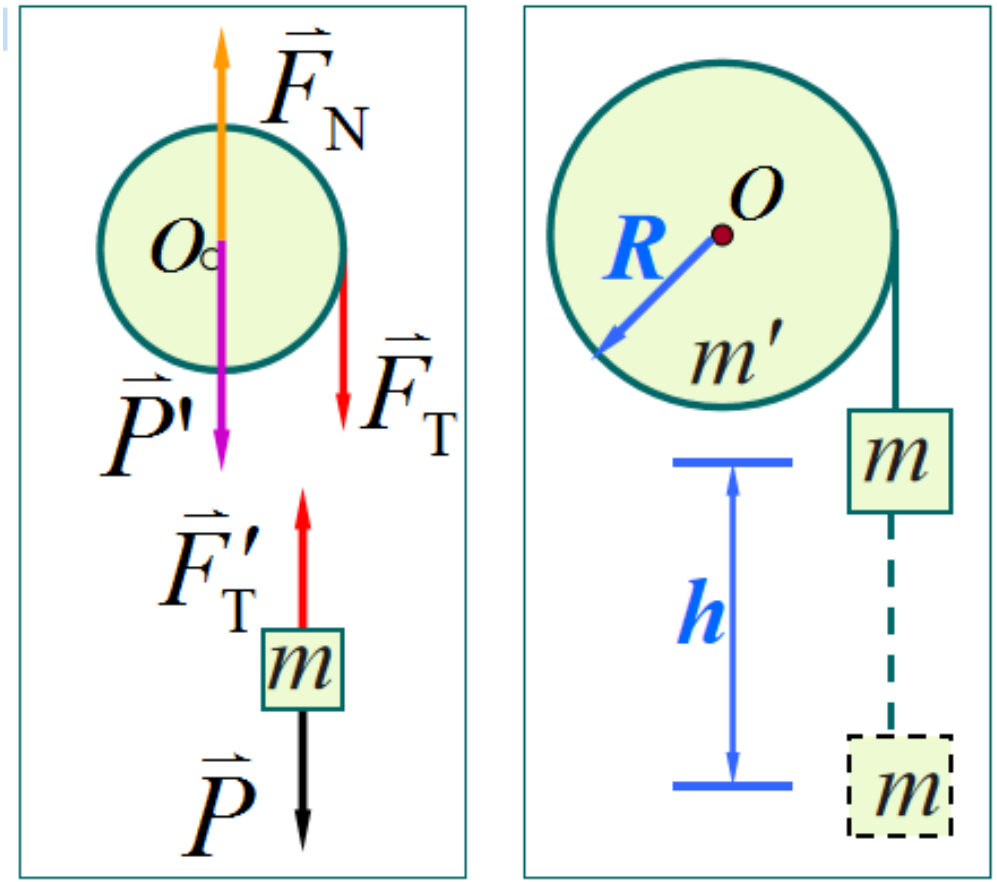


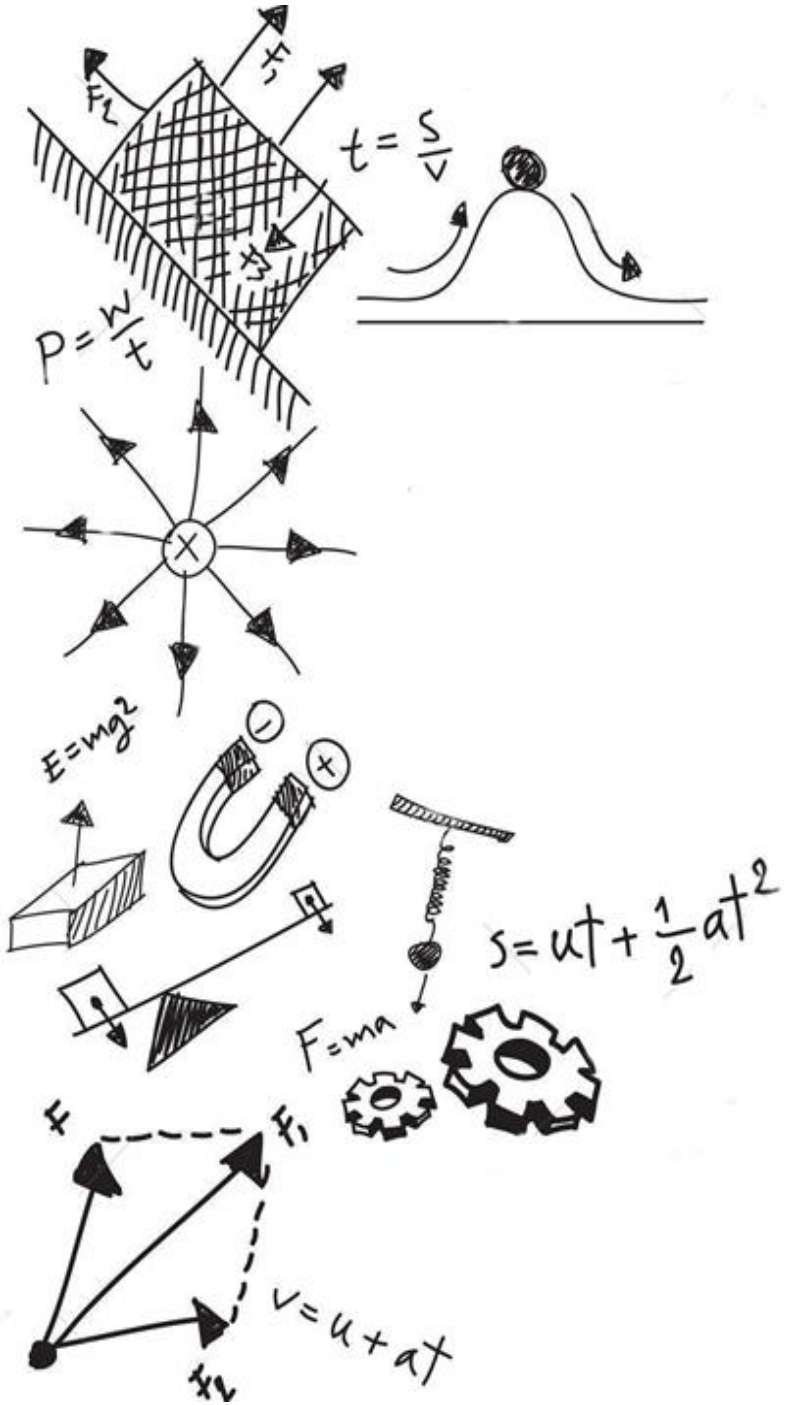
# 【例2】

**解：** $mgh=\frac{1}{2}mv^2+\frac{1}{2}J\omega^2$

$$\omega=\frac{v}{r},J=\frac{1}{2}m'R^2$$

$$v=\sqrt{\frac{2mgh}{m+\frac{m'}{2}}}$$




$t = \frac{s}{v}$
$P = \frac{w}{t}$
$E = mg^2$
$s = ut + \frac{1}{2}at^2$
$F = ma$
$v = u + at$

# Thanks!


$PE = mgh$
$W = F \times S$
$S_x = V_x t$
$S = \left(\frac{u+v}{2}\right) t$
$PE = m \times g \times h$
$t = \frac{s}{v}$