

### 3、转动刚体各点的速度和加速度

## 转动刚体各点的速度和加速度

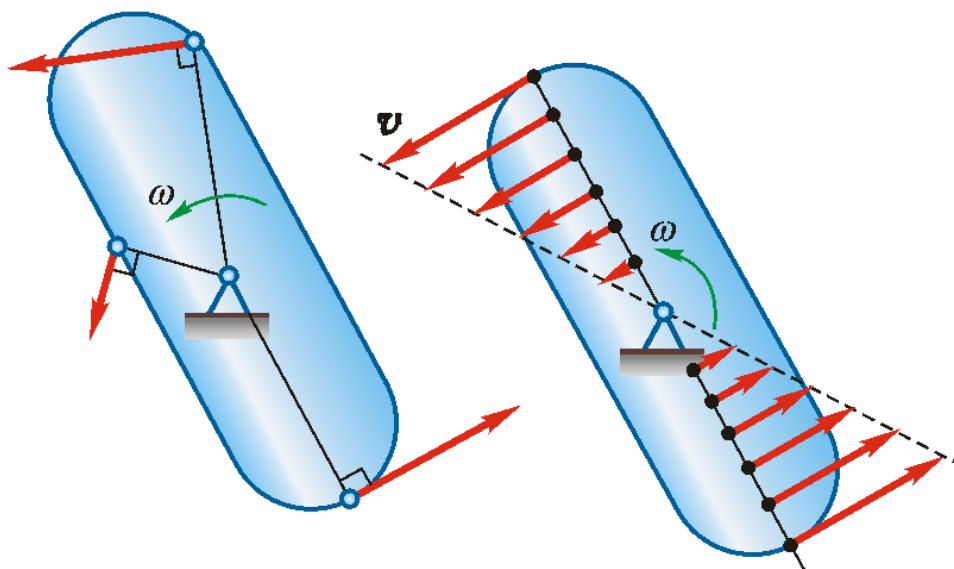
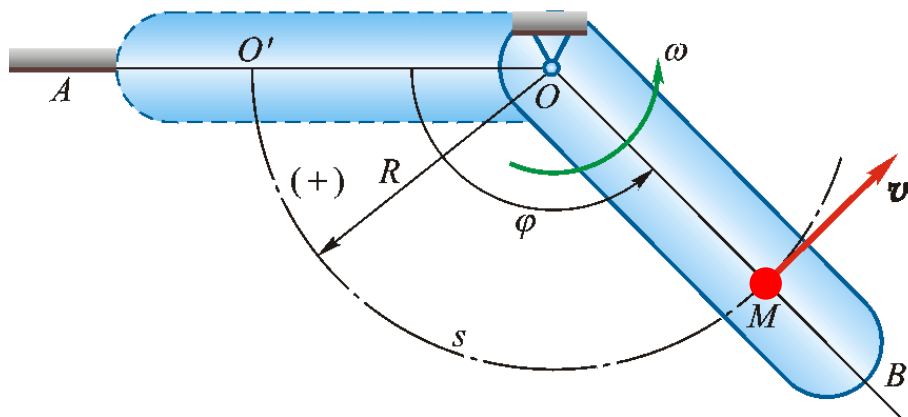
定轴转动刚体上 ? 的运动如何描述  $\rightarrow$  自然法

运动方程

$$s = R\varphi$$

速度

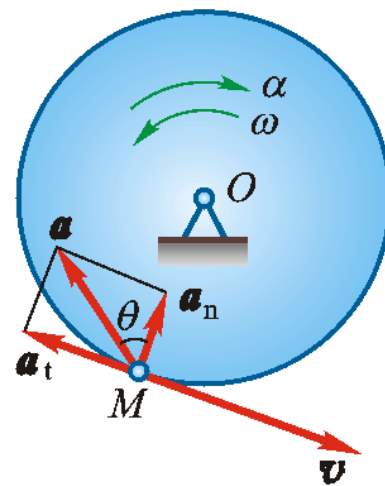
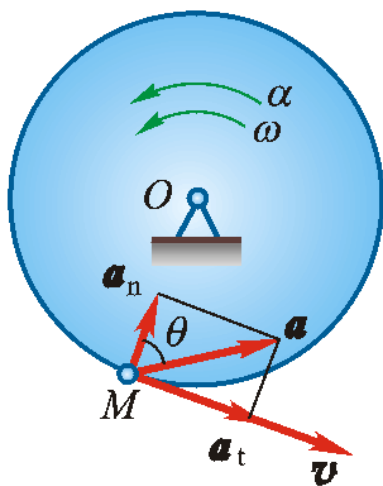
$$v = \dot{s} = R\dot{\varphi} = R\omega$$



# 加速度

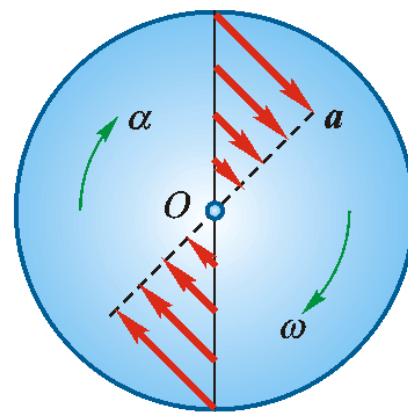
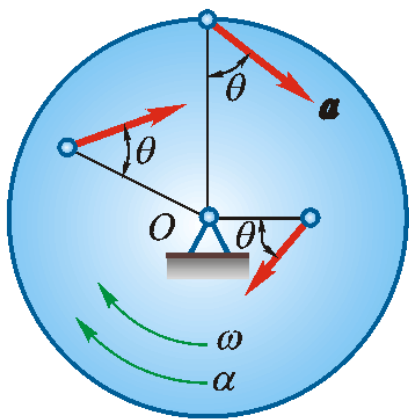
$$a_t = \frac{dv}{dt} = \ddot{s} = R\alpha$$

$$a_n = \frac{v^2}{\rho} = \frac{1}{R}(R\omega)^2 = R\omega^2$$



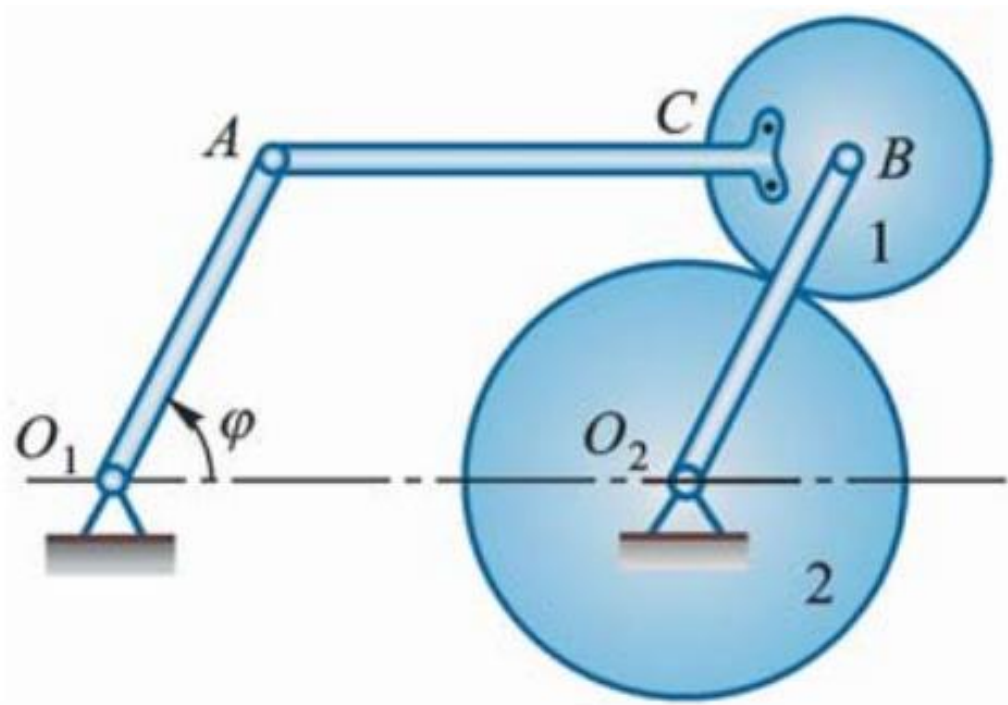
$$a = \sqrt{a_t^2 + a_n^2} = R\sqrt{\alpha^2 + \omega^4}$$

$$\tan \theta = \frac{a_t}{a_n} = \frac{\alpha}{\omega^2}$$



## 例1

如图所示机构中，齿轮1, 2的半径为  $r_1$  和  $r_2$ ， $AB = O_1O_2$ ， $O_1A = O_2B = l$ ， $\varphi = b \sin \omega t$ 。求  $t = \frac{\pi}{2\omega}$  s 时，轮2的角速度和角加速度。



解:  $AB$ 做什么运动?

平移

$$v_A = l\dot{\varphi} = lb\omega \cos \omega t$$

$$\omega_2 = \frac{v_A}{r_2} = \frac{lb\omega \cos \omega t}{r_2} \Big|_{t=\frac{\pi}{2\omega}} = 0$$

$$a_A^t = l\ddot{\varphi} = -lb\omega^2 \sin \omega t = -lb\omega^2$$

$$\alpha_2 = \frac{a_A^t}{r_2} = -\frac{lb\omega^2}{r_2}$$

