4-6

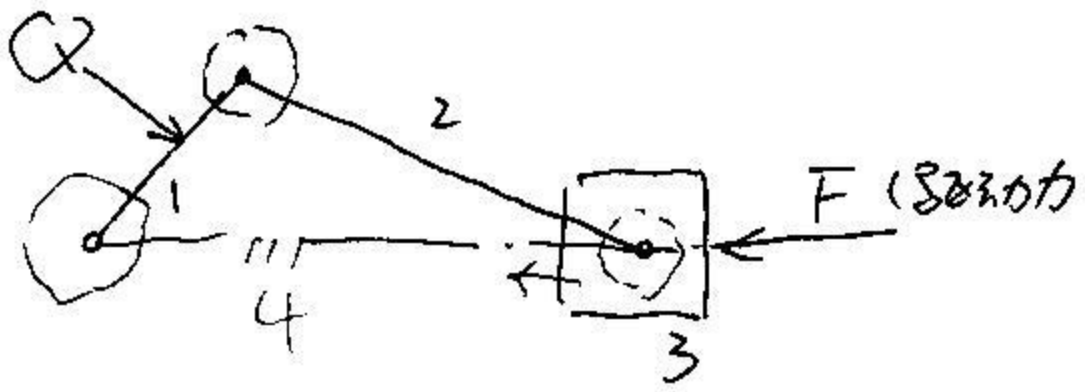
BC为二力杆受压，曲杆AB逆时针转动

2、受压、

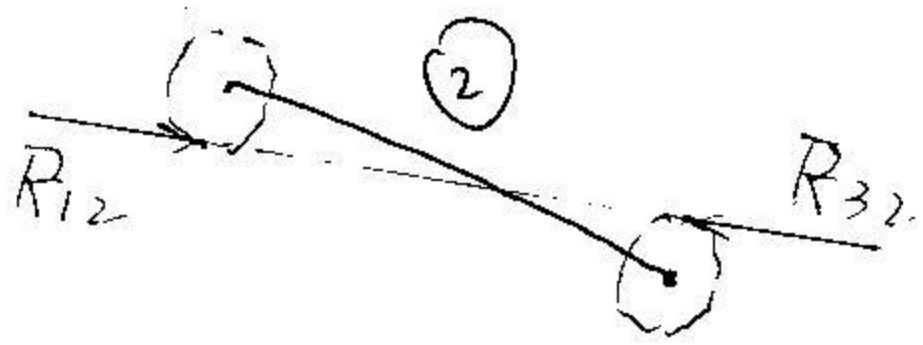
2 相对1 顺时针转动

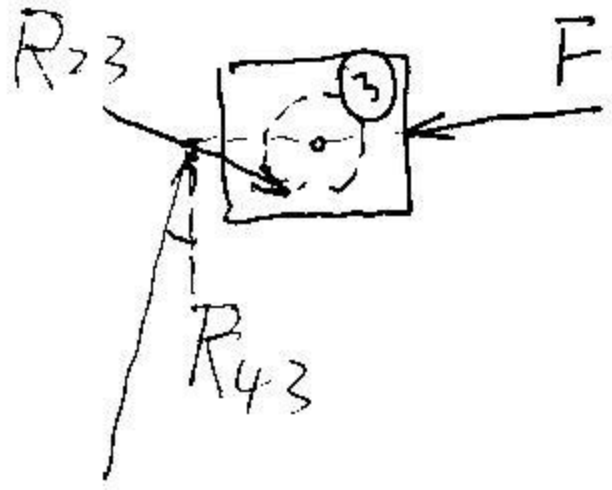
2 相对3 顺时针转动

因此，杆件2的受力如图

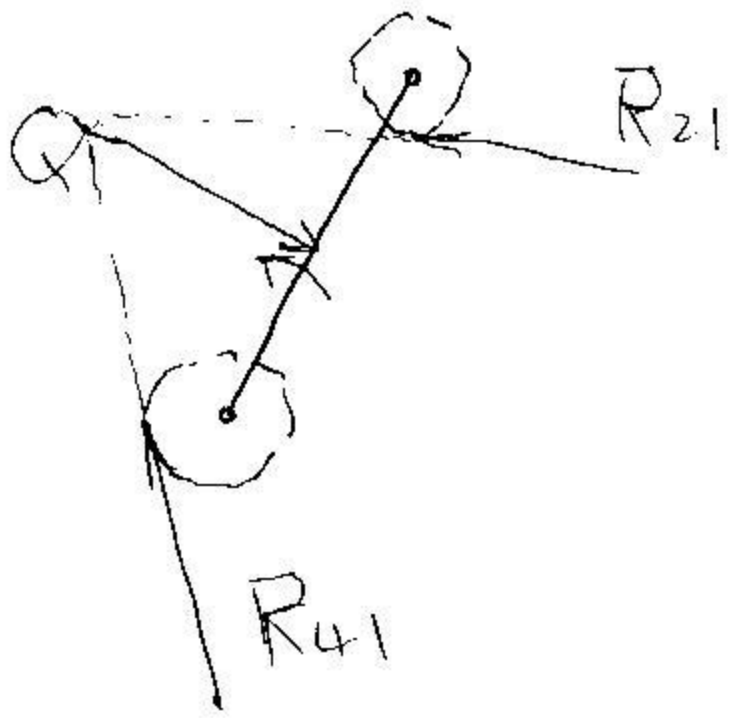


2、





1、



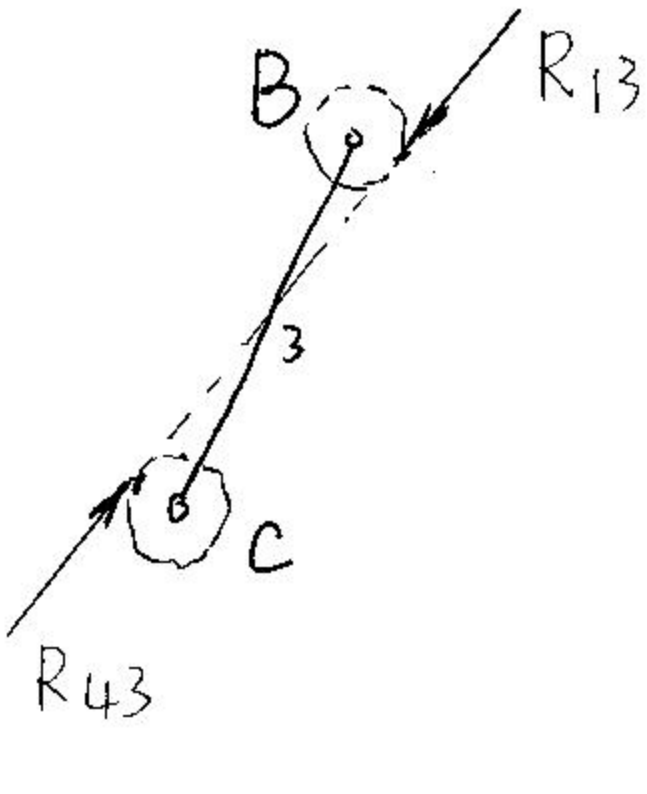
4-8

BC为二力杆，受压力 逆时针方向转动（相对铰链）

③

BC相对于AB① 逆时针

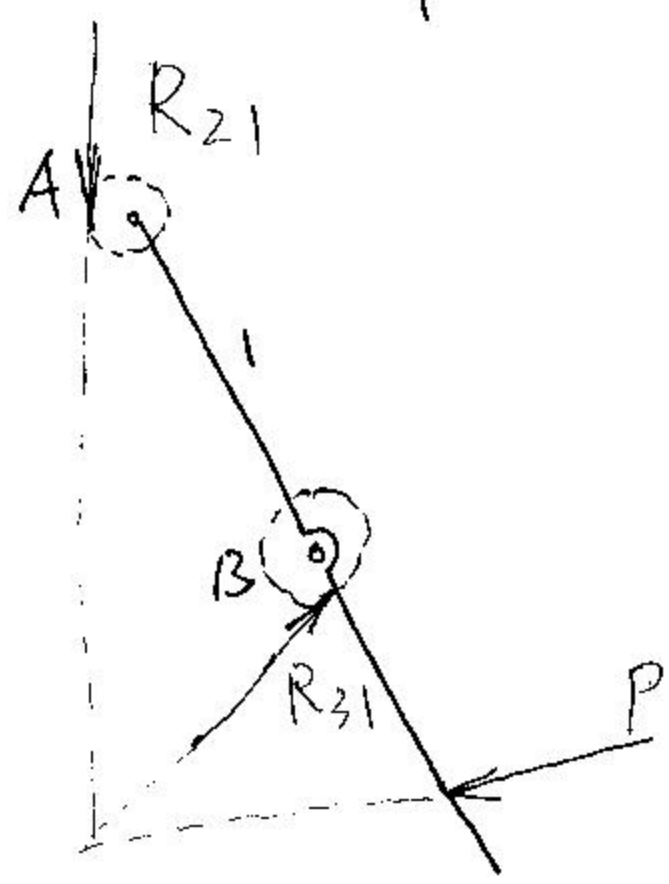
BC③受力为

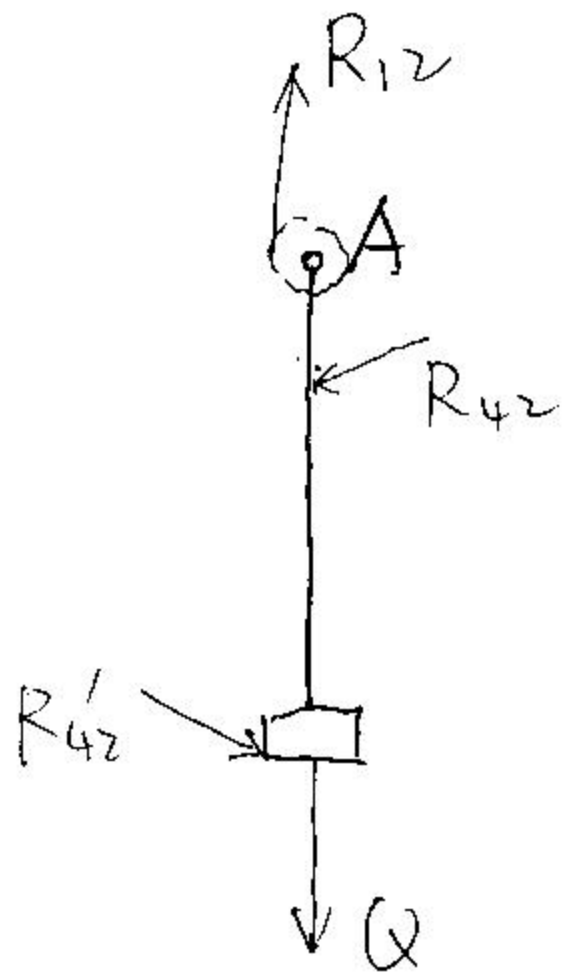


~~AB①相对于~~

AB①相对于②顺时针转动

A点受力向右下



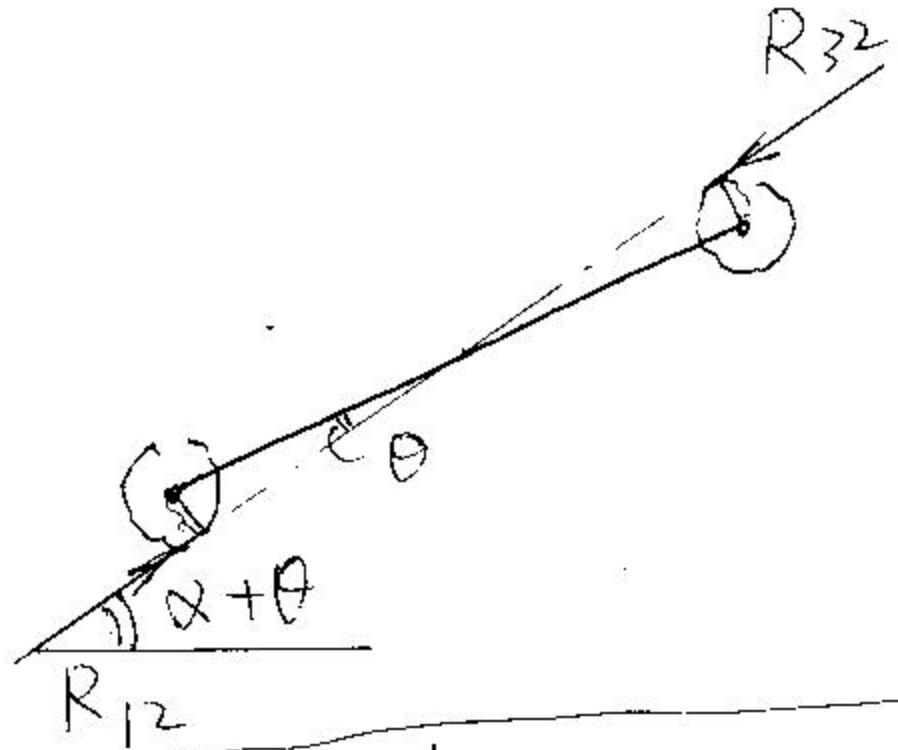


4-11 (1)

AB为二力杆，受压，

AB相对于②顺时针转动

AB相对于③顺时针转动

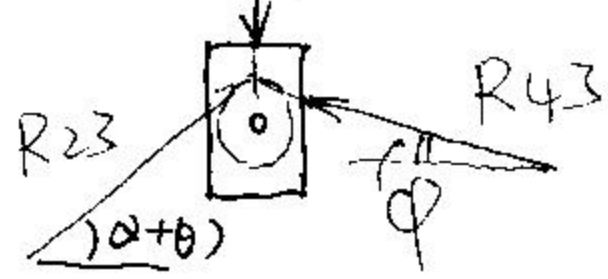


$$\delta\theta = \frac{\rho}{l/2} = \frac{2\rho}{l} = \frac{2rf}{l}$$

$$\theta = \arcsin\frac{2rf}{l}$$

$$\varphi = \operatorname{arctg} f$$

③



$$\begin{cases} R_{43}\sin\varphi + R_{23}\sin(\alpha+\theta) = F \\ R_{43}\cos\varphi = R_{23}\cos(\alpha+\theta) \end{cases}$$

消去R_{43}：

$$R_{23}\left[\frac{\cos(\alpha+\theta)}{\cos\varphi}\times\sin\varphi + \sin(\alpha+\theta)\right] = F$$

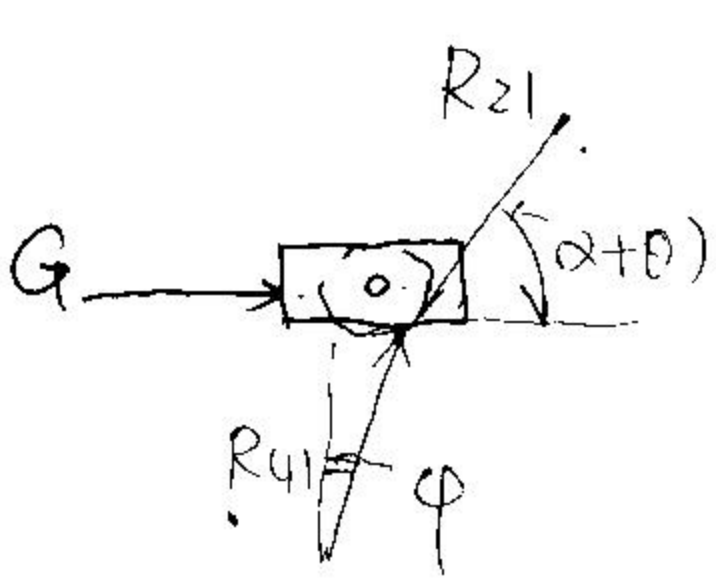
$$R_{23}\left[f\cos(\alpha+\theta) + \sin(\alpha+\theta)\right] = F$$

$$R_{23} = \frac{F}{f\cos(\alpha+\theta) + \sin(\alpha+\theta)}$$

$$\begin{cases} R_{21}\cos(\alpha+\theta) - R_{41}\sin\varphi = G \\ R_{21}\sin(\alpha+\theta) = R_{41}\cos\varphi \end{cases}$$

同样解得

$$R_{21} = \frac{G}{\cos(\alpha+\theta) - f\sin(\alpha+\theta)}$$



4-11 (2)

(1) $R_{23} = R_{21}$

$$\therefore \quad G = F \times \frac{\cos(\alpha+\theta) - f\sin(\alpha+\theta)}{f\cos(\alpha+\theta) + \sin(\alpha+\theta)}$$

无摩擦时. $G_0 = F\,ctg\alpha$

效率

$$\eta = \frac{G}{G_0} = \frac{\cos(\alpha+\theta) - f\sin(\alpha+\theta)}{f\cos(\alpha+\theta) + \sin(\alpha+\theta)} \times tg\alpha$$

自锁条件 $\eta = 0$

(1) 由 $tg\alpha = 0$ 得 $\alpha = 0$ → 驱动为 0

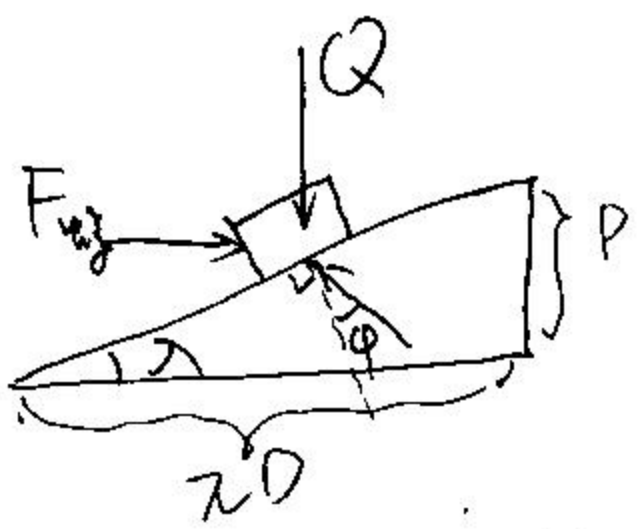
(2) $\cos(\alpha+\theta) - f\sin(\alpha+\theta) = 0$

$$ctg(\alpha+\theta) = f$$

$$\alpha = arc\,ctg\,f - \theta$$

4-14：

螺纹中径 $D=22\,mm$ $P=4\,mm$



$$\lambda = \operatorname{arctg}\frac{P}{\pi D} = 3.3°$$

$$\varphi = \operatorname{arctg} f = \operatorname{arctg} 0.1 = 5.7°$$

$$F_{螺} = Q\,tg(\lambda+\varphi) = 0.158Q\ (N)$$

螺纹面阻矩 $M_{螺} = F_{螺} \times \frac{D}{2} = 1.738Q\ (N\cdot mm)$

摩擦面（环面）

环形摩擦面中径 $D_{环} = 46\,mm$

摩擦力 $F_{摩} = Q \times f = 0.1Q$

摩擦力矩 $M_{摩} = F_{摩} \times \frac{D_{环}}{2} = 0.1Q \times 23 = 2.3Q\ (N\cdot mm)$

∵ 驱动力矩 = 阻力矩

$$P \times l = M_{螺} + M_{摩}$$

$$P \times 300 = 1.738Q + 2.3Q$$

$$\boxed{Q = 75P}$$

当无摩擦时 $F_{螺} = 0.058Q$，$M_{螺} = 0.638Q$

$$M_{摩} = 0$$

$$P \times 300 = 0.638Q_0 \qquad Q_0 = 470P$$

$$\eta = Q/Q_0 = \frac{75}{470} = 16\%$$

有摩擦 $P = 100\,N$，$\boxed{Q = 75P = 7500\,N}$