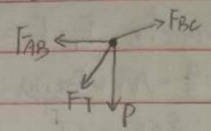
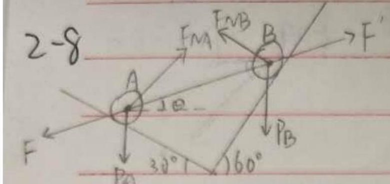
2-4 对于B: $\sum F_x=0$ 则 $F_{BC}\cos30^\circ = F_{AB}+F_T\cos60^\circ$



$\sum F_y=0$ 则 $F_{BC}\sin30^\circ = F_T\cos30^\circ+P$ $\quad P=F_T$

解得 $F_{BC}=74.64kN$ $\quad F_{AB}=54.64kN$

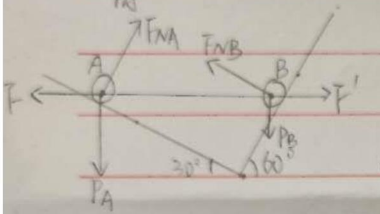
2-8



对于A沿斜面方向: $mg\sin30^\circ = F\cos(30^\circ+\theta)$

对于B沿斜面方向: $mg\sin60^\circ = F'\cos(60^\circ-\theta)$ $\quad F=F$

解得 $\theta=30^\circ$



对于A $\sum F_x=0$ 则 $F_{NA}\cos60^\circ=F$

$\sum F_y=0$ 则 $P_A=F_{NA}\cos30^\circ$ $\quad$ 得 $F=100\sqrt{3}N$

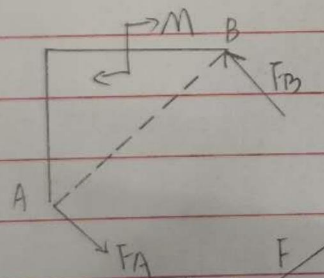
对于B: $F=F'$ $\quad \sum F_x=0$ 则 $F'=F_{NB}\cos30^\circ$

$\sum F_y=0$ 则 $F_{NB}\sin30^\circ=P_B$

解得 $P_B=100N$

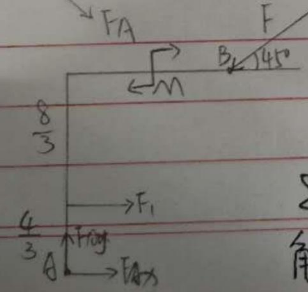
2-11 BC为二力杆 $F_C=-F_B$

$\sum M=0$ $\quad F_A\cdot 2a\cdot\sqrt{2}=M$ $\quad$ 得 $F_A=\frac{\sqrt{2}M}{4a}$



$F_C=F_B=F_A=\frac{\sqrt{2}M}{4a}$

2-19



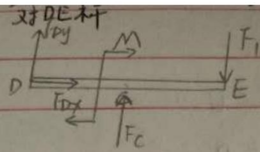
$\sum F_x=0$ 则 $F_{Ax}+F_1-F\cos45^\circ=0$

$\sum F_y=0$ 则 $F_{Ay}=F\sin45^\circ$ $\quad F_1=\frac{q\cdot l}{2}=\cancel{18}\,6kN$

$\sum M_A(F)=0$ 则 $M+F_1\cdot\frac{4}{3}m-F\cdot\frac{\sqrt{2}}{2}m+M_A=0$

解得: $F_{Ax}=0$ $\quad F_{Ay}=6N$ $\quad M_A=12kN\cdot m$

2-39. 对DE杆



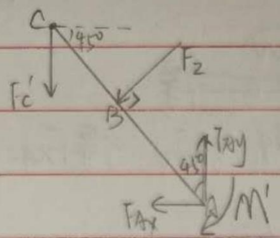
$\Sigma F_x=0$：得 $F_{Dx}=0$

$\Sigma F_y=0$：$F_{Dy}+F_C-F_1=0$

$M_D(F)=0$：$-M+F_C\cdot CD-F_1\cdot DE=0$

解得 $F_{Dx}=0$ $F_C=1800N$ $F_{Dy}=-1400N$

对ABC杆：



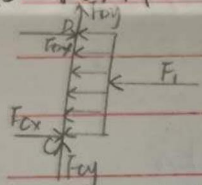
$\Sigma F_x=0$ 得 $F_2\cos45°+F_{Ax}=0$

$\Sigma F_y=0$ 得 $F_C'+F_2\sin45°-F_{Ay}=0$

$M_A(F)=0$ 得 $F_C'\cdot AC\cdot\frac{\sqrt{2}}{2}+F_2\cdot AB+M'=0$

解得 $F_{Ax}=-283N$ $F_{Ay}=2083N$ $M'=-1178N$

2-45. 对CD杆：

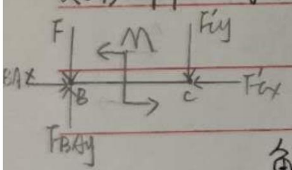


$M_D(F)=0$：$F_{Cx}\cdot CD-F_1\cdot\frac{CD}{2}=0$

$\Sigma F_x=0$：$F_{Dx}+F_{Cx}=0$

解得 $F_{Cx}=\frac{aq}{2}$ $F_{Dx}=\frac{-aq}{2}$

对BC杆(含销钉B)



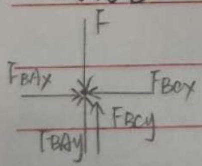
$\Sigma F_x=0$：$F_{BAx}-F_{Cx}'=0$

$\Sigma F_y=0$：$F+F_{Cy}'-F_{BAy}=0$

$M_B(F)=0$：$M-F_{Cy}'\cdot BC=0$

解得：$F_{BAx}=\frac{aq}{2}$ $F_{Cy}'=aq$ $F_{BAy}=F+aq$

对销钉B

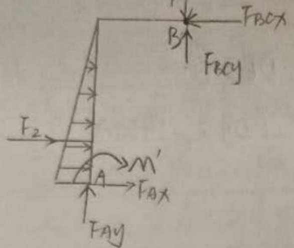


$\Sigma F_x=0$：$F_{BAx}-F_{BCx}=0$

$\Sigma F_y=0$：$F-F_{BAy}-F_{BCy}=0$

解得 $F_{BCx}=\frac{aq}{2}$ $F_{BCy}=-aq$

对弯杆AB(含销钉B)



$\Sigma F_x=0$: $F_2+F_{Ax}-F_{BCx}=0$

$\Sigma F_y=0$: $F-F_{BCy}-F_{Ay}=0$

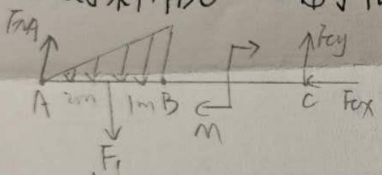
$M_A(F)=0$: $-M'-F_2\cdot a-F\cdot a+F_{BCy}\cdot a+F_{BCx}\cdot 3a=0$

解得 $F_{Ax}=-aq$ $F_{Ay}=F+aq$ $M'=aF+a^2q$

2-51: 对整体: $M_D(F)=0$: ~~$-F_{NA}\cdot 6+F_1\cdot 4=M=0$ 得~~

$-F_{NA}\cdot 6+F_1\cdot 4+F\cdot 1-M=0$ $F_1=\frac{3}{2}q_0=3kN$ 得 $F_{NA}=\frac{2}{3}kN$

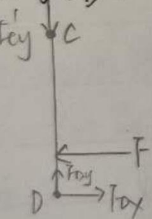
对杆ABC 由于在B点取矩，不再分析B点受力



$M_B(F)=0$: $-F_{NA}\cdot 3+F_1\cdot 1-M+F_{Cy}\cdot 3=0$

解得 $F_{Cy}=3kN$ $F_{Cx}=0$

对杆CD:



$\Sigma F_y=0$: $F'_{Cy}-F_{Dy}=0$ 解得 $F_{Dy}=3kN$

$M_C(F)=0$: $-F\cdot 3+F_{Dx}\cdot 4=0$ 解得 $F_{Dx}=1.5kN$

3-4 A: $\Sigma F_x=0$: $F_1\sin45^\circ = F_2\sin45^\circ$

$\Sigma F_y=0$: $F_3 = F\cos45^\circ$

$\Sigma F_z=0$: $F_1\cos45^\circ + F_2\cos45^\circ = F\cos45^\circ$

解得 $F_1=F_2=5kN$ $F_3=7.07kN$

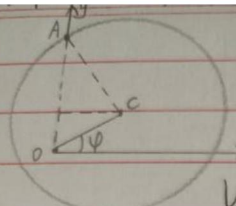
B: $\Sigma F_y=0$: $F_3' = F_6\cos45^\circ$

$\Sigma F_x=0$: $F_4\sin45^\circ = F_5\sin45^\circ$

$\Sigma F_z=0$: $F_4\cos45^\circ + F_5\cos45^\circ = F_6\sin45^\circ$

解得 $F_6=10kN$ $F_4=F_5=5kN$

5-6:



$x_A=0$

$y_A=OA=e\sin\varphi+\sqrt{R^2-(e\cos\varphi)^2}=e\sin wt+\sqrt{R^2-(e\cos wt)^2}$

$V_{Ax}=0$

$V_{Ay}=ew\cos wt+\dfrac{e^2w\sin2wt}{2\sqrt{R^2-(e\sin wt)^2}}$

6-4: $\tan\varphi=\frac{vt}{l}$ 得杆OC的运动方程 $\varphi=\arctan\frac{vt}{l}$

$w=\dot\varphi=\dfrac{\frac{v}{l}}{1+\frac{v^2t^2}{l^2}}=\dfrac{vl}{l^2+v^2t^2}$

$\alpha=\ddot\varphi=\dfrac{-2v^3lt}{(l^2+v^2t^2)^2}$

当$\varphi=\frac{\pi}{4}$时 $vt=l$ 代入得 $w=\frac{v}{2l}$ $\alpha=\frac{-2v^2l\cdot l}{4l^4}=\frac{-v^2}{2l^2}$

A+

7-6：以刀尖为动点，工件为动系，相对运动的角速度为 $\omega=\frac{2\pi n}{60}=\pi\,rad/s$

动点相对运动方程为 $x'=\frac{d}{2}\cos(-\omega t)$ $y'=\frac{d}{2}\sin(-\omega t)$ $z'=z_0'-vt$

显然是螺旋线参数方程 螺距为 $h=\frac{2\pi}{\omega}\cdot v=\frac{2\pi}{\pi}\cdot 10=20mm$

7-7：a. 动点：套筒A 动系：杆 O_2A

绝对运动：圆周运动 相对运动：直线运动 牵连运动：定轴转动

$\vec{V_a}=\vec{V_r}+\vec{V_e}$ $V_a\perp O_1A$ $V_r \parallel O_2A$ $V_e\perp O_2A$

$V_a=\omega_1\cdot O_1A=0.6\,m/s$ $V_e=V_a\cos30^\circ=0.3\sqrt{3}\,m/s$

$\omega_2=\frac{V_e}{O_2A}=\frac{0.3\sqrt{3}}{0.2\cdot\sqrt{3}}=1.5\,rad/s$

b. 动点：套筒A 动系：杆 O_1A

绝对运动：圆周运动 相对运动：直线运动 牵连运动：定轴转动

$\vec{V_a}=\vec{V_r}+\vec{V_e}$ $V_a\perp O_2A$ $V_r\parallel O_1A$ $V_e\perp O_1A$

$V_e=\omega_1\cdot O_1A=0.6\,m/s$ $V_a=\frac{V_e}{\cos30^\circ}=0.4\sqrt{3}\,m/s$

$\omega_2=\frac{V_a}{O_2A}=\frac{0.4\sqrt{3}}{0.2\sqrt{3}}=2\,rad/s$

7-9：动点：套筒A 动系：摇杆OC

绝对运动：~~圆周~~直线运动 相对运动：直线运动 牵连运动：定轴转动

$\vec{V_a}=\vec{V_r}+\vec{V_e}$ $V_a\parallel AB$ $V_r\parallel OC$ $V_e\perp OC$

$V_a=V$ $V_e=V_a\cdot\cos45^\circ=\frac{\sqrt{2}}{2}V$ $V_C=\frac{a}{\sqrt{2}l}V_e=\frac{aV}{2l}$

7-10：动点：C 动系：顶杆AB

绝对运动：圆周运动 相对运动：直线运动 牵连运动：直线运动

$\vec{V_a}=\vec{V_r}+\vec{V_e}$ $V_a\perp OC$ $V_r\parallel OC$ $V_e\parallel OA$

$V_e=V_a\cos\varphi=\omega e\cos0^\circ=\omega e$