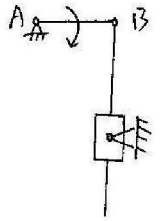
第二章

2-8

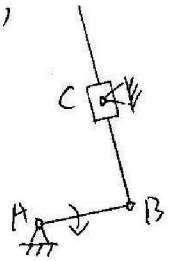
(a)



$n=3$
$P_L=4$
$P_H=0$

$F=3n-2P_L-P_H=3\times3-2\times4=1$

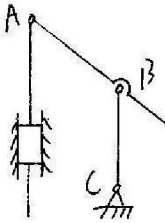
(b)



$n=3$
$P_L=4$
$P_H=0$

$F=3n-2P_L-P_H=3\times3-2\times4=1$

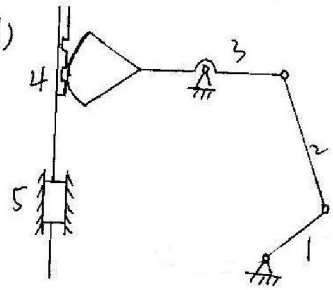
(c)



$n=3$
$P_L=4$
$P_H=0$

$F=3n-2P_L-P_H=3\times3-2\times4=1$

(d)



$n=4$
$P_L=5$
$P_H=1$

$F=3n-2P_L-P_H=3\times4-2\times5-1=1$

2-10

(a)

G为复合铰链

B为局部自由部

$n=7,\ P_H=2,\ P_L=9$

$F=3\times7-2\times9-2=1$

(b)

G为复合铰链

$n=9,\ P_L=13$

$F=3\times9-2\times13=1$

(c) C、F之一为虚约束

$n=4,\ P_L=5$

$F=3\times4-2\times5=2$

(d) K、J之一为虚约束，C、E为局部自由度

$n=6,\ P_L=8,\ P_H=2$

$F=3\times6-2\times8-2=0$

(e) C为复合铰链

$n=7,\ P_L=10$

$F=3\times7-2\times10=1$

(f)

$n=4,\ P_L=5,\ P_H=1$

$F=3\times4-2\times5-1=1$

(注：A为齿轮副)

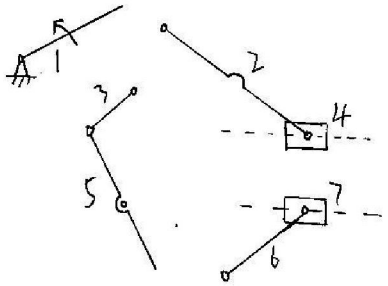
2-11

(1) $n=7$, $P_L=10$, $P_H=0$

$F=3\times7-2\times10=1$

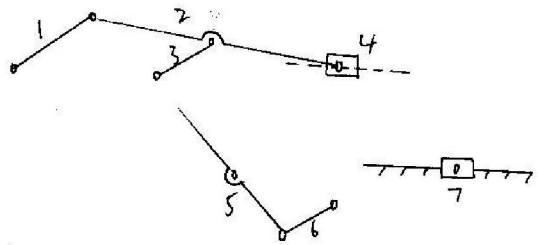
(2)

先拆构件6.7组成的Ⅱ杆组，再拆构件3.5组成的Ⅱ杆组，最后拆构件2.4组成的Ⅱ杆组。



此6机构为Ⅱ机构

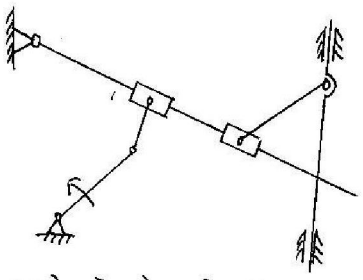
(3)



此6机构为Ⅱ机构

2-15

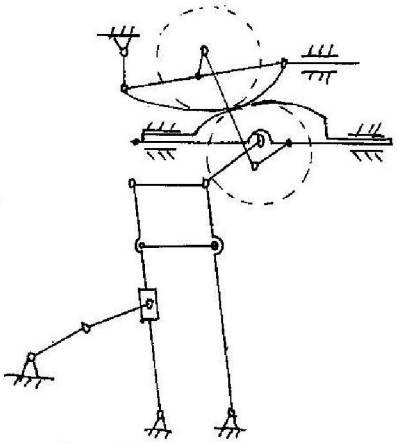
(a)



$n=3$, $P_L=3$, $P_H=2$

$F=3\times3-2\times3-2=1$

(b)



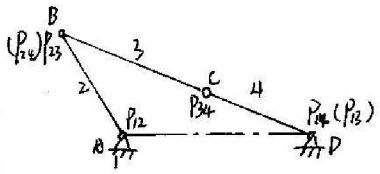
$n=9$, $P_L=12$, $P_H=2$

$F=3\times9-2\times12-2=1$

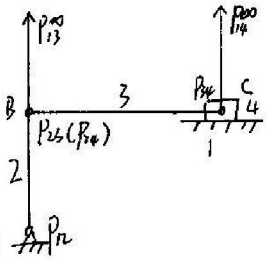
第三章

3-6

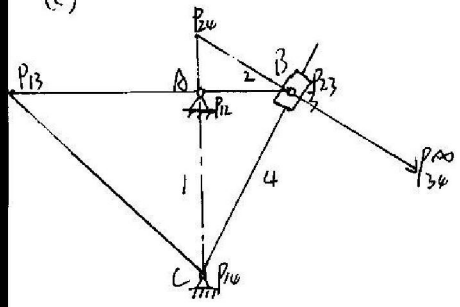
(a)



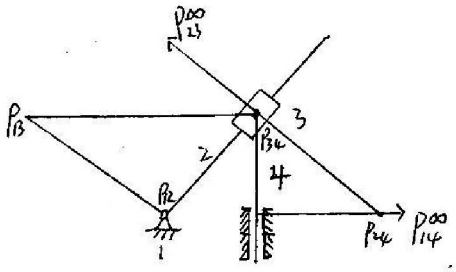
(b)



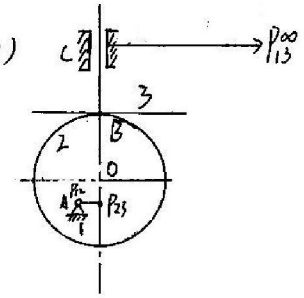
(c)



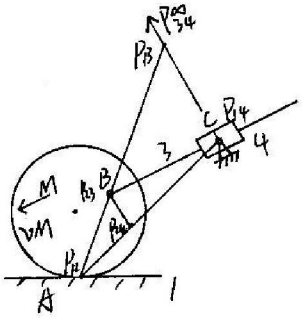
(d)



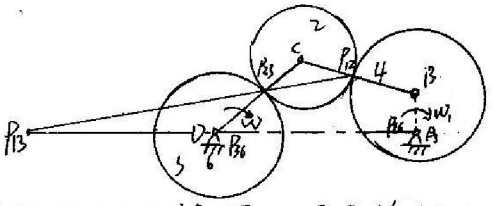
(e)



(f)



3-8

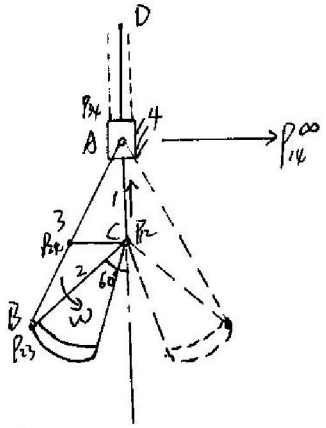


解：P_{13}为齿轮1和齿轮3的速度瞬心，即两轮在P_{13}点的瞬时速度相同

$\therefore \omega_1 \cdot \overline{AP_{13}} = \omega_3 \overline{DP_{13}}$

$\therefore \frac{\omega_1}{\omega_3} = \frac{\overline{DP_{13}}}{\overline{AP_{13}}}$

3-11



解：如上图所示求先瞬心点.

$\therefore V_C = \omega \cdot \overline{P_{24}P_{12}} = V_{CD}$

根据正弦定理：$\frac{\overline{AB}}{\sin\angle ACB} = \frac{\overline{BC}}{\sin\angle BAC}$

$\therefore \angle BAC = \arcsin\frac{\sqrt{3}}{3}$

2根据余弦定理：$\overline{AC}^2 = \overline{AB}^2 + \overline{BC}^2 - 2\overline{AB}\cdot\overline{BC}\cdot\cos\angle ABC$

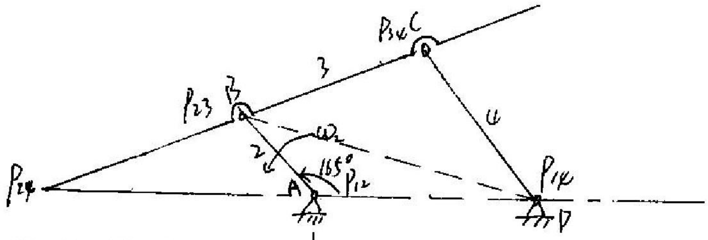
求得 $\overline{AC} = 290mm$

又：$\frac{\overline{AC}}{\cos\angle BAC} = -\frac{\overline{P_{24}P_{12}}}{\sin\angle ABC}$

求得 $\overline{P_{24}P_{12}} = 205mm$

$\therefore \omega = \frac{0.1m/s}{0.205m} = 0.49 rad/s$

3-12



解：1) 如上图所示，求出构件2和构件4的速度瞬心P_{24}，并作对角线BD

$\because v_{P_{24}} = \omega_2 \overline{P_{24}P_{12}} = \omega_4 \overline{P_{14}P_{24}}$

$\therefore \omega_4 = \dfrac{\omega_2 \overline{P_{24}P_{12}}}{\overline{P_{14}P_{24}}}$

$\overline{BD} = \sqrt{\overline{AB}^2 + \overline{AD}^2 - 2\overline{AB}\cdot\overline{AD}\cos 165^\circ}$

$= 178.6$

$\because \cos\angle BCD = \dfrac{\overline{BC}^2 + \overline{CD}^2 - \overline{BD}^2}{2\overline{BC}\cdot\overline{CD}}$

$\therefore \angle BCD = 115.8^\circ$

又 $\because \dfrac{\overline{BD}}{\sin\angle DAD} = \dfrac{\overline{AB}}{\sin\angle ADB}$

$\therefore \angle ADB = 5.0^\circ$

又 $\because \dfrac{\overline{BD}}{\sin\angle BCD} = \dfrac{\overline{BC}}{\sin\angle BDC}$

$\therefore \angle BDC = 37.2^\circ$

$\therefore \angle CP_{24}D = 180^\circ - \angle BCD - \angle CDB - \angle BDA$

$= 22.0^\circ$

$\therefore \dfrac{\overline{CD}}{\sin\angle CP_{24}D} = \dfrac{\overline{P_{24}P_{14}}}{\sin\angle BCD}$

解得：$\overline{P_{24}P_{14}} = 216.4$

又 $\because \dfrac{\overline{AB}}{\sin\angle CP_{24}D} = \dfrac{\overline{P_{24}P_{12}}}{\angle P_{24}DA}$

解得 $\overline{P_{24}P_{12}} = 96.4$

$\therefore \omega_4 = \dfrac{10 \times 96.4}{216.4}$

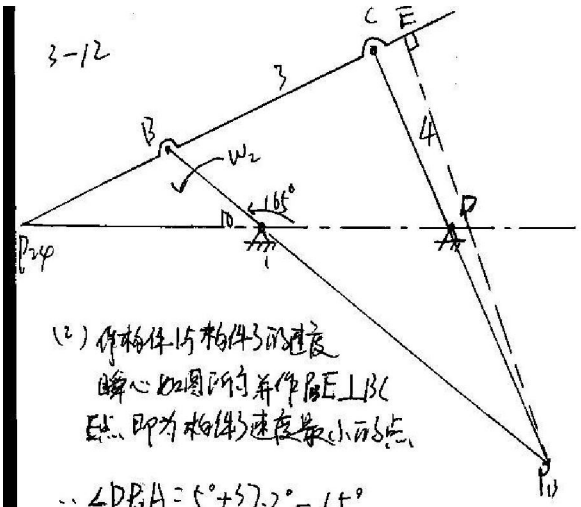
$= 4.5\ rad/s$

$\therefore V_C = \overline{CD}\cdot\omega_4$

$= 0.09 \times 4.5$

$= 0.4\ m/s$

3-12



(2) 作构件1与构件3的速度瞬心如图所示并作BE上BC
E点即为构件3速度最小的点

$\because \angle DP_{13}A = 5° + 57.2° - 15°$
$= 27.2°$

$\therefore \frac{\overline{BP_{13}}}{\sin\angle BCD} = \frac{\overline{BC}}{\sin\angle BP_{13}C}$

求得 $\overline{BP_{13}} = 236.4$

$\because \frac{\overline{BP_{13}}}{\sin\angle BEP_{13}} = \frac{\overline{EP_{13}}}{\sin\angle CBP_{13}}$

$\therefore$ 求得 $\overline{EP_{13}} = 162.3$

$\because V_C = \omega_3 \overline{CP_{13}}$

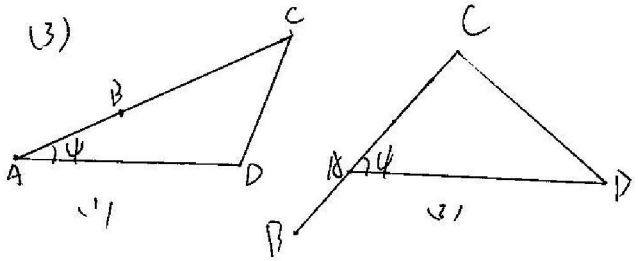
$\because \frac{\overline{CP_{13}}}{\sin\angle BP_{13}C} = \frac{\overline{BC}}{\sin\angle BP_{13}C}$

$\therefore \overline{CP_{13}} = 158.0$

$\therefore \omega_3 = 2.53 rad/s$

$\therefore V_E = \omega_3 \cdot \overline{EP_{13}}$
$= 2.53 \times 0.1623$
$= 0.56 m/s$

(3)



在上图所示两位置时 $V_C = 0$
当出现如图(1)所示情况时:

$\therefore \cos A = \frac{\overline{AD}^2 + \overline{AC}^2 - \overline{CD}^2}{2\overline{AD}\cdot\overline{AC}} = \frac{43}{48}$

$\therefore \angle A = 26.4° = \psi$

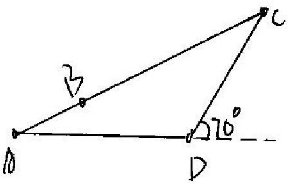
当出现如图(2)所示情况时:

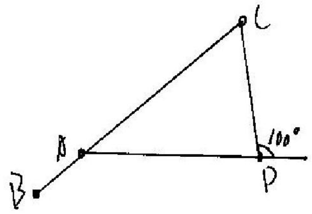
$\cos A = \frac{\overline{AD}^2 + \overline{AC}^2 - \overline{CD}^2}{2\overline{AD}\cdot\overline{AC}} = \frac{11}{16}$

$\therefore \angle A = 46.6° = \psi$

3-14

解:





∵因为摇杆的摆角在70°—100°之间变化，所以将会出现如上图的两种极端情况。
并假设 $CD=1$，$AD=1.2$

∴根据余弦定理

$$\begin{cases} (\overline{AB}+\overline{BC})^2=\overline{AD}^2+\overline{CD}^2-2\overline{AD}\cdot\overline{CD}\cdot\cos 110^\circ \\ (\overline{BC}-\overline{AB})^2=\overline{AD}^2+\overline{CD}^2-2\overline{AD}\,\overline{CD}\cdot\cos 80^\circ \end{cases}$$

即：$(\overline{BC}+\overline{AB})^2=3.2608$

$(\overline{BC}-\overline{AB})^2=2.0224$

∴ $\overline{BC}=1.614$

$\overline{AB}=0.192$