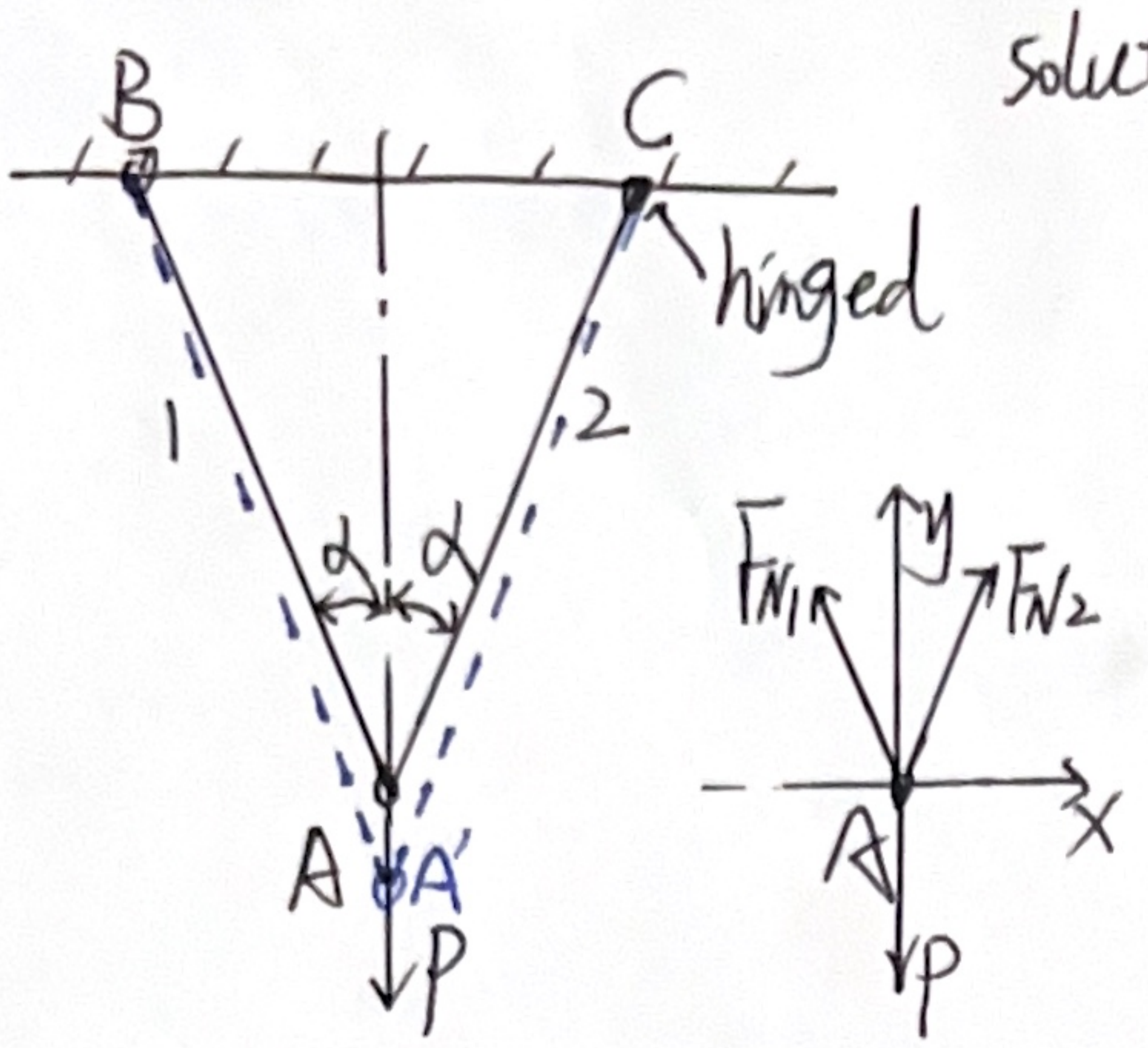
solution ①




$\alpha = 30^\circ$, $l = 200\,mm$, $d = 25\,mm$

$l$ → Rod width

$d$ → Rod diameter

Rod material: steel.

$E = 210\,GPa$  Poisson's ratio: 0.3

$P = 100\,KN$

get the displacement of node A ($\Delta A$)

Solution: $\Sigma F_x = 0 \Rightarrow F_{N2}\sin\alpha - F_{N1}\sin\alpha = 0$

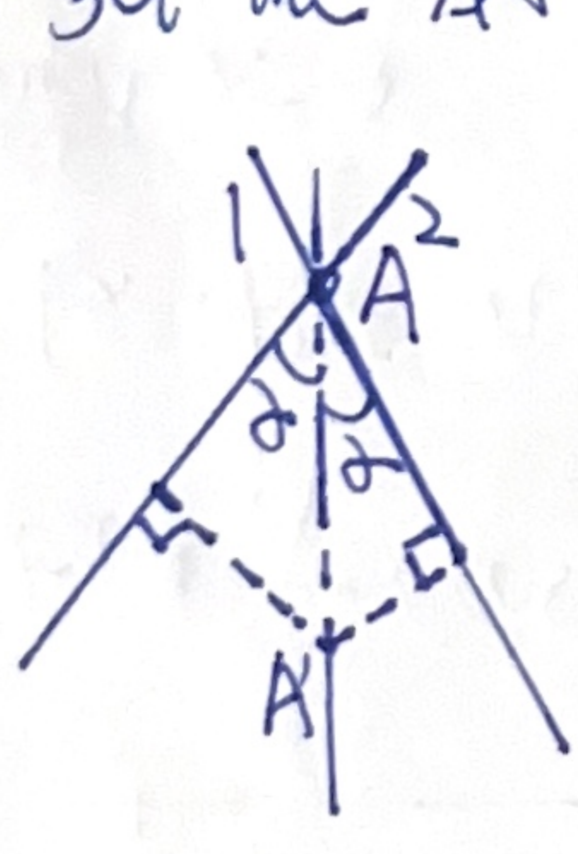
$\Sigma F_y = 0 \Rightarrow F_{N1}\cos\alpha + F_{N2}\cos\alpha - P = 0$

$$\Rightarrow F_{N1} = F_{N2} = \frac{P}{2\cos\alpha}$$

Hooke's law: $\varepsilon = \sigma / E$

$$\Rightarrow \Delta l_1 = \Delta l_2 = \frac{F_{N1} l}{EA} = \frac{Pl}{2EA\cos\alpha}$$ , $A = \pi\left(\frac{d}{2}\right)^2$ is the cross-sectional area

To get the $\Delta A$, we have to use Infinstesimal strain theory




$$\Delta A = AA' = \frac{\Delta l_1}{\cos\alpha}$$

$$= \frac{Pl}{2EA\cos^2\alpha} \approx 0.12934\,mm$$

Solution 2:

strain energy: $U = \frac{F}{2}\delta = \frac{F^2 l}{2AE}$

So, $U_{total} = 2\cdot U = 2 * (F_N^2 l)/2AE = \frac{F_N^2 l}{AE} = 6.467\,J$

$U_{total} = \frac{1}{2}\cdot P\cdot \Delta A \Rightarrow \Delta A = 0.12934\,mm$