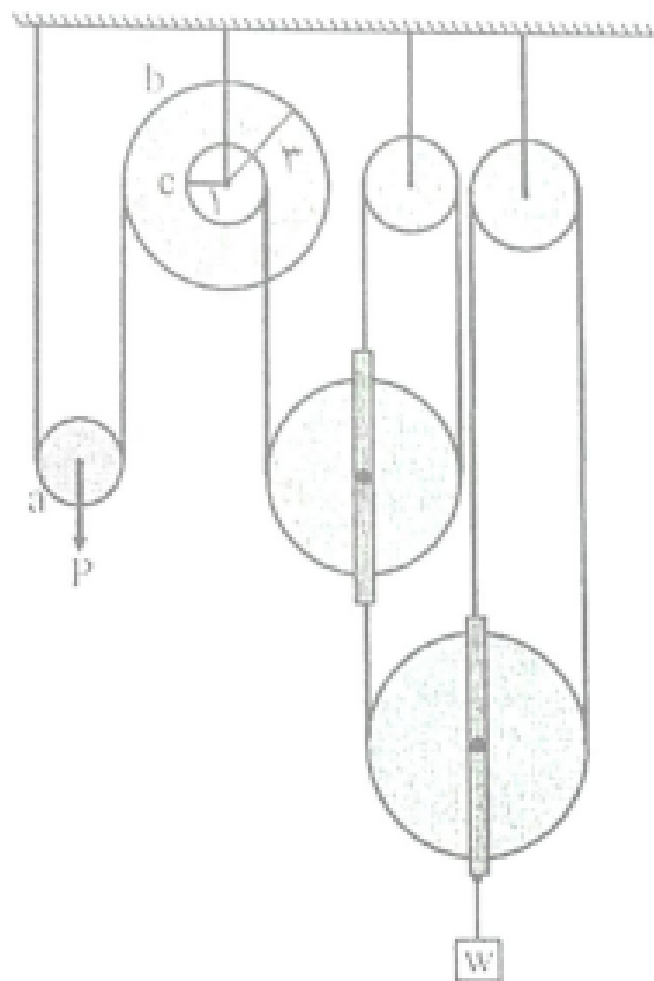
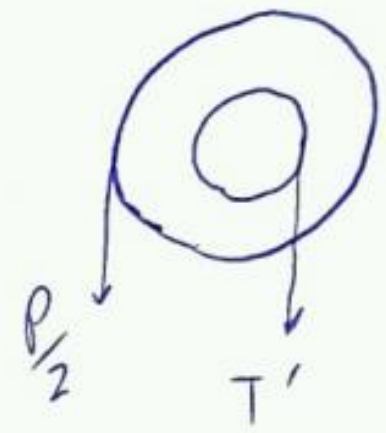
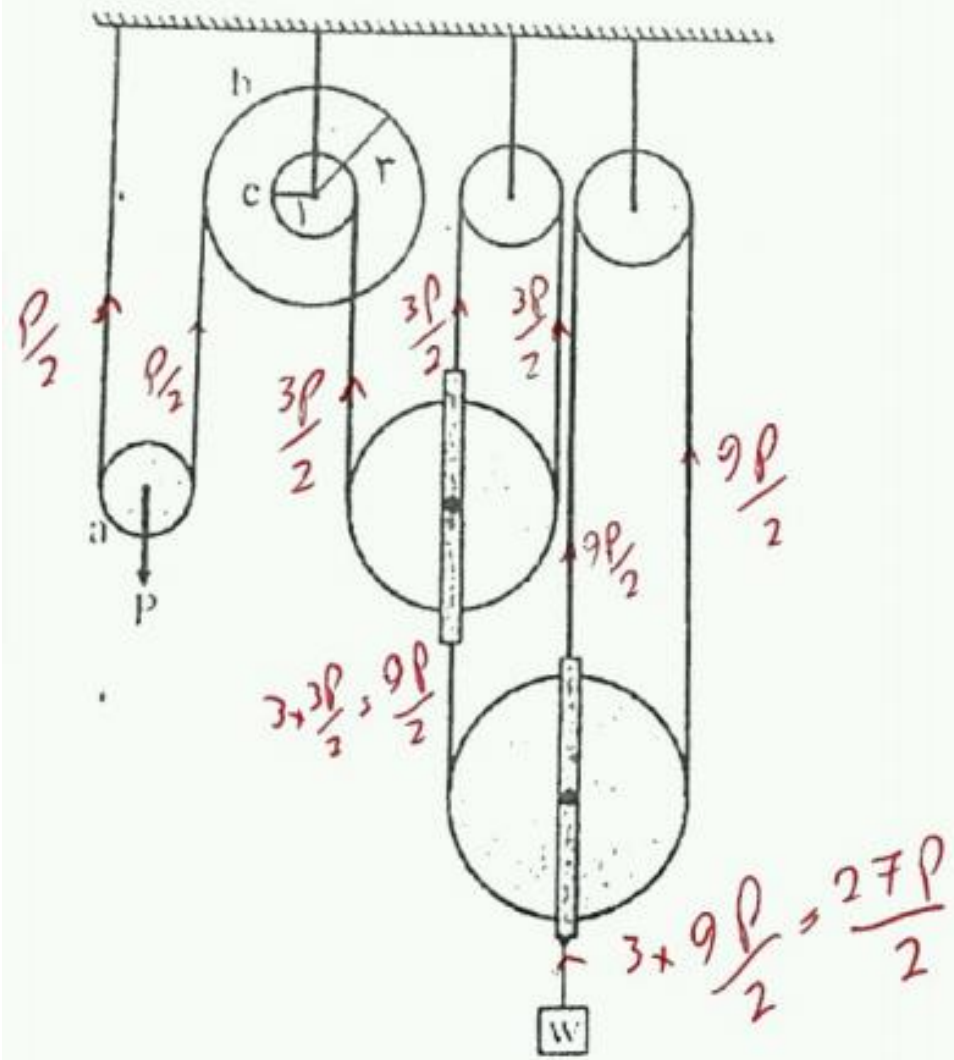


در سیستم قرقره و کابل نشان داده شده نیروی  $P$  را بر حسب  $W$  به دست آورید. شعاع خارجی قرقره‌ی  $b$  سه برابر شعاع داخلی آن است.

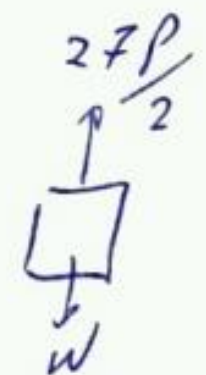




$$T' \times 1 = \frac{P}{2} \times 3$$

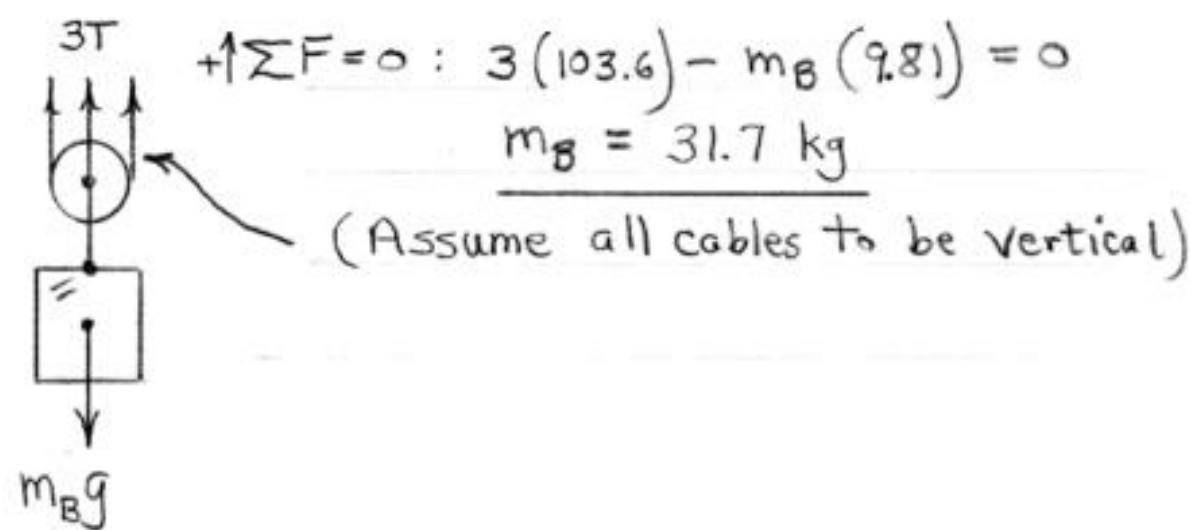
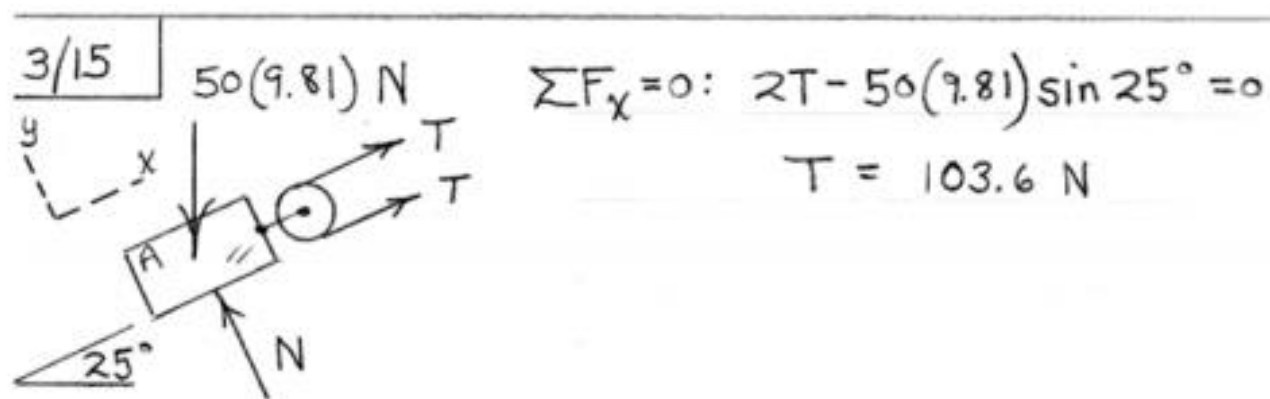
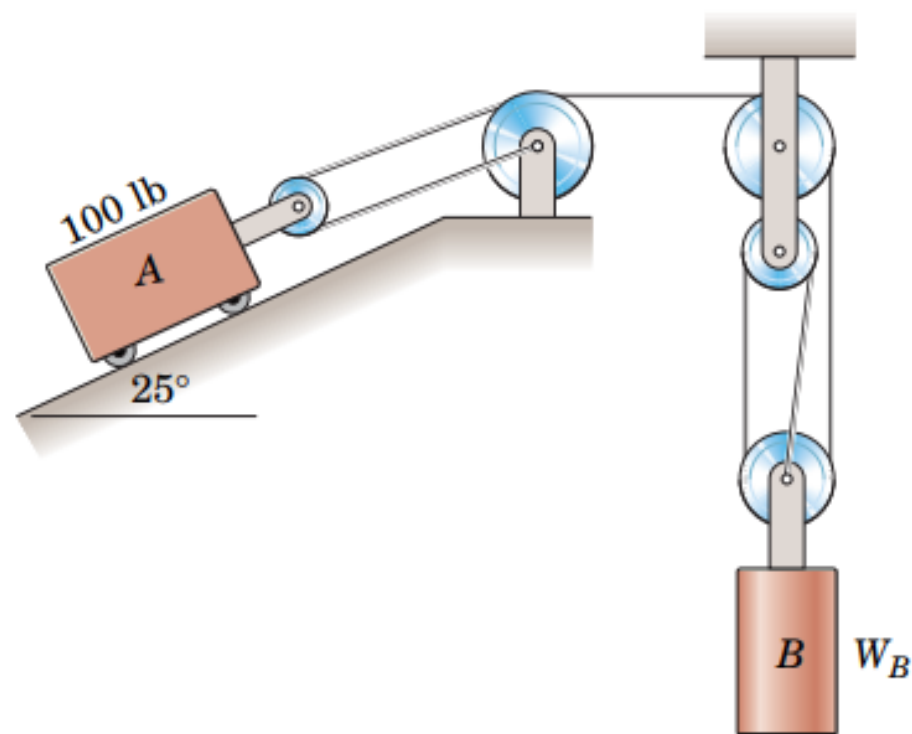
$$\Rightarrow T' = \frac{3P}{2}$$

$\Rightarrow \Rightarrow$

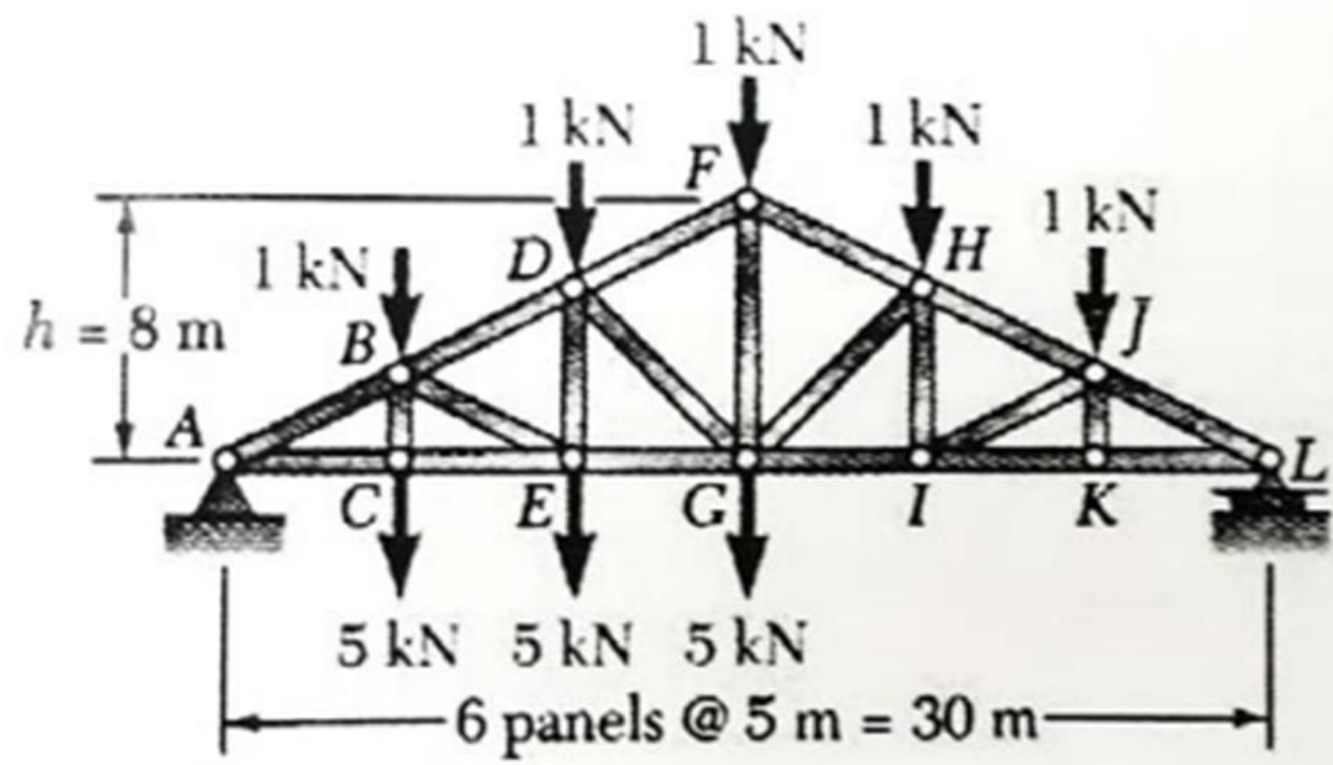


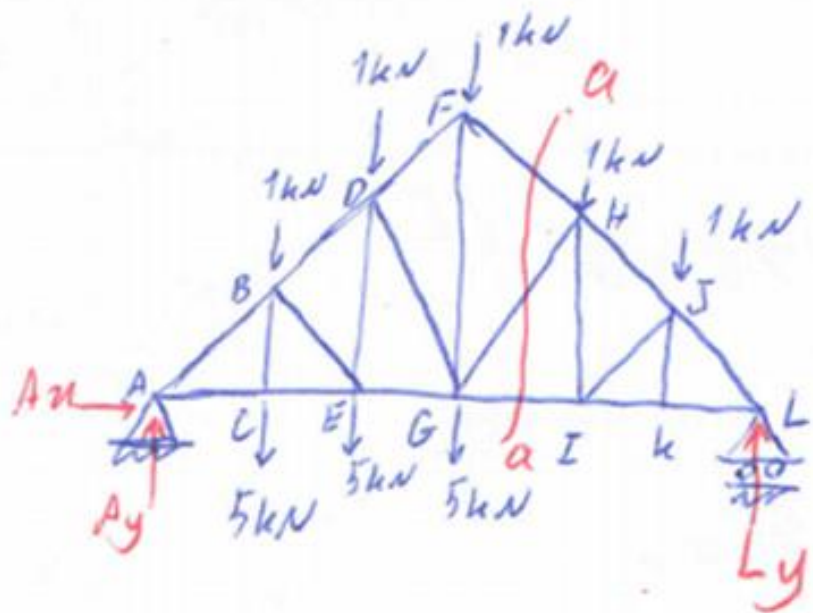
$$\Rightarrow W = \frac{27P}{2}$$

What weight  $W_B$  will cause the system to be in equilibrium? Neglect all friction, and state any other assumptions.



با استفاده از روش مقاطع، نیروهای هر یک از اعضای  
FH، GH و GI را مشخص کنید.

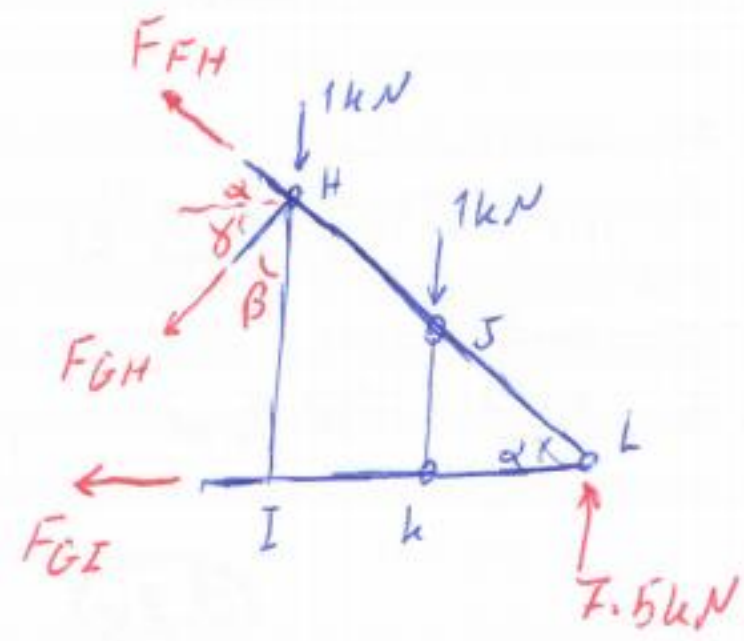
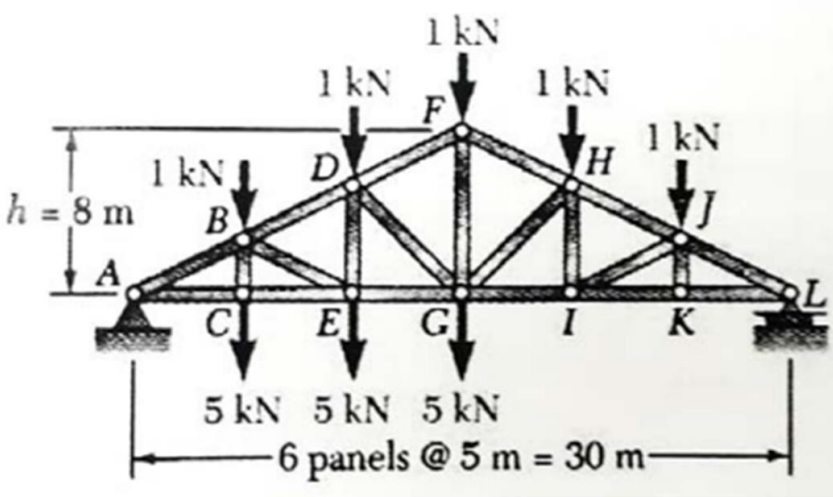




$$\textcircled{a} \sum M_A = 0$$

$$\Rightarrow L_y \times 30 - (1 \times 25) - (1 \times 20) - (1 \times 15) - (5 \times 15) \\ - (1 \times 10) - (5 \times 10) - (1 \times 5) - (5 \times 5) = 0$$

$$\Rightarrow \sqrt{L_y = 7.5 \text{ kN}}$$



$$\frac{HI}{FG} = \frac{10}{15} \quad FG = h = 8 \quad HI = 8 \times \frac{2}{3} = \frac{16}{3}$$

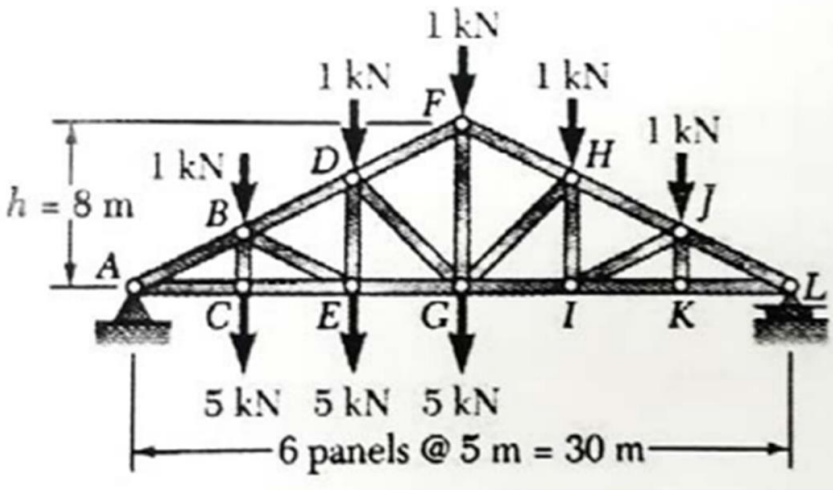
$$\sum M_H = 0 \quad -F_{GI} \left( \frac{16}{3} \right) - (1 \times 5) + (7.5 \times 10) = 0 \quad F_{GI} = 13.125$$

$$\tan \alpha = \frac{8}{15} \rightarrow \alpha = 28.072 \rightarrow \begin{cases} \cos \alpha = 0.882 \\ \sin \alpha = 0.471 \end{cases}$$

$$HI^2 + GI^2 = HG^2 \quad \left( \frac{16}{3} \right)^2 + 5^2 = HG^2 \quad HG = 7.311$$

$$\sin \beta = \frac{HG}{GI} = \frac{7.311}{15} \quad \sin \beta = \frac{5}{7.311} \quad \beta = 43.149^\circ$$

$$\gamma + \beta = 90 \quad \gamma = 46.851 \rightarrow \begin{cases} \cos \gamma = 0.684 \\ \sin \gamma = 0.729 \end{cases}$$



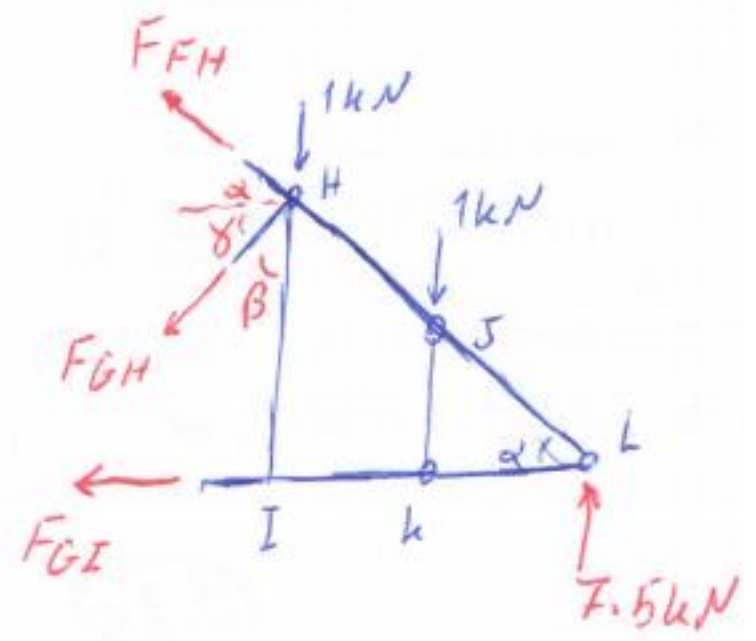
$$\sum F_x = 0 \quad F_{FH} \cos \alpha + F_{GH} \cos \gamma + F_{GI} = 0$$

$$0.882 F_{FH} + 0.684 F_{GH} + 13.125 = 0 \quad (1)$$

$$\sum F_y = 0 \quad F_{FH} \sin \alpha - F_{GH} \sin \gamma + 7.5 - 1 - 1 = 0$$

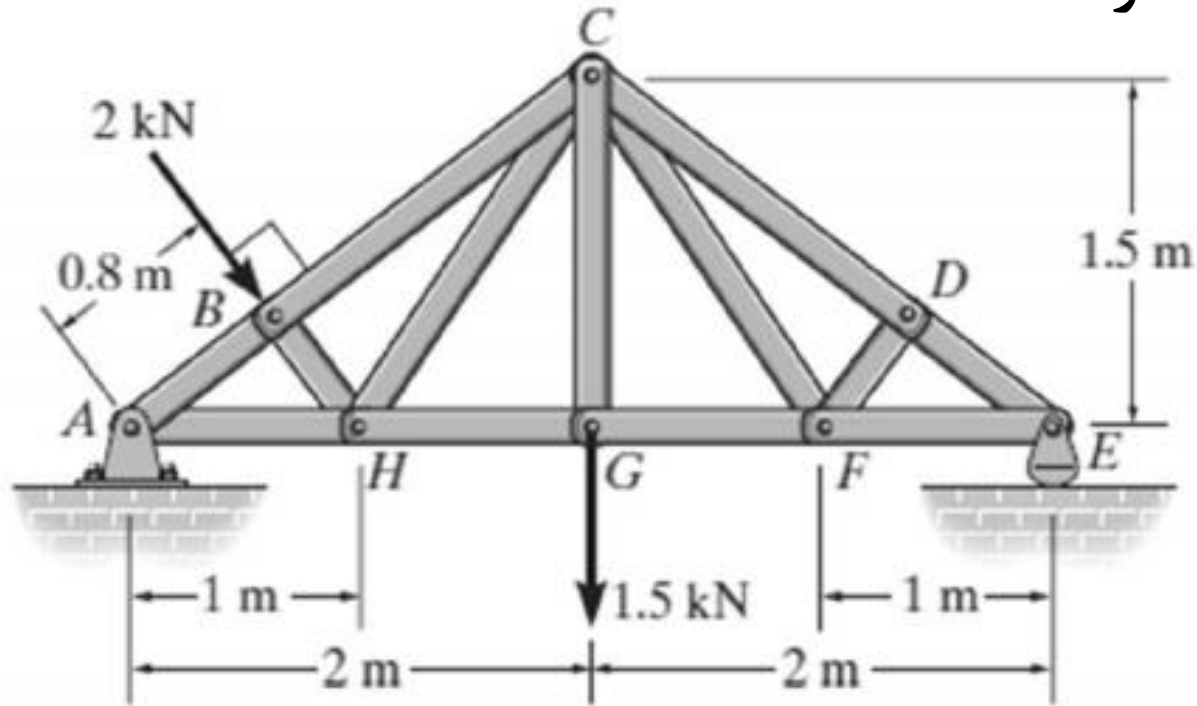
$$0.471 F_{FH} - 0.729 F_{GH} + 5.5 = 0 \quad (2)$$

$$(1), (2) \rightarrow F_{FH} = -13.811 \quad F_{GH} = -1.379 \quad \text{or } \text{tension}$$





در سازه خرپا روبرو معین و نامعین بودن استاتیکی سازه  
و هم چنین اعضا با نیروی صفر را بدست آورید؟



تعداد محصلات کلیه اعضا  $R = 3$

تعداد اعضاء  $m = 13$

تعداد درون وصل  $j = 8$

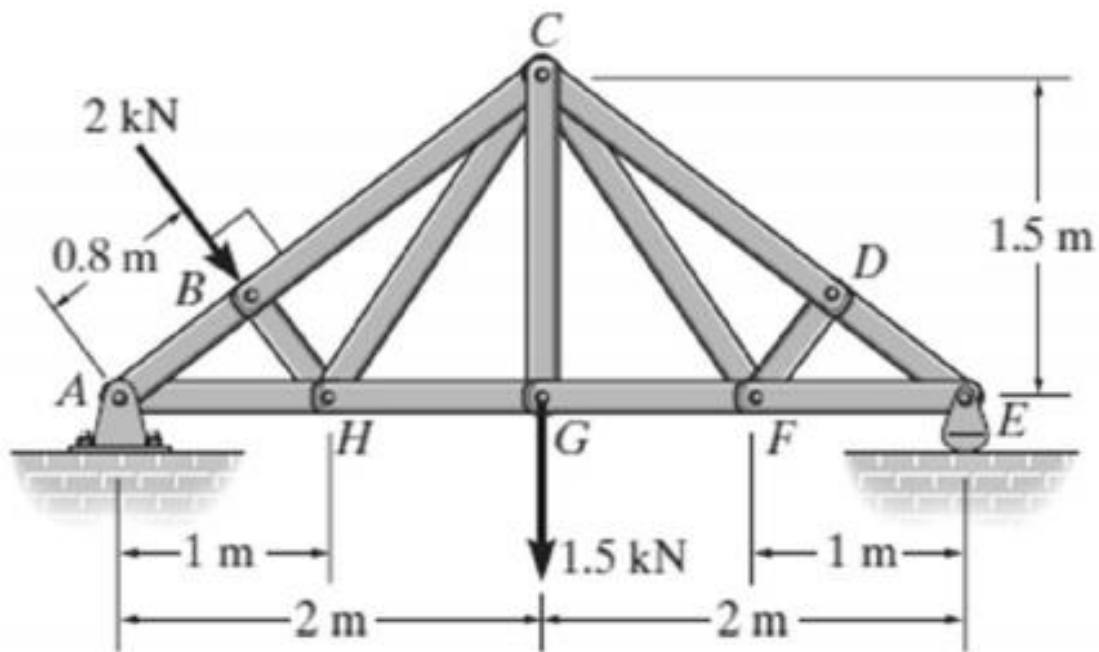
$$m + R = 2j$$

$$3 + 13 = 2(8)$$

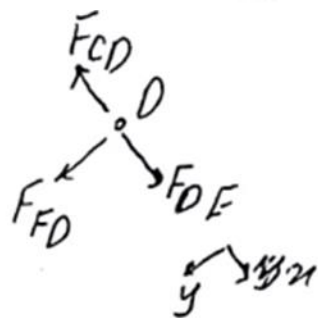
از لحاظ استاتیکی

معین است



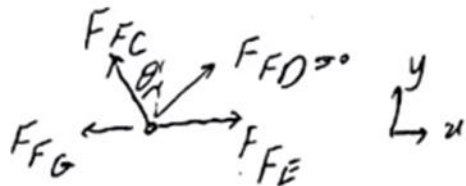


D Jüesil :



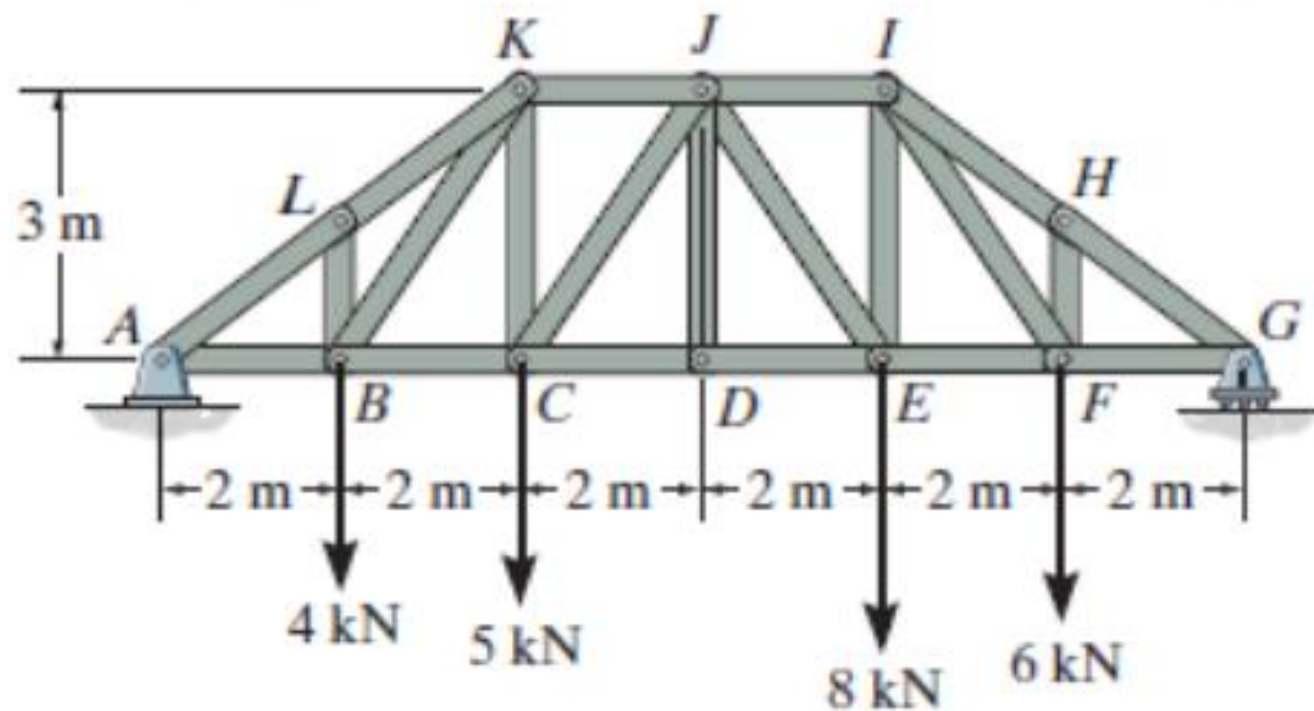
$\Sigma F_y = 0 \Rightarrow \sqrt{F_{FD}} = 0$  : *istis yir sind*

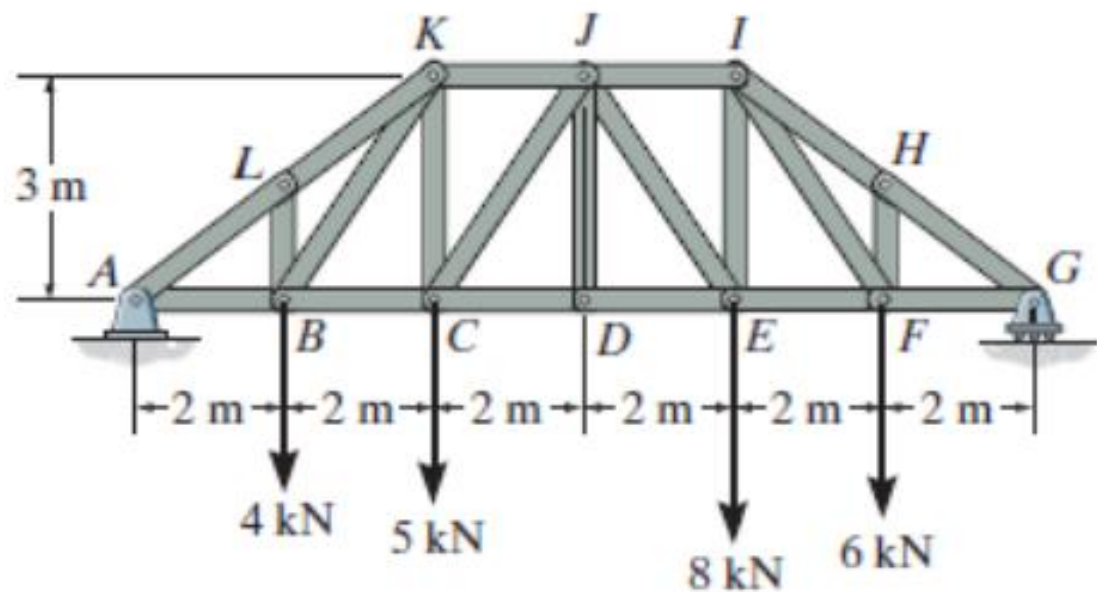
F Jüesil :



$\Sigma F_y = 0 \Rightarrow F_{FC} \cos \theta = 0$   
 $\Rightarrow \sqrt{F_{FC}} = 0$

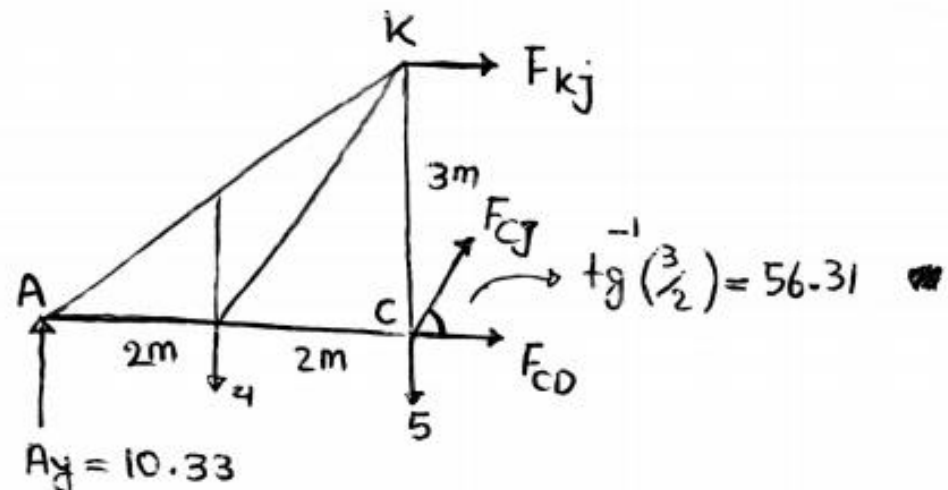
در خرپای شکل زیر نیروی اعضای  $EF$  و  $FI$ ،  $HI$ ،  $CD$ ،  $CJ$ ،  $JK$  را به روش برش به دست آورید.





$$\begin{aligned} \rightarrow \Sigma F_x &= 0 \\ \curvearrowright + \Sigma M_G &= 0 \end{aligned}$$

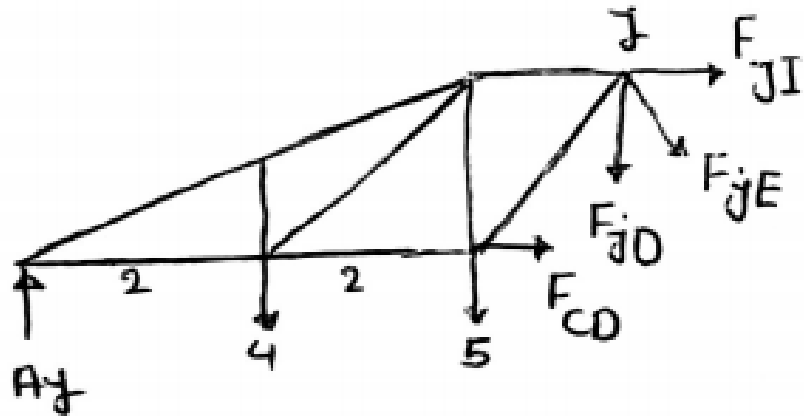
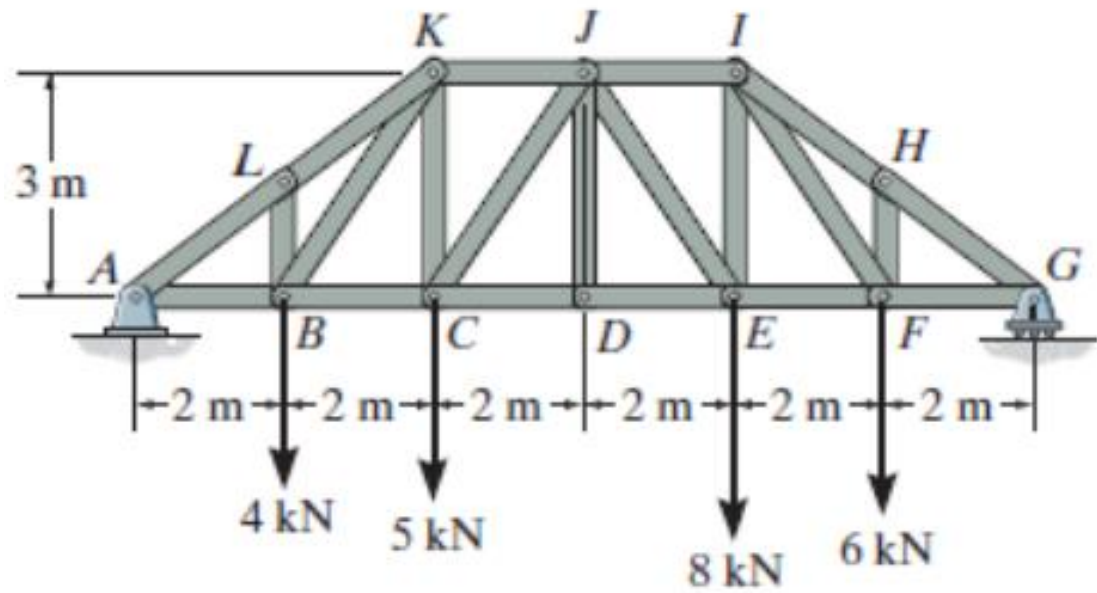
$$\begin{aligned} A_x &= 0 \\ 6(2) + 8(4) + 5(8) + 4(10) - A_y(12) &= 0 \\ A_y &= 10.33 \text{ kN} \end{aligned}$$



$$\begin{aligned} \Sigma M_c &= 0 \\ -F_{kj}(3) + 4(2) - 10.33(4) &= 0 \\ F_{kj} &= -11.1 \text{ kN} \end{aligned}$$

$$\begin{aligned} \Sigma F_y &= 0 \\ 10.33 - 4 - 5 + F_{cj} \sin(56.31) &= 0 \\ F_{cj} &= -1.59 \text{ kN} \end{aligned}$$

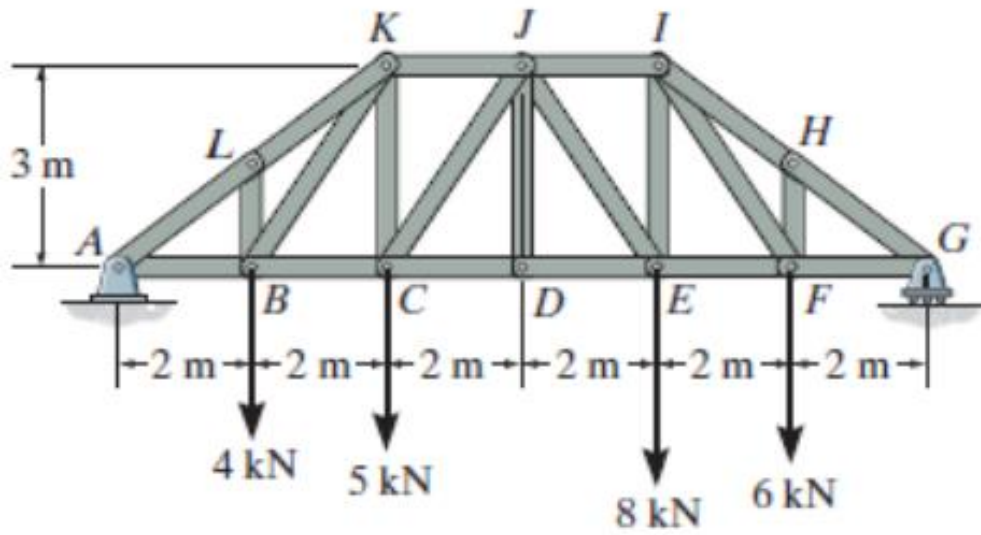
$$\tan^{-1}\left(\frac{3}{2}\right) = 56.31^\circ$$



$$\sum M_j = 0$$

$$F_{CD}(3) + 5(2) + 4(4) - A_y(6) = 0$$

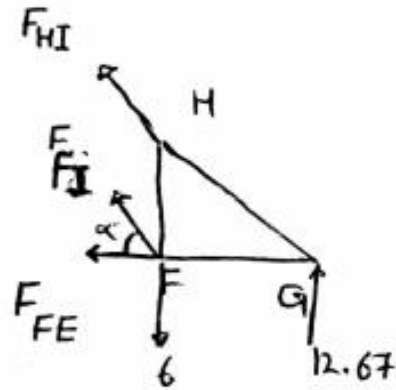
$$F_{CD} = 12 \text{ kN} \quad \text{کسر}$$



$$\sum M_A = 0$$

$$N_G(2) - 4(2) - 5(4) - 8(8) - 6(10) = 0$$

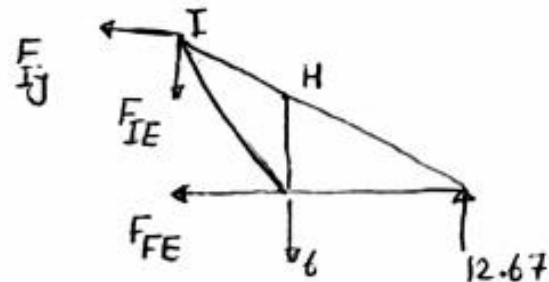
$$N_G = 12.67 \text{ kN}$$



$$\alpha = \tan^{-1}\left(\frac{3}{2}\right) = 56.31^\circ$$

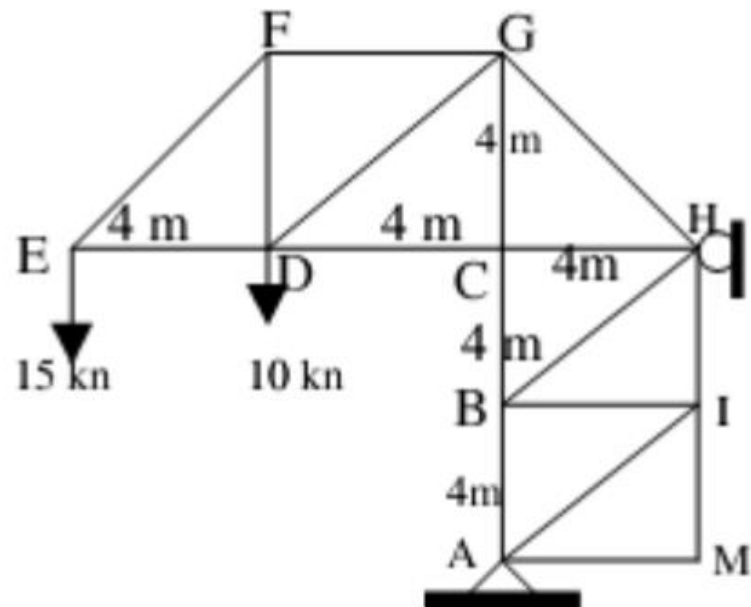
$$\sum M_G = 0 \quad -F_{FI} \sin(56.31) + 6(2) = 0 \quad F_{FI} = 7.21 \text{ kN}$$

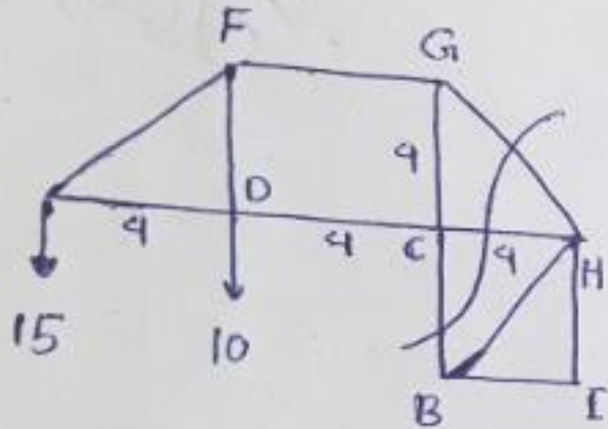
$$\sum M_F = 0 \quad 12.67(2) + F_{HI} \left(\frac{3}{5}\right)(2) = 0 \quad F_{HI} = -21.1 \text{ kN}$$



$$\sum M_I = 0 \quad 12.67(4) - 6(2) - F_{FE}(3) = 0 \quad F_{FE} = 12.9 \text{ kN}$$

نیرو را در عضوهای  $GH$ ,  $CB$  و  $CH$  از خرابای زیر تعیین کنید  
و همچنین تعیین نمایید که این اعضا تحت کشش هستند یا  
فشار.

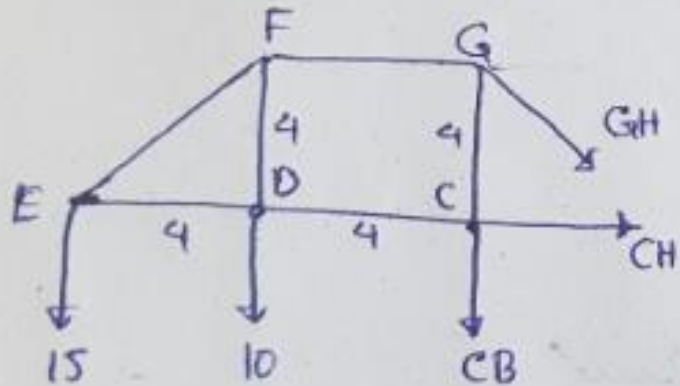




$$\sum M_G = 0 \quad \curvearrowright^+ \quad CH \times 4 + 10 \times 4 + 15 \times 8 = 0$$

$$\sum M_H = 0 \quad BC \times 4 + 10 \times 8 + 15 \times 12 = 0$$

$$\sum M_C = 0 \quad 10 \times 4 + 15 \times 8 - GH \times 4 \times \frac{\sqrt{2}}{2} = 0$$



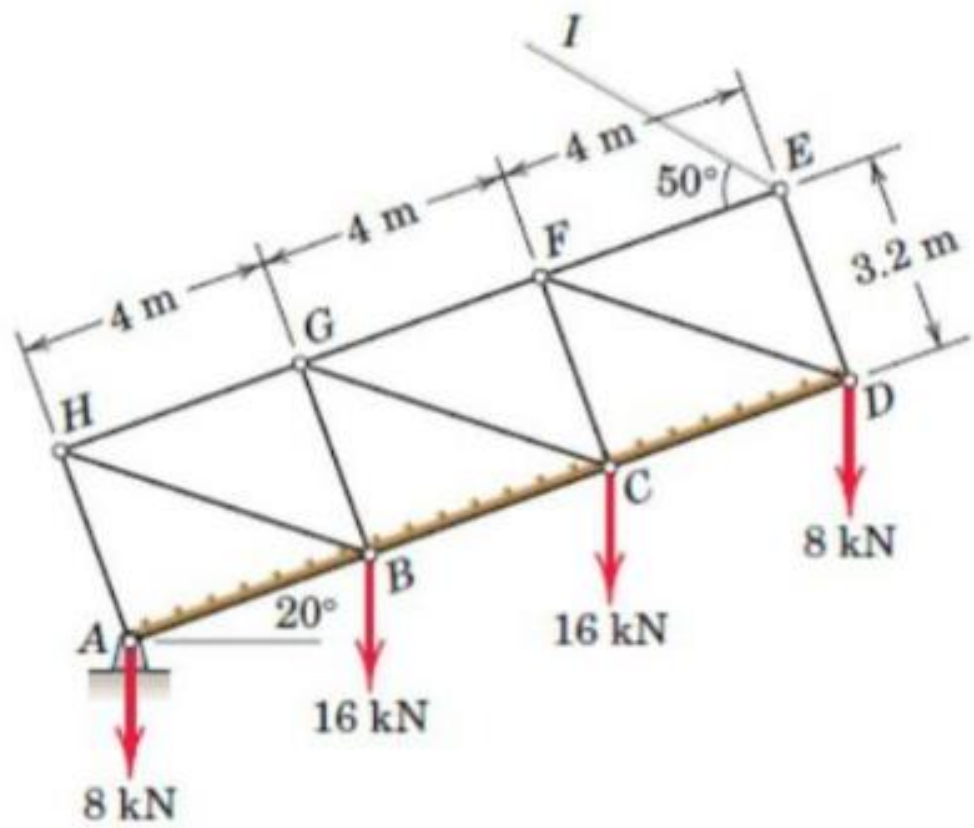
$$CH = -90$$

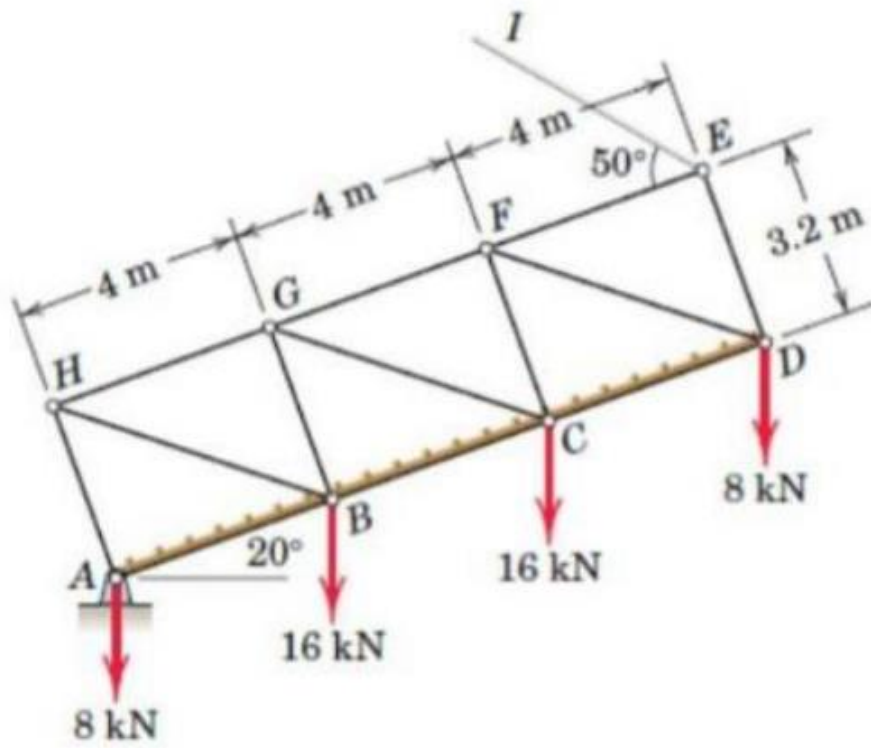
$$BC = -65$$

$$GH = 112$$



A drawbridge is being raised by a cable  $EI$ . The four joint loadings shown result from the weight of the roadway. Determine the forces in members  $EF$ ,  $DE$ ,  $DF$ ,  $CD$ , and  $FG$ .

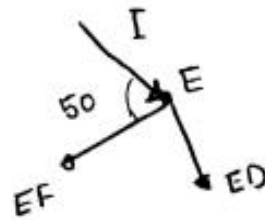




$$\sum M_A = 0$$

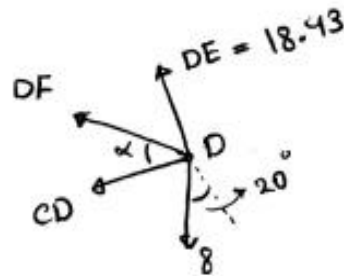
$$I \cos 50 \times 3.2 + I \sin 50 \times 12 + 16 \cos 20 \times 4 + 16 \cos 20 \times 8$$

$$+ 8 \cos 20 \times 12 = 0 \quad I = -24.0574$$



$$I \cos 50 = EF = -15.46$$

$$I \sin 50 = -ED \quad ED = 18.43$$

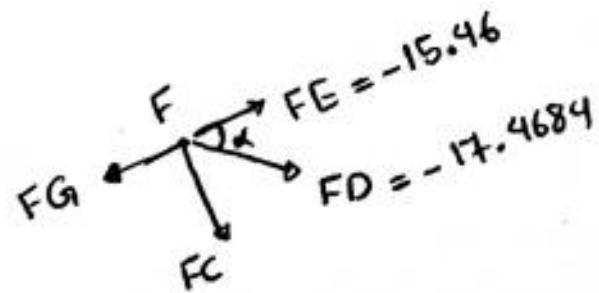
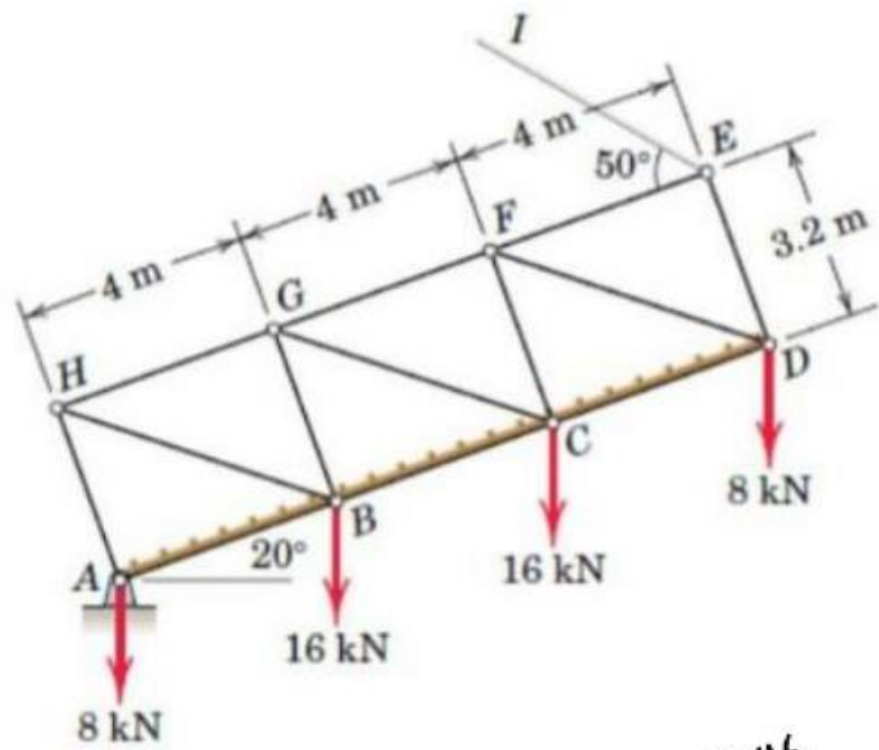


$$\cos \alpha = \frac{4}{\sqrt{3.2^2 + 4^2}} = 0.7809$$

$$\sin \alpha = \frac{3.2}{\sqrt{3.2^2 + 4^2}} = 0.6247$$

$$18.43 - 8 \cos 20 + DF \sin \alpha = 0 \quad DF = -17.4684$$

$$-8 \sin 20 + CD - DF \cos \alpha = 0 \quad CD = 10.9049$$



$$FE + FD \cos \alpha - FG = 0$$

$$-15.46 - 17.4689(0.7809) - FG = 0 \quad FG = -29.1010$$

$$FD \sin \alpha + FC = 0 \quad FC = 10.91$$