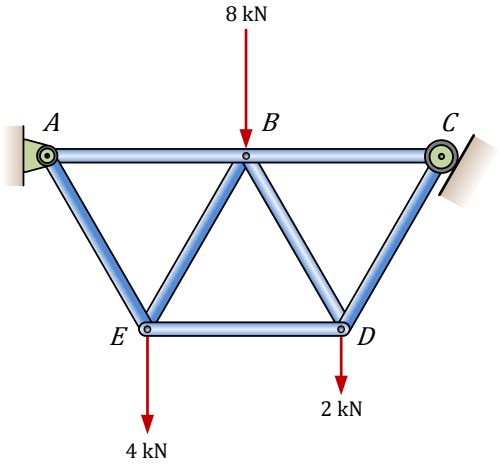
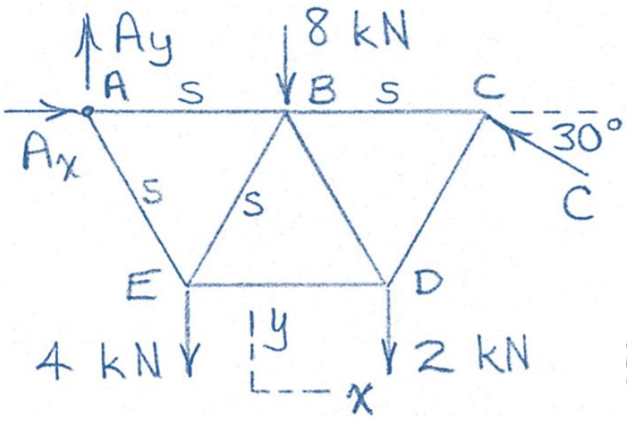
## Question 3.10.

Determine the magnitude and nature of forces in each member of the loaded truss. All triangles are equilateral.




## Solution




*Consider the equilibrium of the whole truss*

$+\circlearrowleft \sum M_A = 0$

$$-8s - 4\left(\frac{s}{2}\right) - 2\left(\frac{3s}{2}\right) + C\sin 30°\,(2s) = 0$$

$$C = 13 \text{ kN}$$

$+\rightarrow \sum F_x = 0$

$$A_x - C\cos 30° = 0$$

$$A_x - 13\cos 30° = 0$$

$$A_x = 13\frac{\sqrt{2}}{2} = 11.26 \text{ kN}$$

$+\uparrow \sum F_y = 0$

$$C\sin 30° - 4 - 2 - 8 + A_y = 0$$

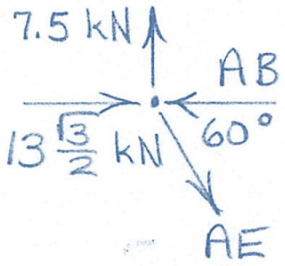
$$A_y = 14 - 13\sin 30° = 7.5 \text{ kN}$$

*Joint A*

$+\uparrow \sum F_y = 0$

$7.5 - AE \sin 60° = 0$

$AE = 5\sqrt{3} = 8.66 \text{ kN (T)}$ (Answer)




$+\rightarrow \sum F_x = 0$

$11.26 - AB + AE \cos 60° = 0$

$11.26 - AB + 8.66 \cos 60° = 0$

$AB = 9\sqrt{3} = 15.59 \text{ kN (C)}$ (Answer)

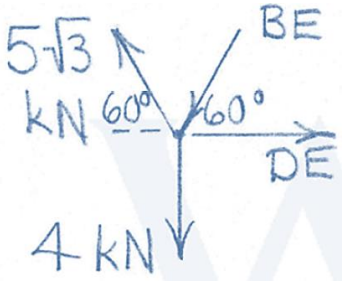
*Joint E*

$+\uparrow \sum F_y = 0$

$5\sqrt{3} \sin 60° - BE \sin 60° - 4 = 0$

$BE = 7\left(\frac{\sqrt{3}}{3}\right) = 4.04 \text{ kN (C)}$

(Answer)




$+\rightarrow \sum F_x = 0$

$DE - 5\sqrt{3} \cos 60° - BE \cos 60° = 0$

$DE - 5\sqrt{3} \cos 60° - 7\left(\frac{\sqrt{3}}{3}\right) \cos 60° = 0$

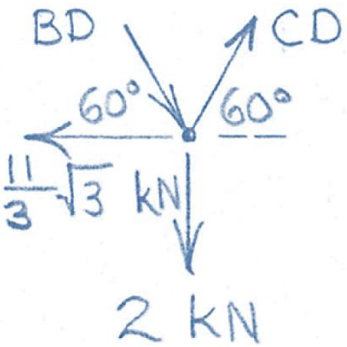
$DE = 11\left(\frac{\sqrt{3}}{3}\right) = 6.35 \text{ kN (T)}$

(Answer)

*Joint D*

$+\uparrow \sum F_y = 0$

$CD \sin 60° - BD \sin 60° - 2 = 0$ ------- (a)




$+\rightarrow \sum F_x = 0$

$CD \cos 60° + BD \cos 60° - 11\left(\frac{\sqrt{3}}{3}\right) = 0$

------- (b)

*Solving (a) and (b) simultaneously*

$CD = 13\left(\frac{\sqrt{3}}{3}\right) = 7.505$ kN (T)

(Answer)

$BD = 3\sqrt{3} = 5.196$ kN (C)

(Answer)

*Joint C*

$+\rightarrow \sum F_x = 0$

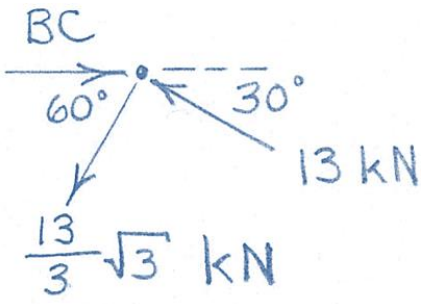
$BC - 13\cos 30° - 13\left(\frac{\sqrt{3}}{3}\right)\cos 60° = 0$

$CD = 13\left(\frac{\sqrt{3}}{3}\right) = 7.505$ kN (T)

(Answer)

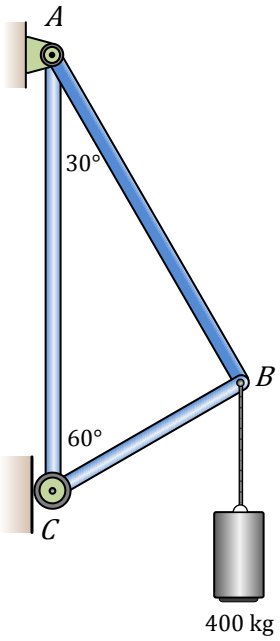
$BC = 26\left(\frac{\sqrt{3}}{3}\right) = 15.01$ kN (C)

(Answer)



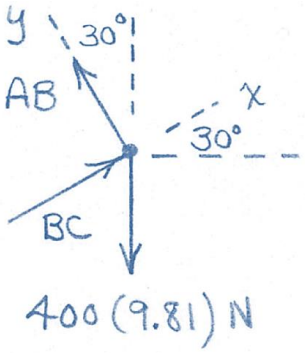
## Question 3.11.

Determine the magnitude and nature of forces in each member of the loaded truss.




## Solution

*Joint B*




$+\rightarrow \sum F_x = 0$

$BC - 400(9.81)\cos 60° = 0$

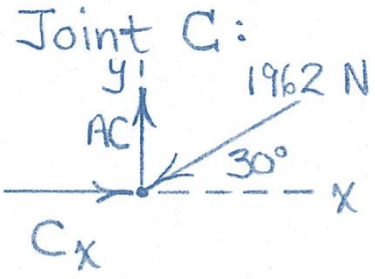
$BC = 1962$ N (C) (Answer)

$+\uparrow \sum F_y = 0$

$AB - 400(9.81)\sin 60° = 0$

$AB = 3400$ N (T) (Answer)

*Joint C*



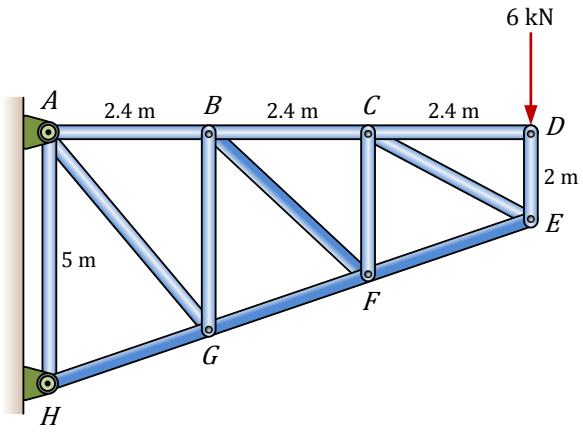

$+\uparrow \sum F_y = 0$

$AC - 1962\sin 30° = 0$

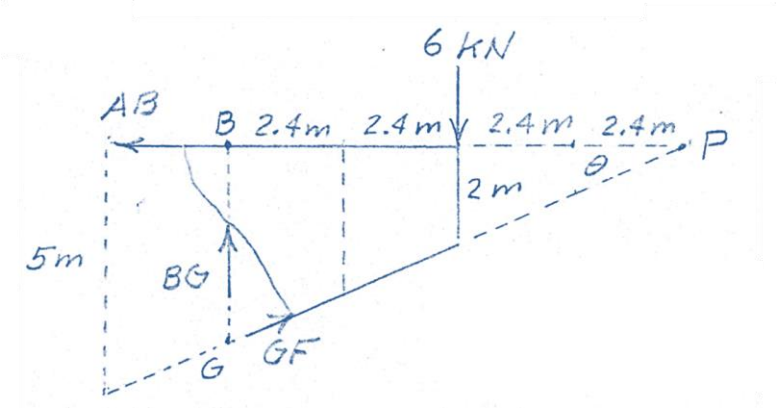
$AC = 981$ N (T) (Answer)

## Question 3.12.

Determine the magnitude and nature of the forces in members $AB$, $BG$ and $GF$.




## Solution




$\tan\theta = \frac{5}{12}$

$\cos\theta = \frac{12}{13}$

$+\circlearrowleft \sum M_P = 0$

$BG(8)(2.4) - 6(2)(2.4) = 0$

$BG = 3$ kN (C) (Answer)

$+\circlearrowleft \sum M_B = 0$

$GF\left(\frac{12}{13}\right)(4) - 6(2)(2.4) = 0$

$GF = 7.8$ kN (C) (Answer)

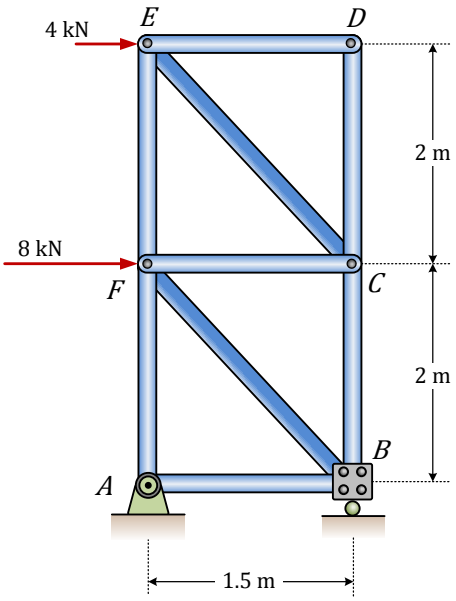
$+\circlearrowleft \sum M_G = 0$

$AB(4) - 6(2)(2.4) = 0$

$AB = 7.2$ kN (T) (Answer)

## Question 3.13.

Determine the force in members $EF$, $CF$, and $BC$, and state if the members are in tension or compression.




## Solution

*Support Reactions. Not required.*

*Method of Sections: $F_{BC}$ and $F_{EF}$ can be determined directly by writing the moment equations of equilibrium about points F and C, respectively, by referring to the FBD of the upper portion of the truss section through a–a shown below.*

$+\circlearrowleft \sum M_F = 0$

$F_{BC}(1.5) - 4(2) = 0$

$F_{BC} = 5.33$ kN (C) (Answer)

$+\circlearrowleft \sum M_C = 0$

$F_{EF}(1.5) - 4(2) = 0$

$F_{EF} = 5.33$ kN (T) (Answer)

*Also, write the force equation of equilibrium along the x axis,*

$+\rightarrow \sum F_x = 0$

$4 - F_{CF} = 0$

$F_{CF} = 4$ kN (T) (Answer)