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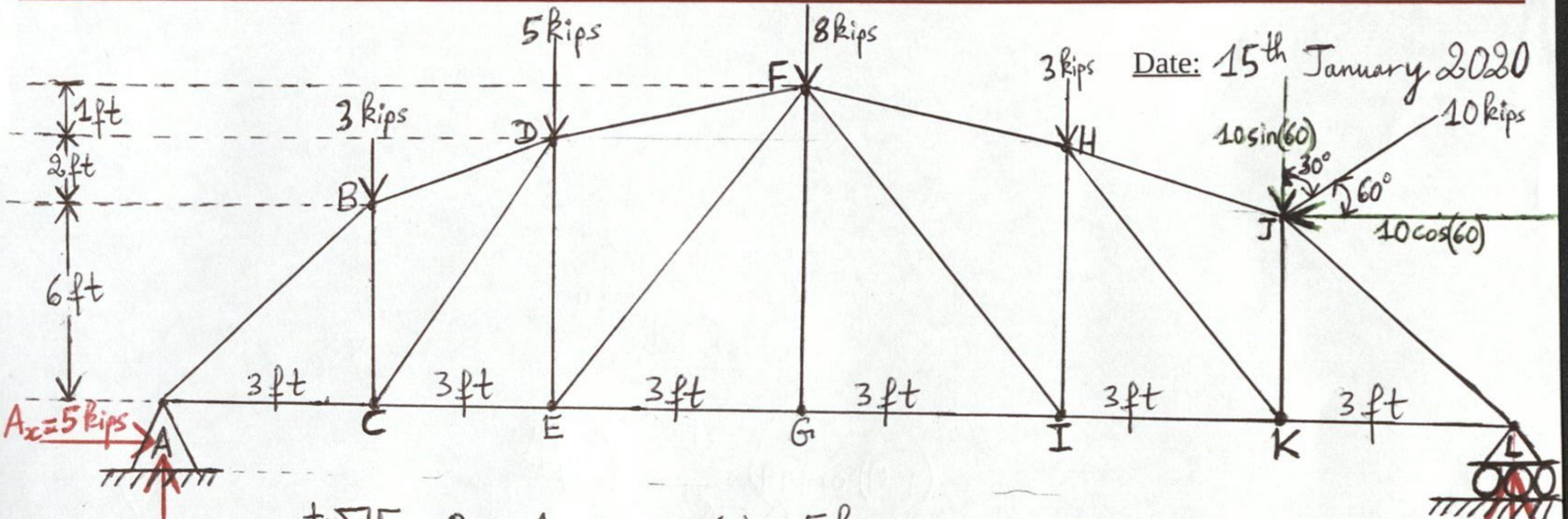
Date: 15th January 2020



$$\overset{+}{\rightarrow}\sum F_x = 0;\quad A_x = 10\cos(60) = 5\text{ kips}$$

$$+\circlearrowleft\sum M_A = 0;\quad (-3k)(3ft) + (-5k)(6ft) + (-8k)(9ft) + (-3k)(12ft) + (10\cos(60))(6ft) + (-10\sin(60))(15ft) + (L_y)(18ft) = 0$$

$$L_y = 13.71687836\text{ kips} = 13.7\text{ kips}$$

$$+\uparrow\sum F_y = 0;\quad A_y + L_y = [3+5+8+3+10\sin(60)]\text{ kips}$$

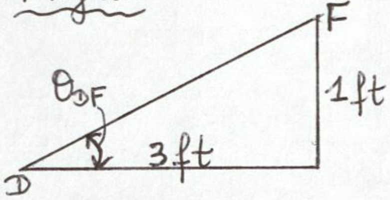
$$A_y = 27.66025404 - L_y$$

$$= 27.66025404 - 13.71687836$$

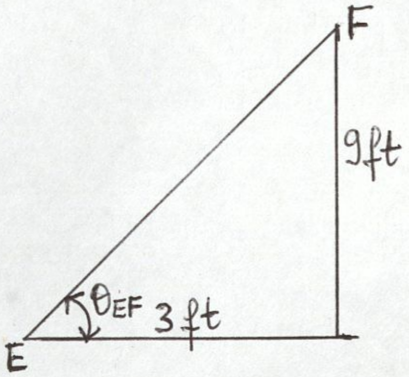
$$= 13.94337568\text{ kips}$$

$$A_y = 13.9\text{ kips}$$

Angles



$$\Rightarrow \tan(\theta_{DF}) = \frac{1\cancel{ft}}{3\cancel{ft}} \Rightarrow \theta_{DF} = \tan^{-1}\left(\frac{1}{3}\right) = 18.43494882°$$



$$\Rightarrow \tan(\theta_{EF}) = \frac{9\cancel{ft}}{3\cancel{ft}} \Rightarrow \theta_{EF} = \tan^{-1}\left(\frac{9}{3}\right) = 71.56505118°$$

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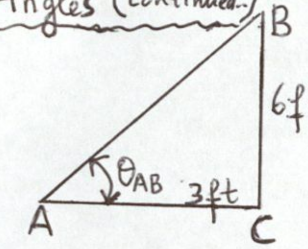
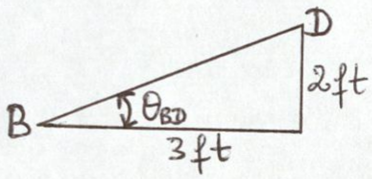
Angles (continued..)



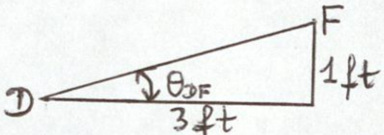
$$\Rightarrow \tan(\theta_{AB}) = \frac{6\,\cancel{ft}}{3\,\cancel{ft}}$$

$$\theta_{AB} = \tan^{-1}\left(\frac{6}{3}\right) = 63.4^\circ = \theta_{JL}$$



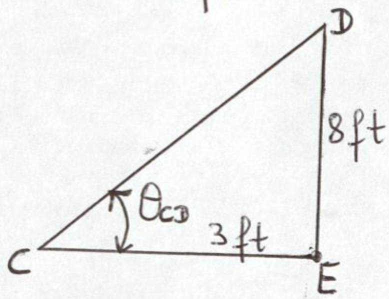
$$\Rightarrow \tan(\theta_{BD}) = \frac{2\,\cancel{ft}}{3\,\cancel{ft}}$$

$$\theta_{BD} = \tan^{-1}\left(\frac{2}{3}\right) = 33.69^\circ = \theta_{HJ}$$



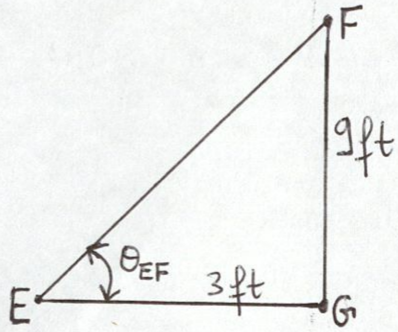
$$\Rightarrow \tan(\theta_{DF}) = \frac{1\,\cancel{ft}}{3\,\cancel{ft}}$$

$$\theta_{DF} = \tan^{-1}\left(\frac{1}{3}\right) = 18.4^\circ = \theta_{HF}$$



$$\Rightarrow \tan(\theta_{CD}) = \frac{8\,\cancel{ft}}{3\,\cancel{ft}}$$

$$\theta_{CD} = \tan^{-1}\left(\frac{8}{3}\right) = 69.4^\circ = \theta_{HK}$$



$$\Rightarrow \tan(\theta_{EF}) = \frac{9\,\cancel{ft}}{3\,\cancel{ft}}$$

$$\theta_{EF} = \tan^{-1}\left(\frac{9}{3}\right) = 71.56^\circ = \theta_{IF}$$

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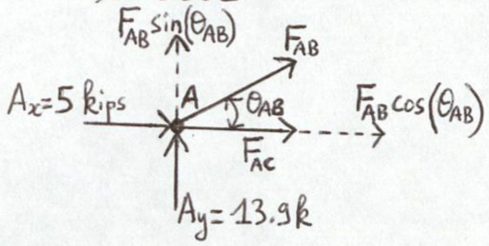
Joint A



$+\uparrow \Sigma F_y = 0$; $A_y + F_{AB}\sin(\theta_{AB}) = 0$

$(13.9) + F_{AB}\sin(63.4^\circ) = 0$

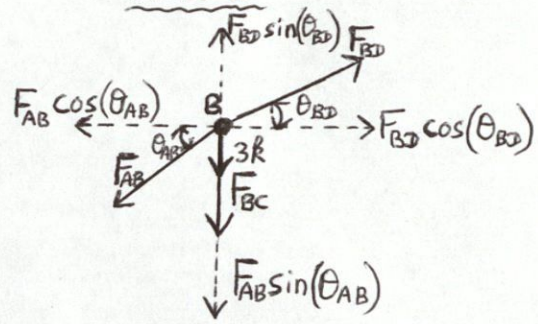
$\boxed{F_{AB} = -15.58916793k = 15.6k\,(C)}$

$\xrightarrow{+} \Sigma F_x = 0$; $A_x + F_{AC} + F_{AB}\cos(\theta_{AB}) = 0$

$(5) + (F_{AC}) + [(-15.589)\cos(63.4)] = 0$

$\boxed{F_{AC} = 1.971687842k = 1.97k\,(T)}$

Joint B



$\xrightarrow{+} \Sigma F_x = 0$; $F_{AB}\cos(\theta_{AB}) = F_{BD}\cos(\theta_{BD})$

$$F_{BD} = \frac{F_{AB}\cos(\theta_{AB})}{\cos(\theta_{BD})} = \frac{-15.6\cos(63.4)}{\cos(33.69)} = -8.378925997k$$

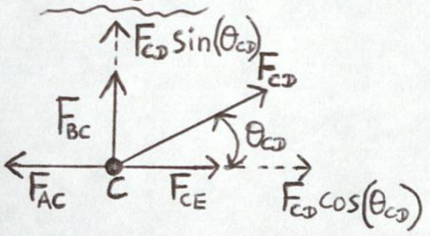
$\boxed{F_{BD} = 8.38 \text{ kips } (C)}$

$+\uparrow \Sigma F_y = 0$; $F_{BD}\sin(\theta_{BD}) - F_{BC} - F_{AB}\sin(\theta_{AB}) - 3 = 0$

$[-8.38\sin(33.69)] - F_{BC} - [-15.6\sin(63.4^\circ)] - 3 = 0$

$\boxed{F_{BC} = 6.295583786 \text{ kips} = 6.30 \text{ kips } (T)}$

Joint C



$+\uparrow \Sigma F_y = 0$; $F_{CD}\sin(\theta_{CD}) + F_{BC} = 0$

$F_{CD}\sin(69.4^\circ) + (6.29) = 0$

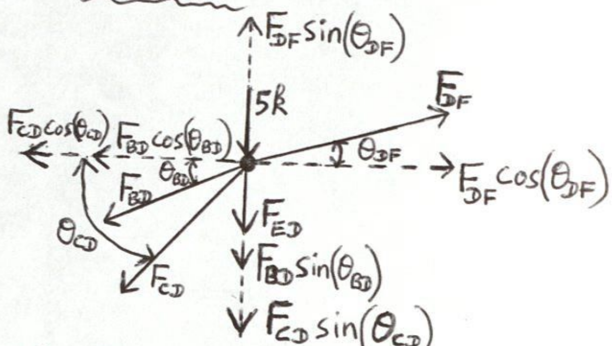
$\boxed{F_{CD} = -6.723686431 \text{ kips} = 6.72 \text{ kips } (C)}$

$\xrightarrow{+} \Sigma F_x = 0$; $F_{CE} + F_{CD}\cos(\theta_{CD}) - F_{AC} = 0$

$F_{CE} + [-6.72\cos(69.4)] - (1.97) = 0$

$\boxed{F_{CE} = 4.332531762 \text{ kips} = 4.33 \text{ kips } (T)}$

Joint D



$\xrightarrow{+} \Sigma F_x = 0$; $F_{DF}\cos(\theta_{DF}) = F_{CD}\cos(\theta_{CD}) + F_{BD}\cos(\theta_{BD})$

$F_{DF}\cos(18.4) = (-6.72)\cos(69.4) + (-8.38)\cos(33.69)$

$\boxed{F_{DF} = -9.837358008 \text{ kips} = 9.84 \text{ kips } (C)}$

$+\uparrow \Sigma F_y = 0$; $F_{DF}\sin(\theta_{DF}) = (5k) + F_{ED} + F_{BD}\sin(\theta_{BD}) + F_{CD}\sin(\theta_{CD})$

$[-9.84\sin(18.4)] = (5k) + F_{ED} + [-6.72\sin(69.4)] + [-8.38\sin(33.69)]$

$\boxed{F_{ED} = 2.832340097 \text{ kips} = 2.83 \text{ kips } (T)}$

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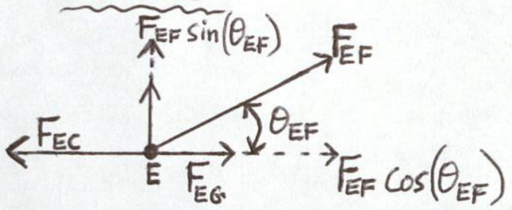
Joint E



$+\uparrow \sum F_y = 0;\ F_{ED} + F_{EF}\sin(\theta_{EF}) = 0$

$(2.832340097) + F_{EF}\sin(71.56°) = 0$

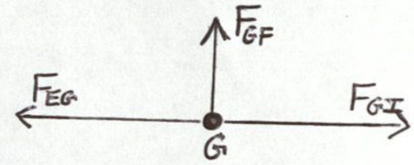
$\boxed{F_{EF} = -2.985548605 \text{ kips} = 2.99 \text{ kips (C)}}$

$\overset{+}{\rightarrow} \sum F_x = 0;\ F_{EG} + F_{EF}\cos(\theta_{EF}) - F_{EC} = 0$

$F_{EG} + (-2.985548605)\cos(71.56) - (4.3325) = 0$

$\boxed{F_{EG} = 5.276645128 \text{ kips} = 5.28 \text{ kips (T)}}$

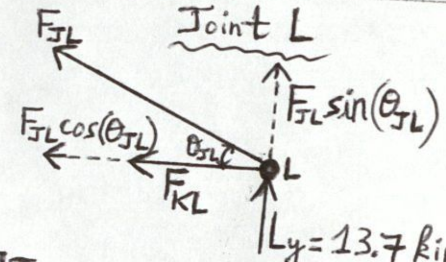
Joint G



$+\uparrow \sum F_y = 0;\ \boxed{F_{GF} = 0 = \text{zero force member}}$

$\overset{+}{\rightarrow} \sum F_x = 0;\ \boxed{F_{GI} = F_{EG} = 5.28 \text{ kips (T)}}$

Joint L



$+\uparrow \sum F_y = 0;\ F_{JL}\sin(\theta_{JL}) + L_y = 0$

$F_{JL}\sin(63.4) + 13.7 = 0$

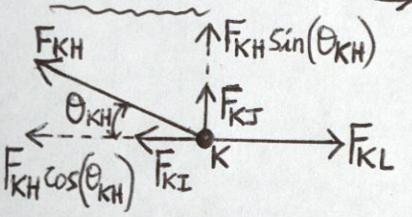
$\boxed{F_{JL} = -15.33593623 \text{ k} = 15.3 \text{ kips (C)}}$

$\overset{+}{\leftarrow} \sum F_x = 0;\ F_{KL} + F_{JL}\cos(\theta_{JL}) = 0$

$F_{KL} + (-15.33593623)\cos(63.4) = 0$

$\boxed{F_{KL} = 6.858439182 \text{ k} = 6.86 \text{ kips (T)}}$

Joint K



$\overset{+}{\rightarrow} \sum F_x = 0;\ F_{KL} - F_{KI} - F_{KH}\cos(\theta_{KH}) = 0$

$(6.86) - F_{KI} - 3.04\cos(69.4) = 0$

$F_{KI} = 5.79007105 \text{ kips}$

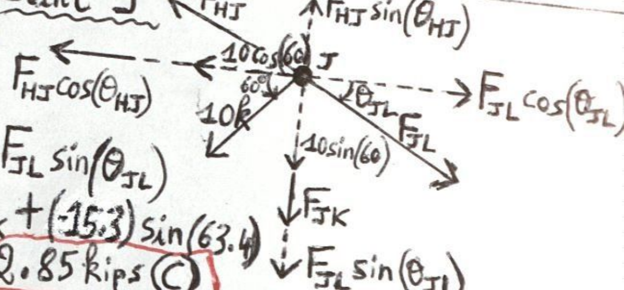
$\boxed{F_{KI} = 5.79 \text{ kips (T)}}$

$+\uparrow \sum F_y = 0;\ F_{KJ} + F_{KH}\sin(\theta_{KH}) = 0$

$(-2.848981686) + F_{KH}\sin(69.4) = 0$

$\boxed{F_{KH} = 3.042713774 \text{ kips} = 3.04 \text{ kips (T)}}$

Joint J



$+\uparrow \sum F_y = 0;$

$F_{HJ}\sin(\theta_{HJ}) = 10\sin(60) + F_{JK} + F_{JL}\sin(\theta_{JL})$

$(-14.25)\sin(33.69) = [10\sin(60)] + F_{JK} + (-15.3)\sin(63.4)$

$\boxed{F_{JK} = -2.848981686 \text{ k} = 2.85 \text{ kips (C)}}$

$\overset{+}{\rightarrow} \sum F_x = 0;\ F_{HJ}\cos(\theta_{HJ}) + 10\cos(60) = F_{JL}\cos(\theta_{JL})$

-15.33

$\boxed{F_{HJ} = -14.25205898 \text{ kips} = 14.3 \text{ kips (C)}}$

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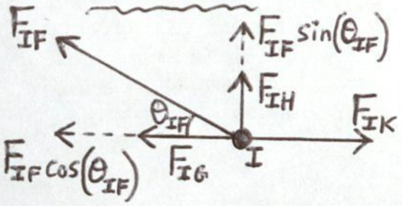
Joint I



$$\overset{+}{\rightarrow}\Sigma F_x = 0;\quad F_{IK} - F_{IG} - F_{IF}\cos(\theta_{IF}) = 0$$

$$(5.79) - (5.28) - [F_{IF}\cos(71.56)] = 0$$

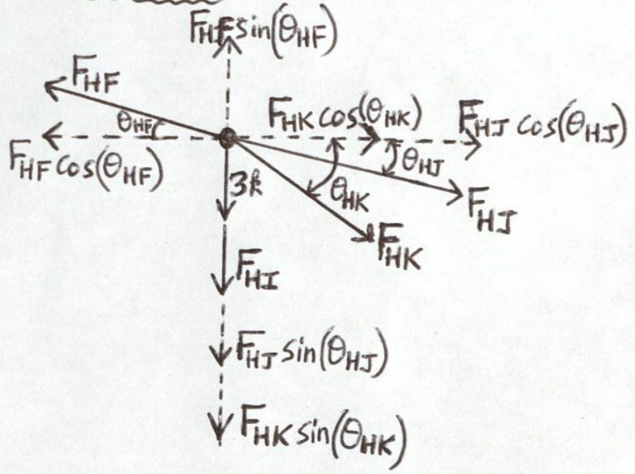
$$\boxed{F_{IF} = 1.622842348\text{ kips} = 1.62\text{ kips (T)}}$$

$$+\uparrow\Sigma F_y = 0;\quad F_{IH} + F_{IF}\sin(\theta_{IF}) = 0$$

$$F_{IH} + [(1.62)\sin(71.56)] = 0$$

$$\boxed{F_{IH} = -1.539563431\text{ kips} = 1.54\text{ kips (C)}}$$

Joint H



$$\overset{+}{\rightarrow}\Sigma F_x = 0;\quad F_{HK}\cos(\theta_{HK}) + F_{HJ}\cos(\theta_{HJ}) - F_{HF}\cos(\theta_{HF}) = 0$$

$$[3.04\cos(69.4)] + [-14.3\cos(33.69)] - F_{HF}\cos(18.4) = 0$$

$$\boxed{F_{HF} = -11.37373355\text{ kips} = 11.4\text{ kips (C)}}$$