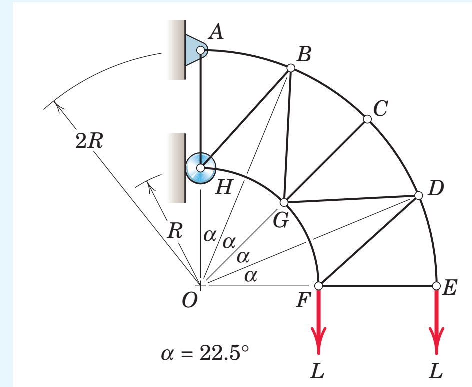
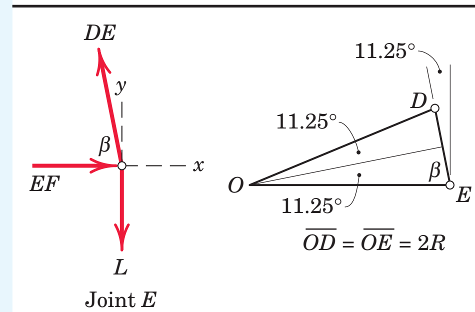
SAMPLE PROBLEM 4/2

The simple truss shown supports the two loads, each of magnitude L. Determine the forces in members DE, DF, DG, and CD.



Solution. First of all, we note that the curved members of this simple truss are all two-force members, so that the effect of each curved member within the truss is the same as that of a straight member.

We can begin with joint E because there are only two unknown member forces acting there. With reference to the free-body diagram and accompanying geometry for joint E, we note that $\beta = 180° - 11.25° - 90° = 78.8°$.



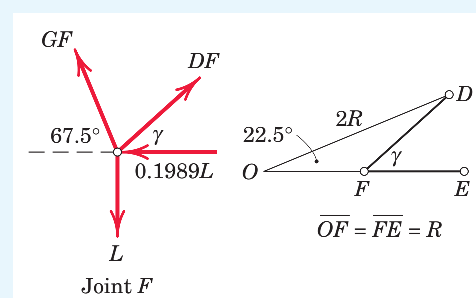
① $[\Sigma F_y = 0]$ $\quad DE \sin 78.8° - L = 0 \qquad DE = 1.020L\ T$ *Ans.*

$[\Sigma F_x = 0]$ $\quad EF - DE \cos 78.8° = 0 \qquad EF = 0.1989L\ C$

We must now move to joint F, as there are still three unknown members at joint D. From the geometric diagram,

$$\gamma = \tan^{-1}\left[\frac{2R \sin 22.5°}{2R \cos 22.5° - R}\right] = 42.1°$$

From the free-body diagram of joint F,



$[\Sigma F_x = 0]$ $\quad -GF \cos 67.5° + DF \cos 42.1° - 0.1989L = 0$

$[\Sigma F_y = 0]$ $\quad GF \sin 67.5° + DF \sin 42.1° - L = 0$

Simultaneous solution of these two equations yields

$$GF = 0.646L\ T \qquad DF = 0.601L\ T$$ *Ans.*

For member DG, we move to the free-body diagram of joint D and the accompanying geometry.

$$\delta = \tan^{-1}\left[\frac{2R \cos 22.5° - 2R \cos 45°}{2R \sin 45° - 2R \sin 22.5°}\right] = 33.8°$$

$$\epsilon = \tan^{-1}\left[\frac{2R \sin 22.5° - R \sin 45°}{2R \cos 22.5° - R \cos 45°}\right] = 2.92°$$

Then from joint D:

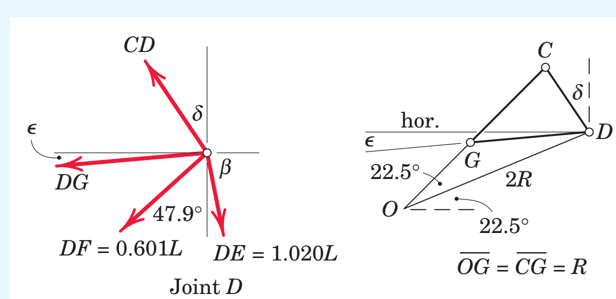
$[\Sigma F_x = 0]$ $\quad -DG \cos 2.92° - CD \sin 33.8° - 0.601L \sin 47.9° + 1.020L \cos 78.8° = 0$

$[\Sigma F_y = 0]$ $\quad -DG \sin 2.92° + CD \cos 33.8° - 0.601L \cos 47.9° - 1.020L \sin 78.8° = 0$

The simultaneous solution is

$$CD = 1.617L\ T \qquad DG = -1.147L \text{ or } DG = 1.147L\ C$$ *Ans.*

Note that ϵ is shown exaggerated in the accompanying figures.



Helpful Hint

① Rather than calculate and use the angle $\beta = 78.8°$ in the force equations, we could have used the 11.25° angle directly.