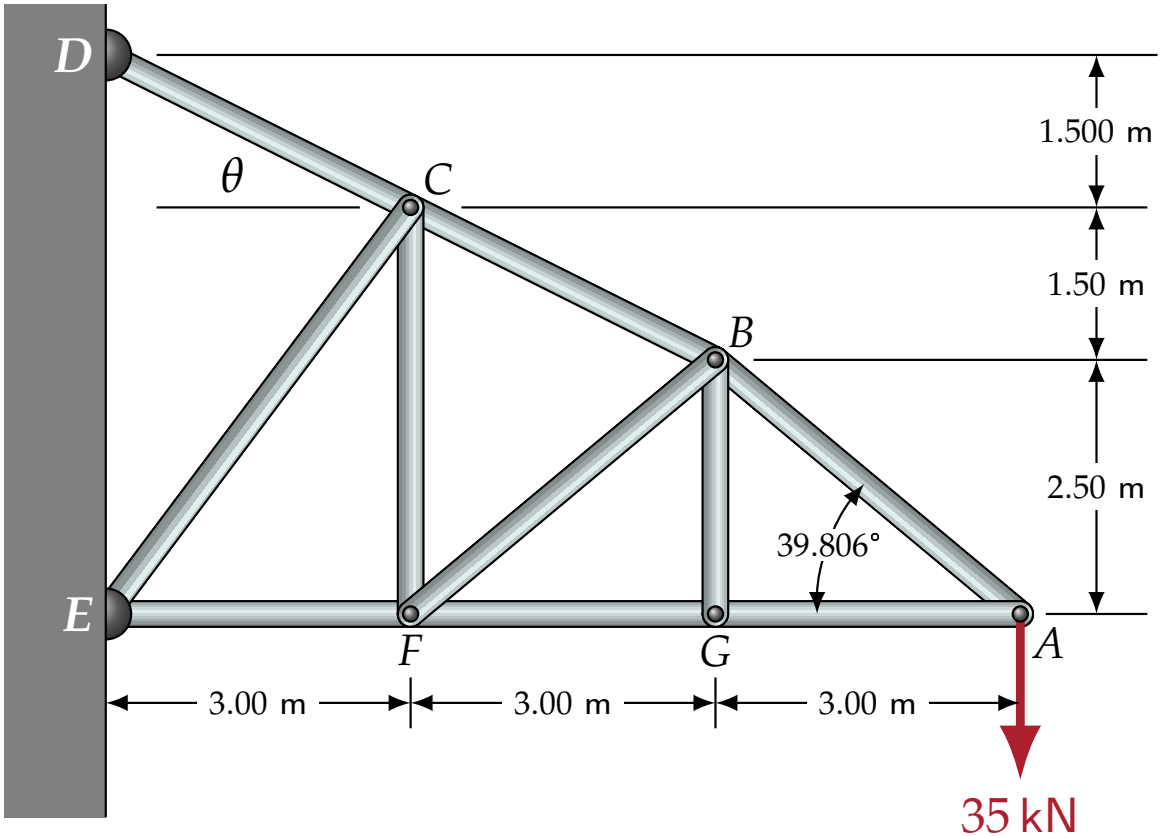
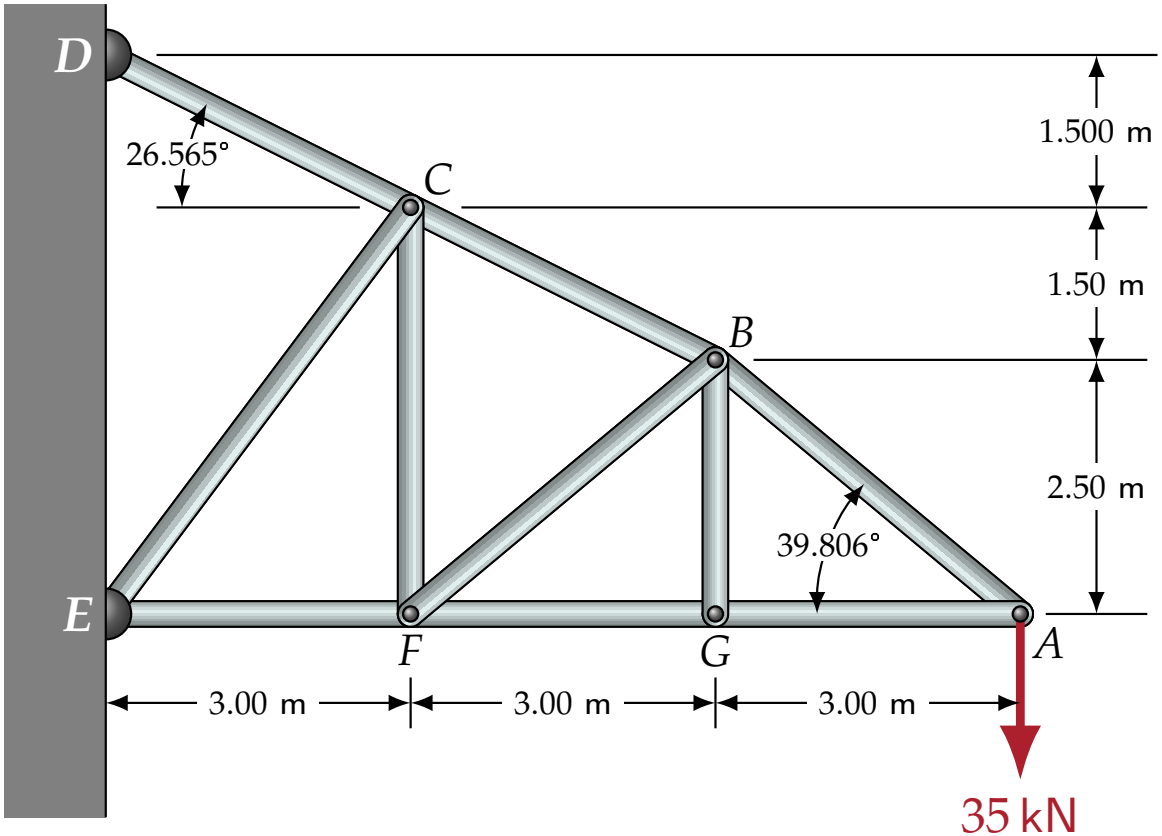


Calculate Angles

$$\angle BAG = \tan^{-1}\left[\frac{2.50}{3.00}\right]$$

$$= 39.806^\circ$$



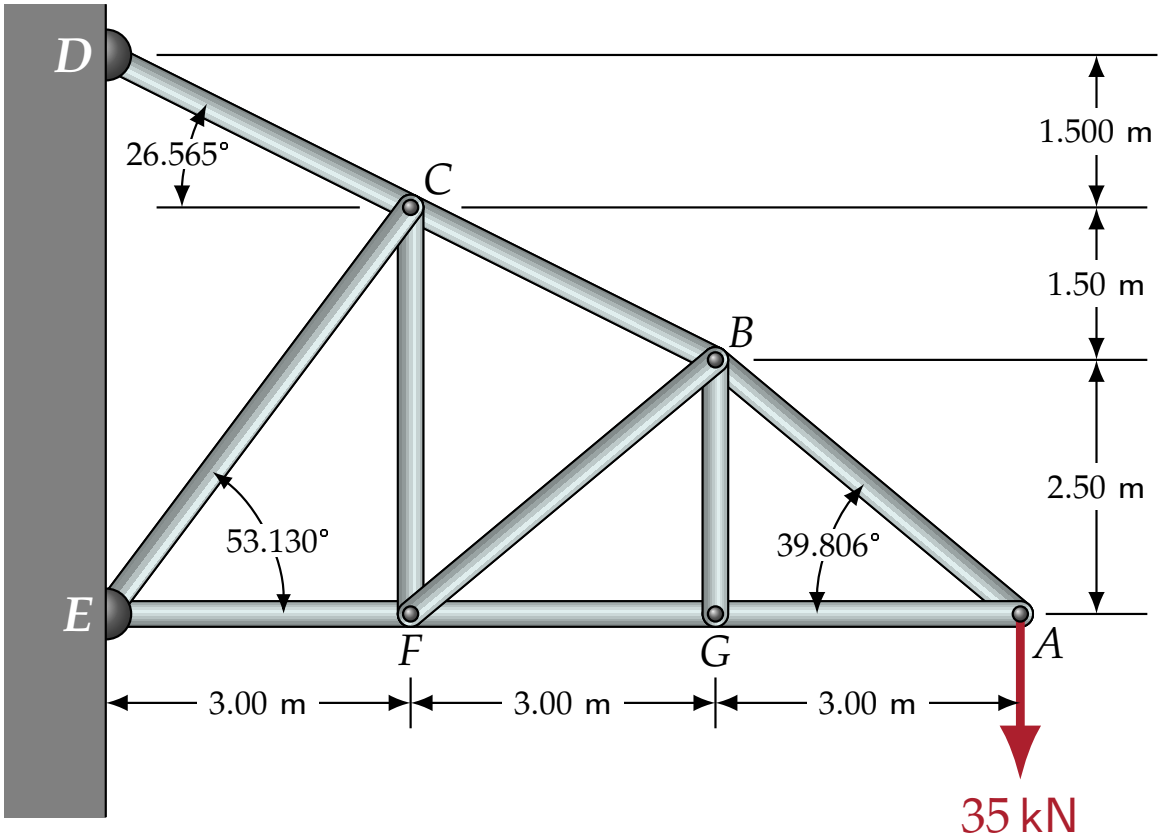
Calculate Angles

$$\angle BAG = \tan^{-1}\left[\frac{2.50}{3.00}\right]$$

$$= 39.806°$$

$$\theta = \tan^{-1}\left[\frac{1.500}{3.00}\right]$$

$$= 26.565°$$

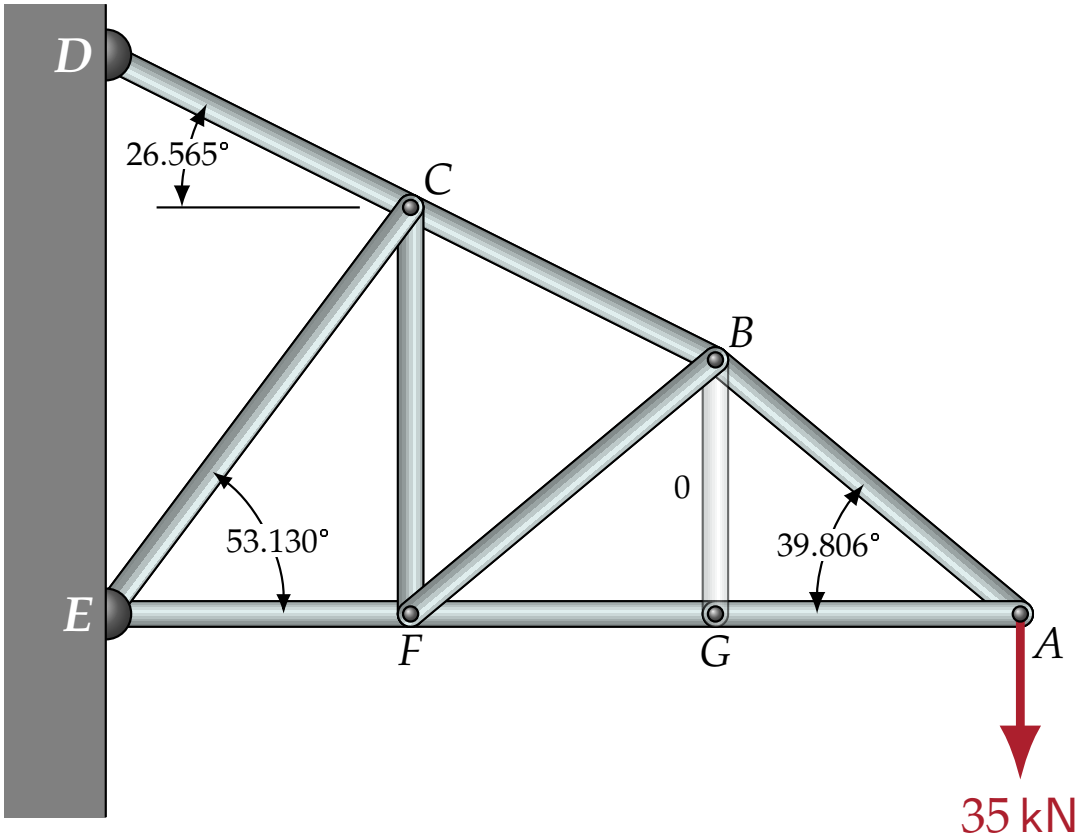


Calculate Angles

$$\angle BAG = \tan^{-1}\left[\frac{2.50}{3.00}\right]$$
$$= 39.806°$$

$$\theta = \tan^{-1}\left[\frac{1.500}{3.00}\right]$$
$$= 26.565°$$

$$\angle CEF = \tan^{-1}\left[\frac{4.00}{3.00}\right]$$
$$= 53.130°$$



Calculate Angles

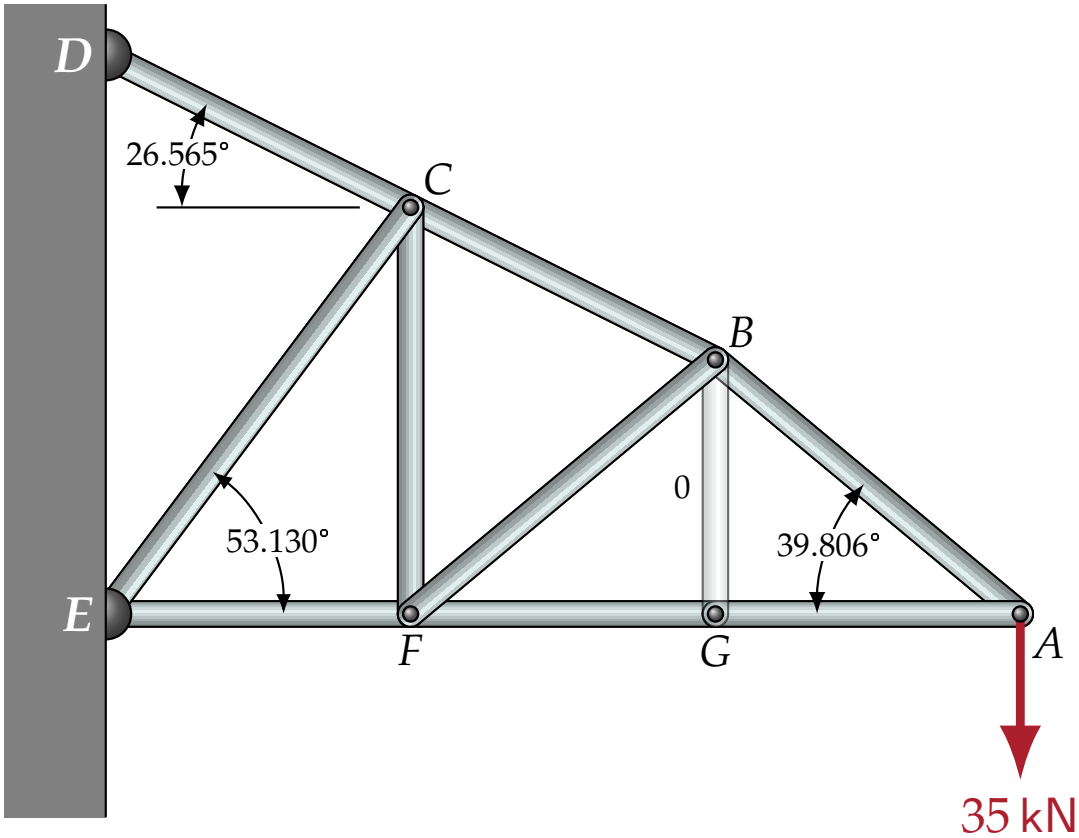
$$\angle BAG = \tan^{-1}\left[\frac{2.50}{3.00}\right]$$
$$= 39.806°$$

$$\theta = \tan^{-1}\left[\frac{1.500}{3.00}\right]$$
$$= 26.565°$$

$$\angle CEF = \tan^{-1}\left[\frac{4.00}{3.00}\right]$$
$$= 53.130°$$

Notice:

1. By inspection, truss member BG is a **zero-force** member.



Calculate Angles

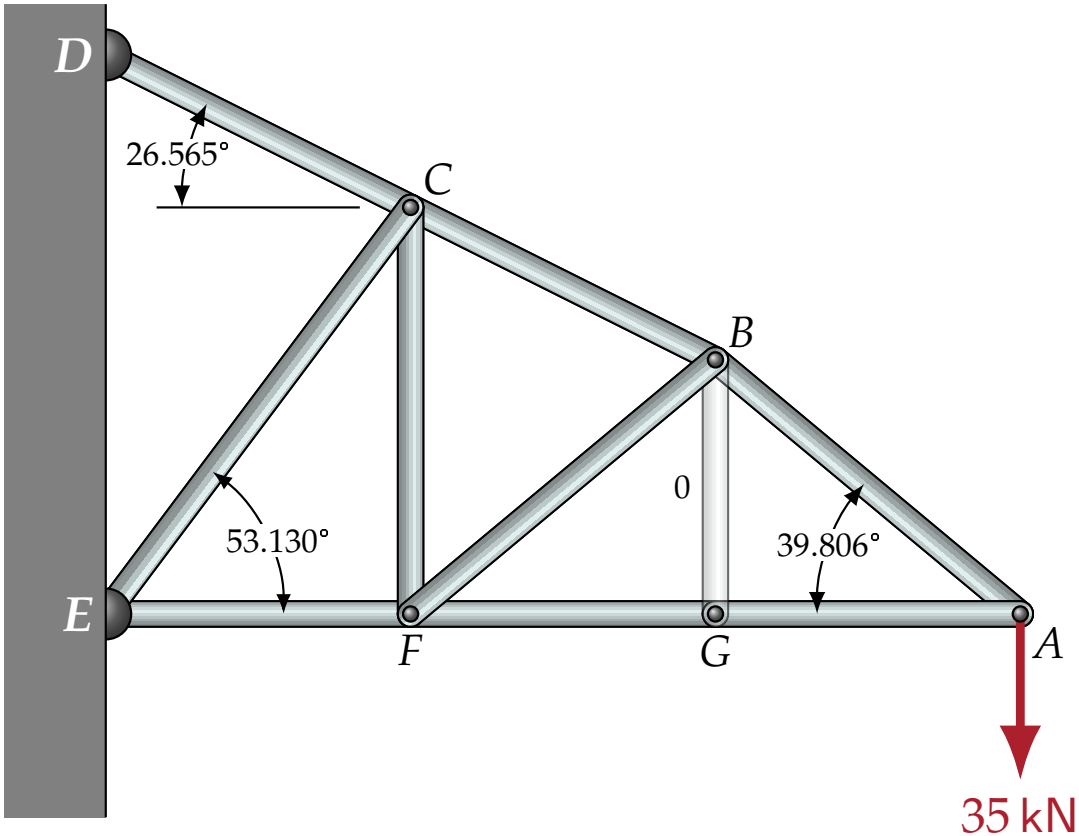
$$\angle BAG = \tan^{-1}\left[\frac{2.50}{3.00}\right]$$
$$= 39.806°$$

$$\theta = \tan^{-1}\left[\frac{1.500}{3.00}\right]$$
$$= 26.565°$$

$$\angle CEF = \tan^{-1}\left[\frac{4.00}{3.00}\right]$$
$$= 53.130°$$

Notice:

1. By inspection, truss member BG is a **zero-force** member.
2. We can start at joint A and proceed through the truss joints $A \to G \to B \to C \to F$, without calculating the reactions at D and E.



Calculate Angles

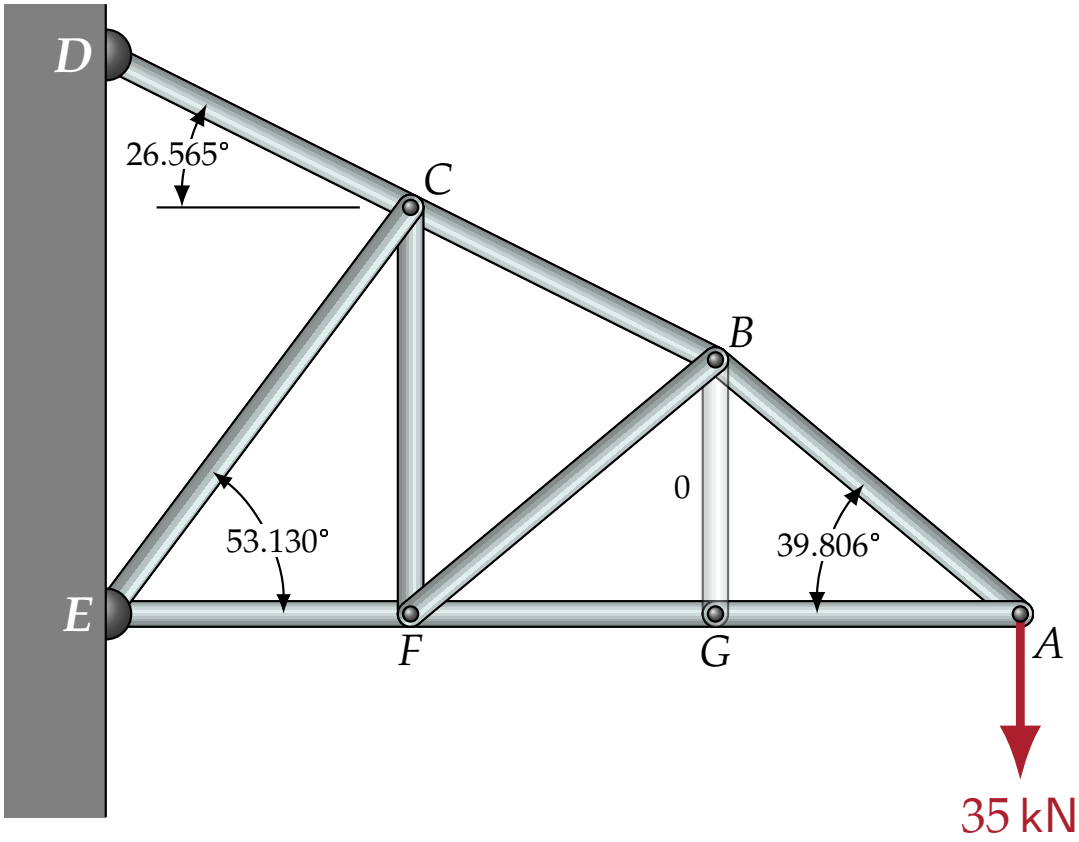
$$\angle BAG = \tan^{-1}\left[\frac{2.50}{3.00}\right]$$
$$= 39.806°$$

$$\theta = \tan^{-1}\left[\frac{1.500}{3.00}\right]$$
$$= 26.565°$$

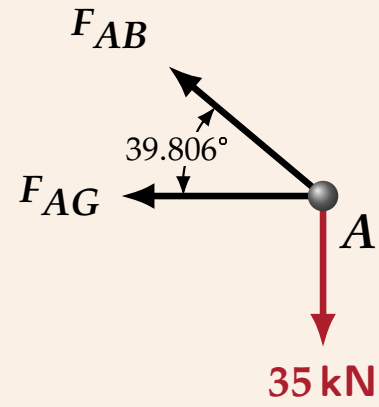
$$\angle CEF = \tan^{-1}\left[\frac{4.00}{3.00}\right]$$
$$= 53.130°$$

Notice:

1. By inspection, truss member BG is a **zero-force** member.
2. We can start at joint A and proceed through the truss joints $A \to G \to B \to C \to F$, without calculating the reactions at D and E.
3. Finding the reactions at D and E **is** useful to verify our results; if we have not made mistakes, then the sum of all forces acting at D (including the reaction) will equal 0. Similarly, the sum of all forces acting at E will equal 0.

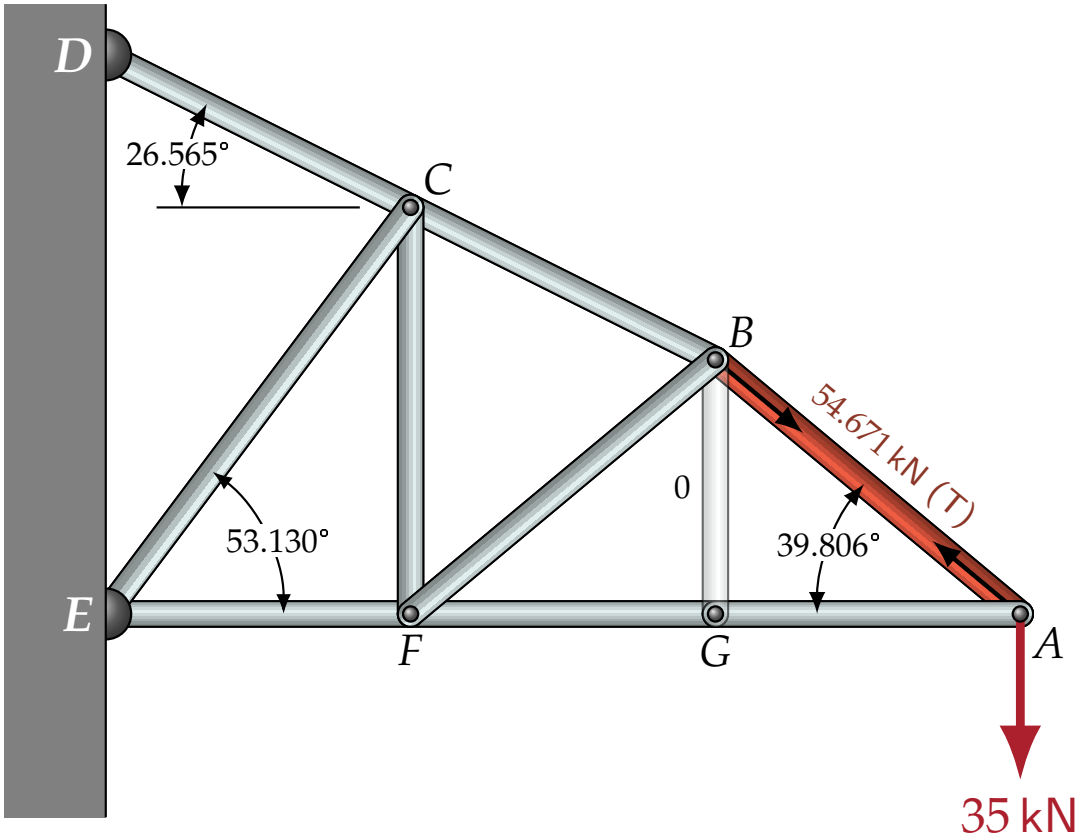


Free Body Diagram: A

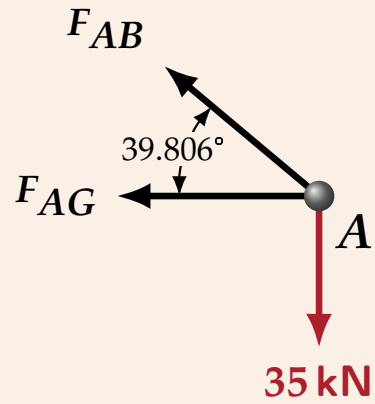


Joint A

Sum the y components first, so that we have only one variable and don't need to solve a system of simultaneous equations:



Free Body Diagram: A

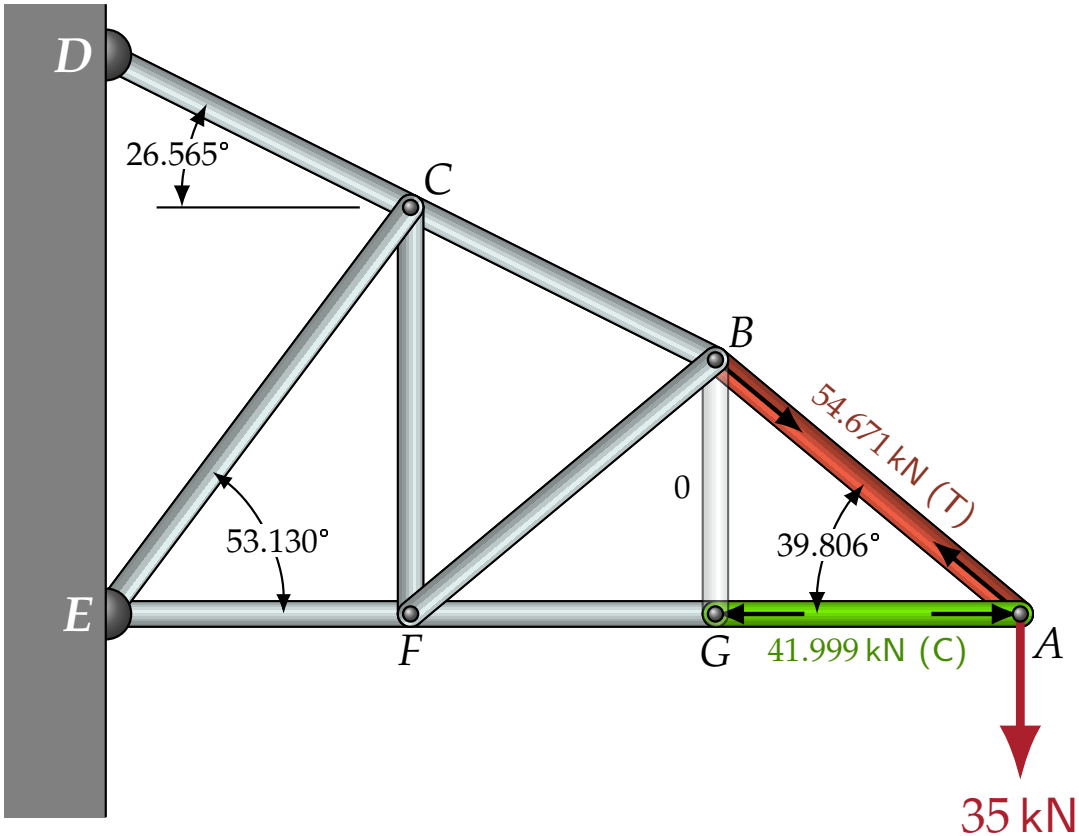


Joint A

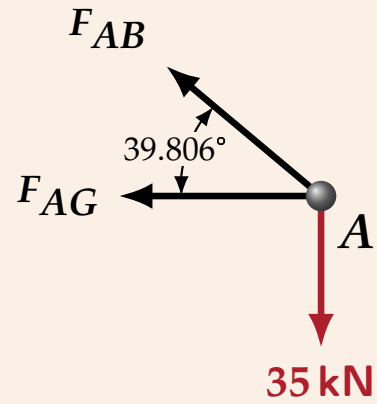
Sum the y components first, so that we have only one variable and don't need to solve a system of simultaneous equations:

$$\Sigma F_y = F_{AB} \sin 39.806° - 35 \text{ kN} = 0$$

$$\Rightarrow F_{AB} = 54.671 \text{ kN}$$



Free Body Diagram: A

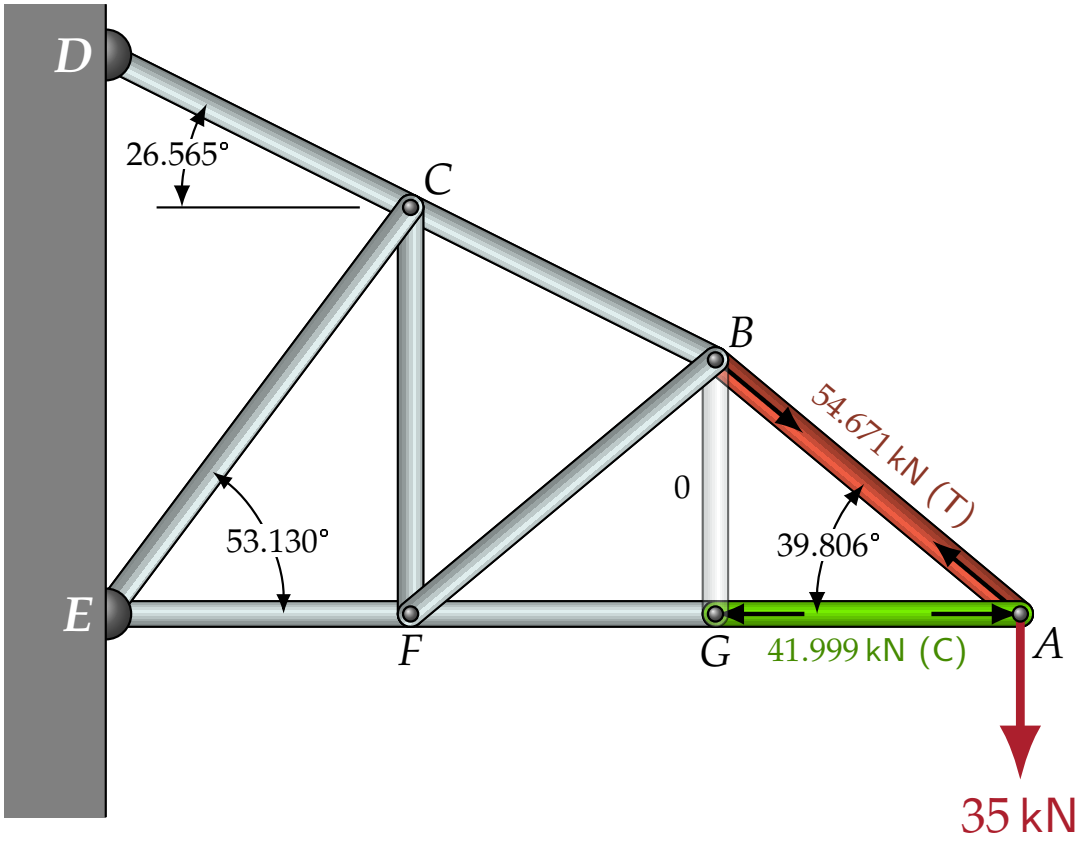


Joint A

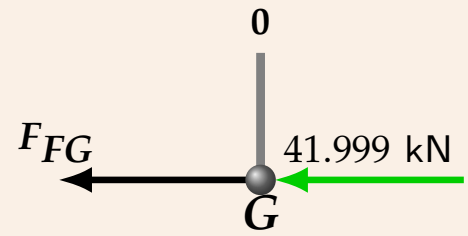
Sum the y components first, so that we have only one variable and don't need to solve a system of simultaneous equations:

$$\Sigma F_y = F_{AB} \sin 39.806° - 35 \text{ kN} = 0$$
$$\Rightarrow F_{AB} = 54.671 \text{ kN}$$

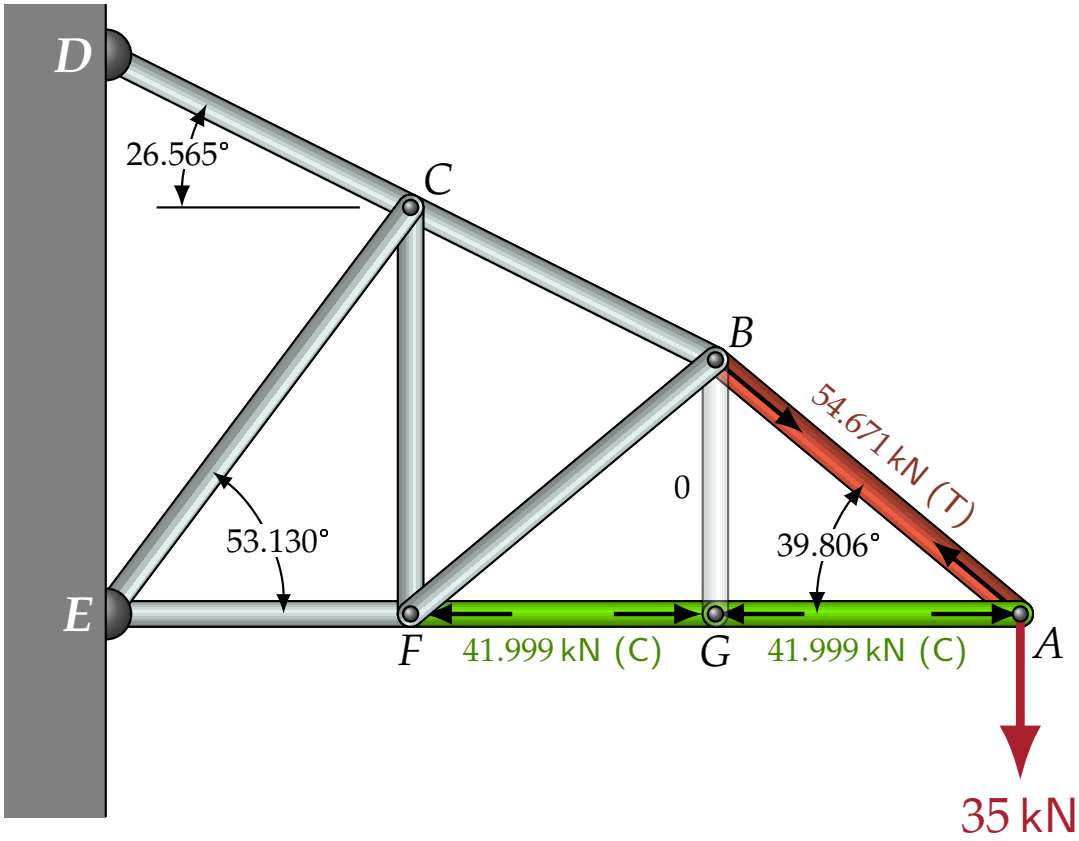
$$\Sigma F_x = -F_{AB} \cos 39.806° - F_{AG} = 0$$
$$\Rightarrow F_{AG} = -54.671 \cos 39.806° \text{ kN}$$
$$= -41.999 \text{ kN}$$



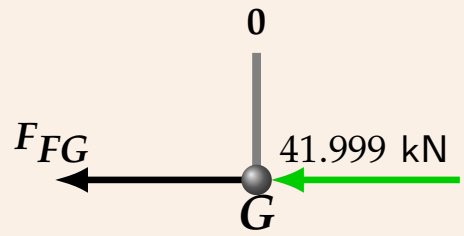
Free Body Diagram: G



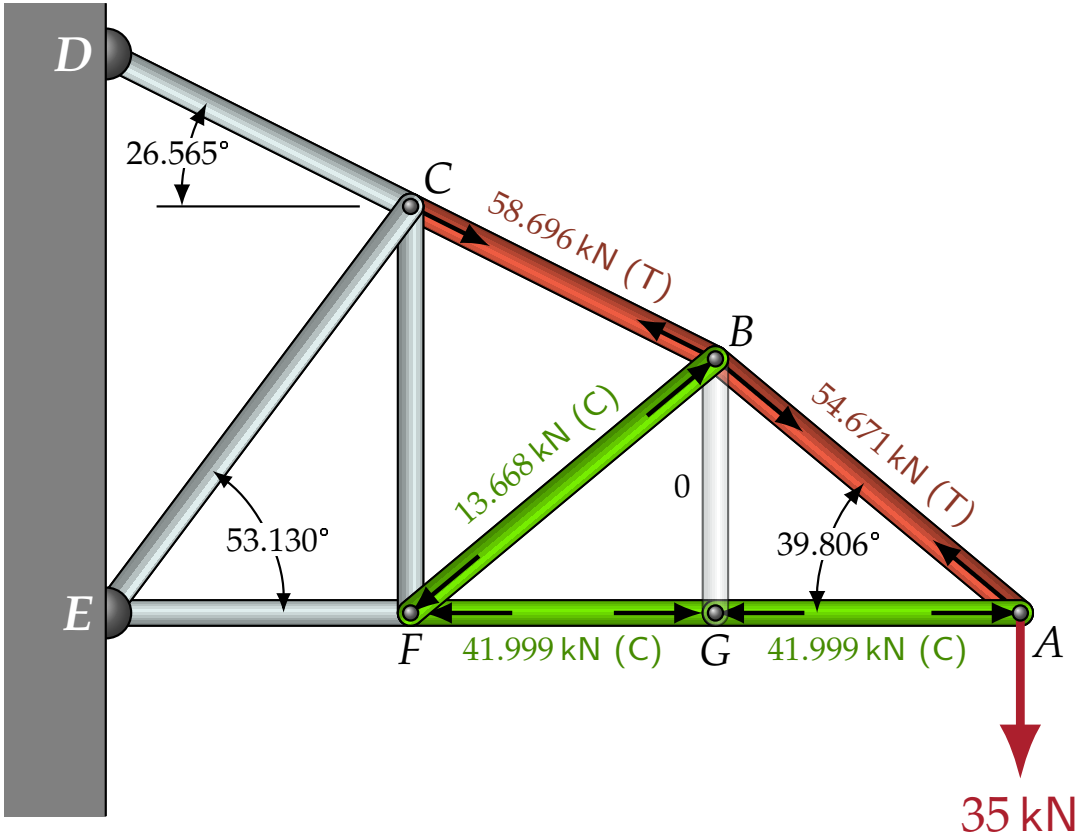
Joint G

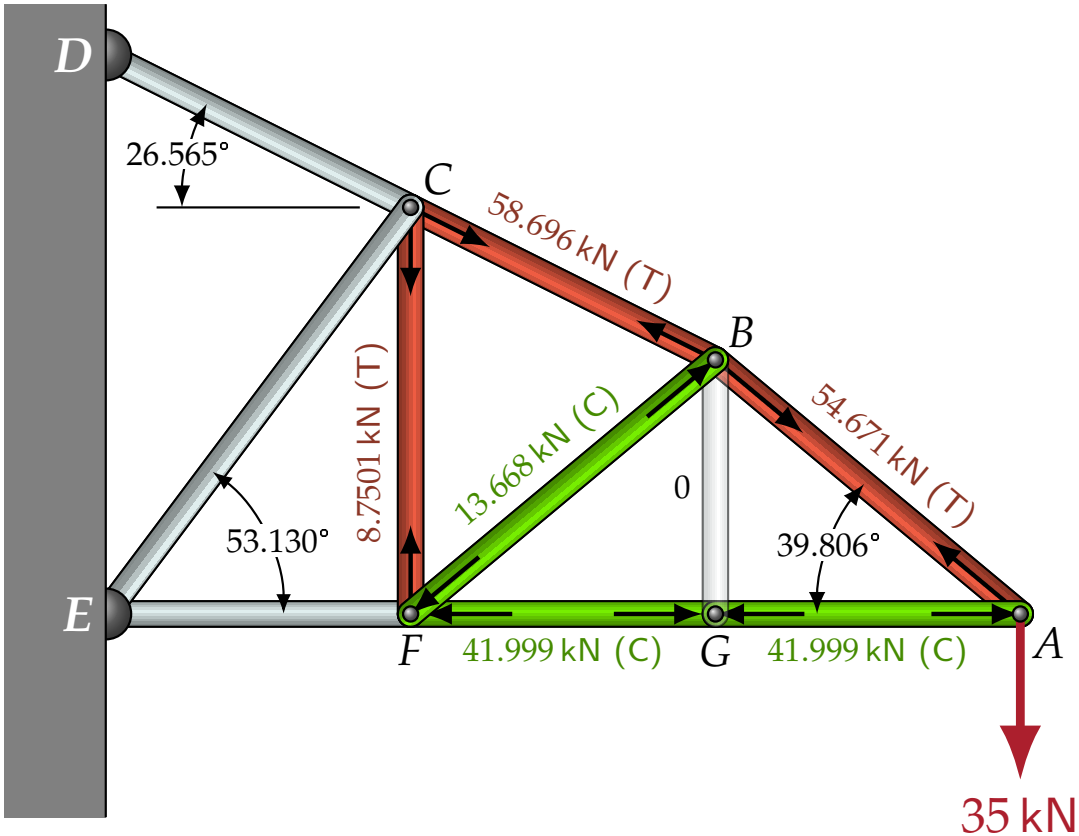


Free Body Diagram: G

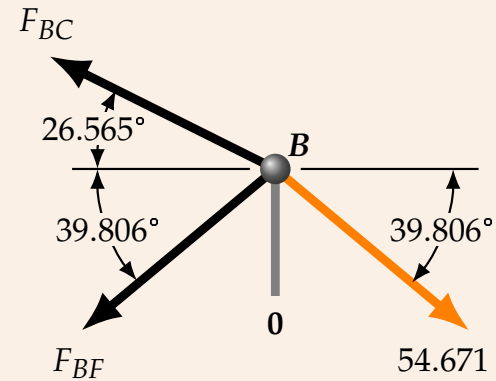


Joint G


D
26.565°
C
58.696 kN (T)
B
54.671 kN (T)
13.668 kN (C)
0
53.130°
39.806°
E
F
41.999 kN (C)
G
41.999 kN (C)
A
35 kN



Free Body Diagram: B



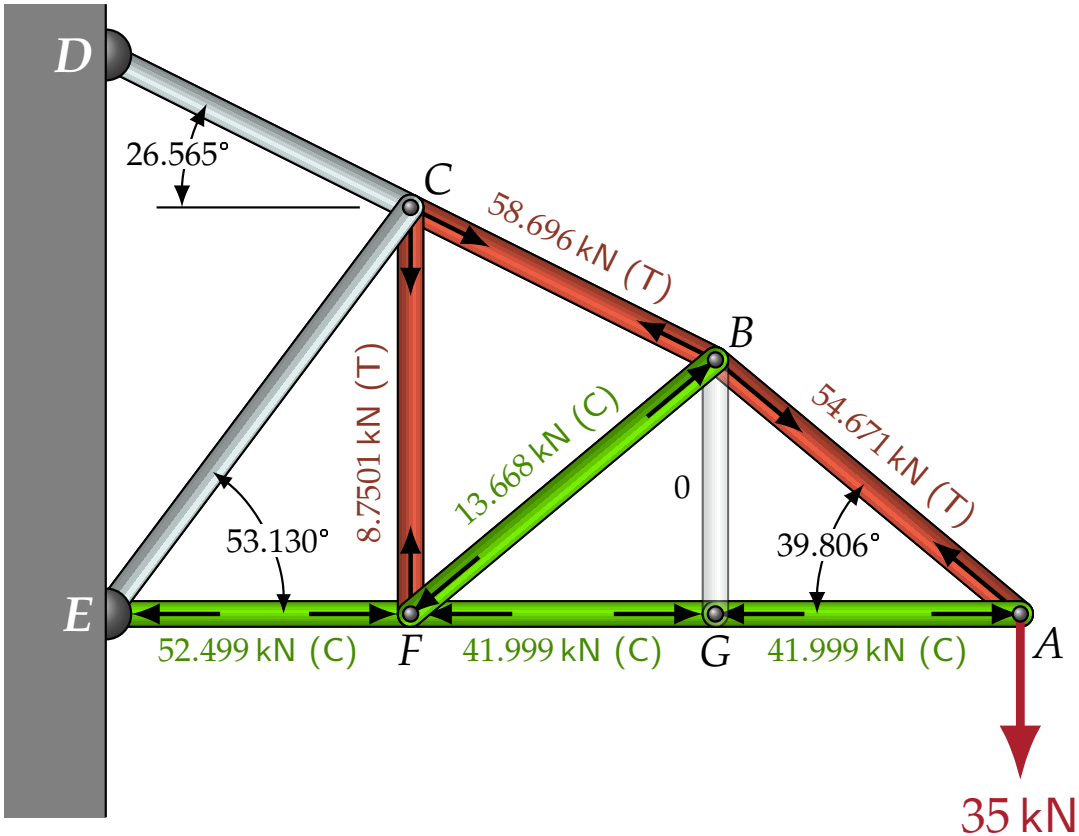
Joint B

$$\Sigma F_y = F_{BC}\sin 26.565° - F_{BF}\sin 39.806° - 54.671\sin 39.806° \text{ kN} = 0$$

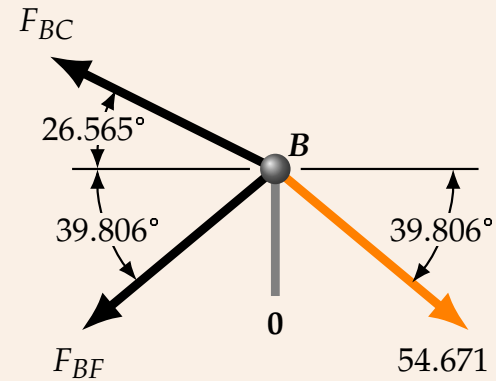
$$\Rightarrow \quad F_{BC}\sin 26.565° - F_{BF}\sin 39.806° = 35.000 \text{ kN}$$

$$\Sigma F_x = 54.671\cos 39.806° - F_{BC}\cos 26.565° - F_{BF}\cos 39.806° = 0$$

$$\Rightarrow \quad F_{BC}\cos 26.565° + F_{BF}\cos 39.806° = 41.999 \text{ kN}$$



Free Body Diagram: B



Joint B

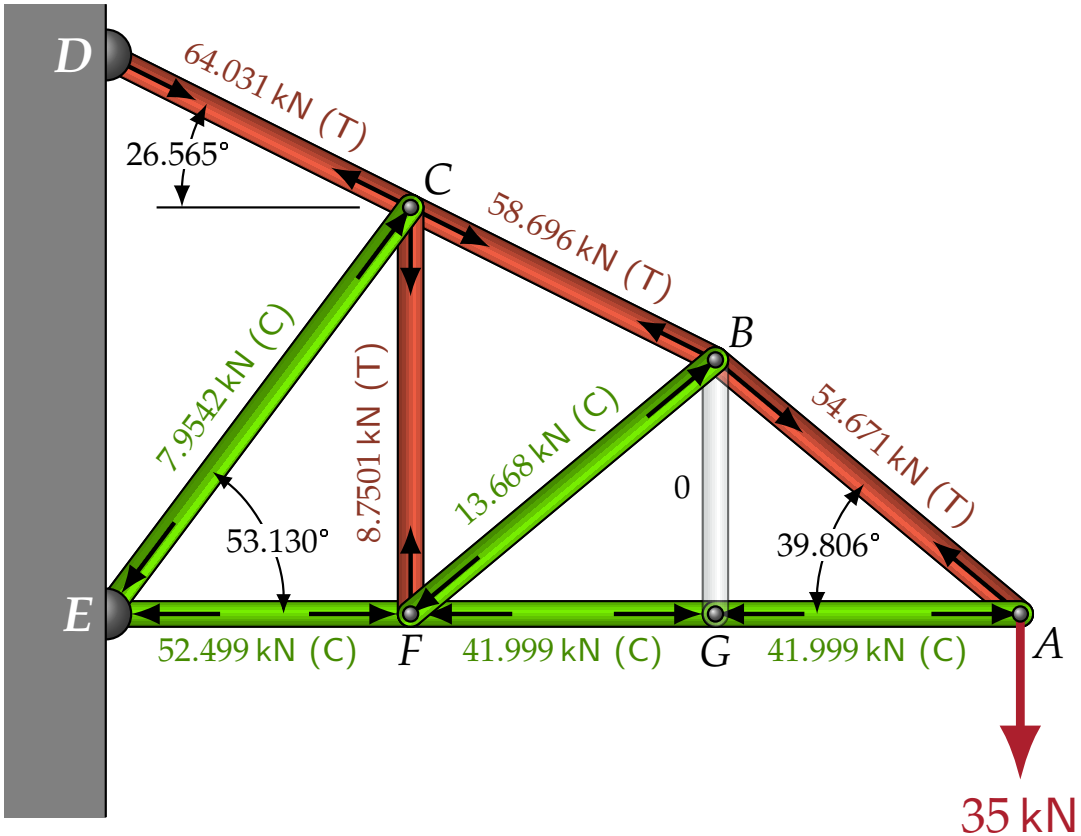
$$\Sigma F_y = F_{BC}\sin 26.565° - F_{BF}\sin 39.806° - 54.671\sin 39.806° \text{ kN} = 0$$

$$\Rightarrow \quad F_{BC}\sin 26.565° - F_{BF}\sin 39.806° = 35.000 \text{ kN}$$

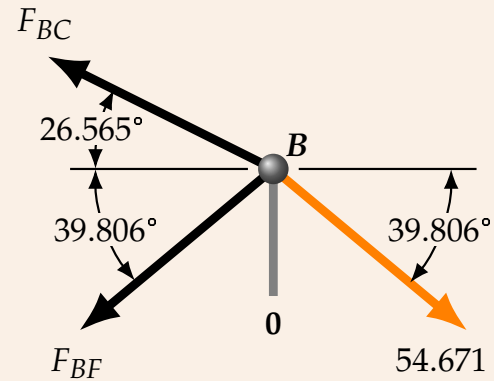
$$\Sigma F_x = 54.671\cos 39.806° - F_{BC}\cos 26.565° - F_{BF}\cos 39.806° = 0$$

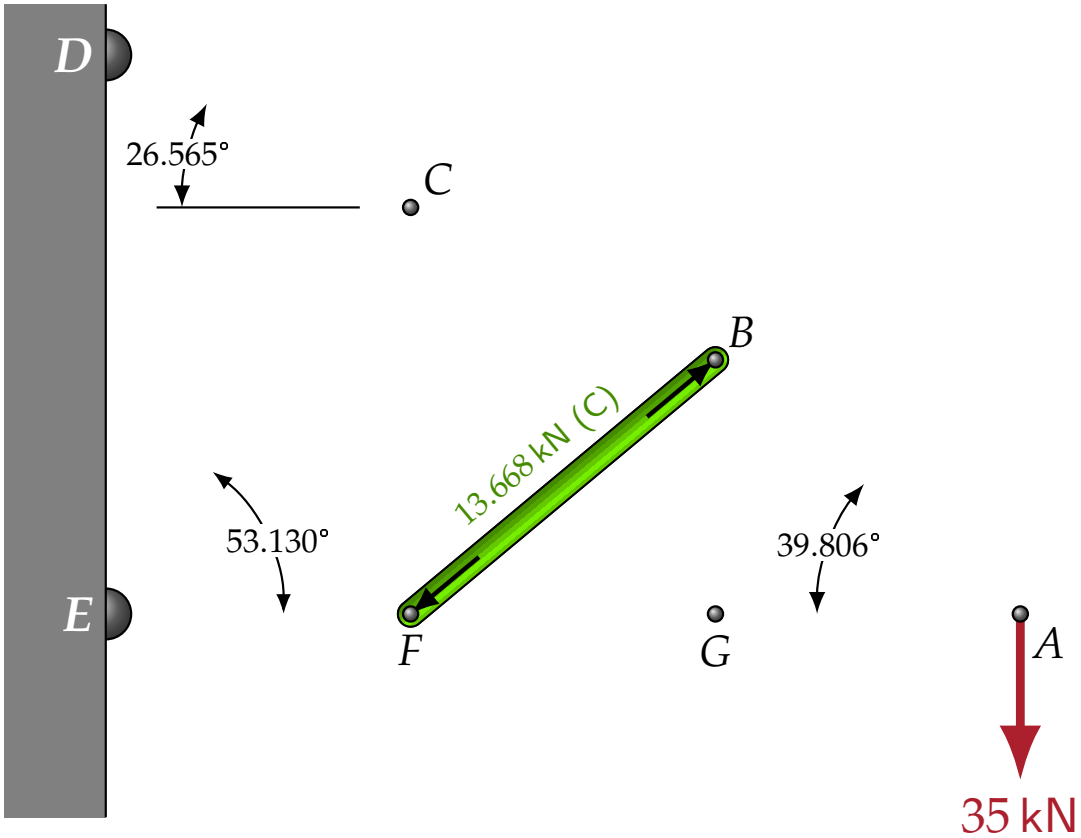
$$\Rightarrow \quad F_{BC}\cos 26.565° + F_{BF}\cos 39.806° = 41.999 \text{ kN}$$

Use the **system-solver** on your calculator to find $F_{BC} = 58.696$ kN, $F_{BF} = -13.668$ kN

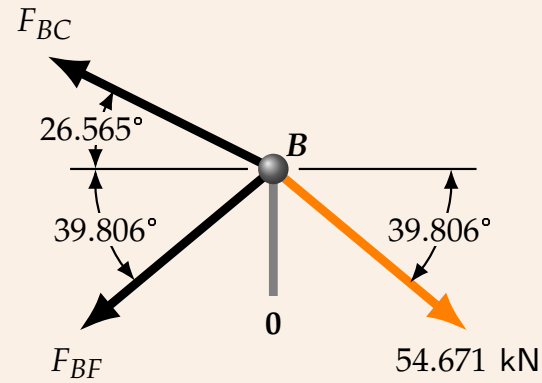


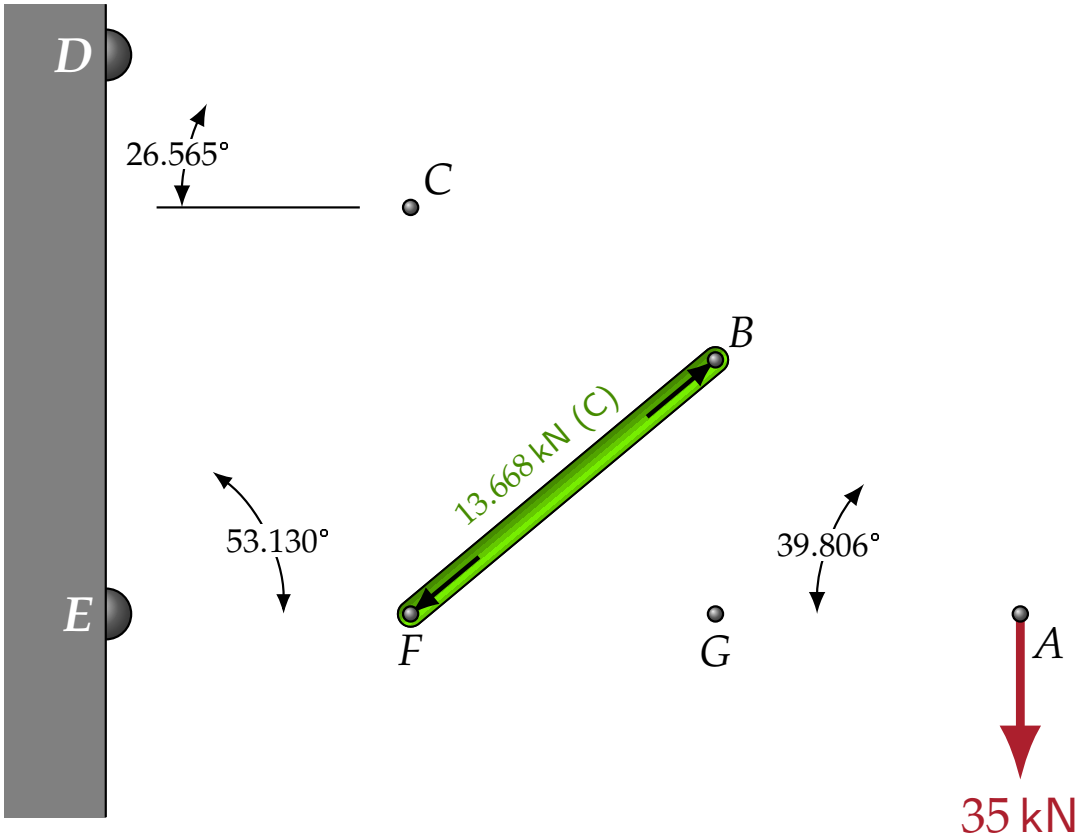
Free Body Diagram: B



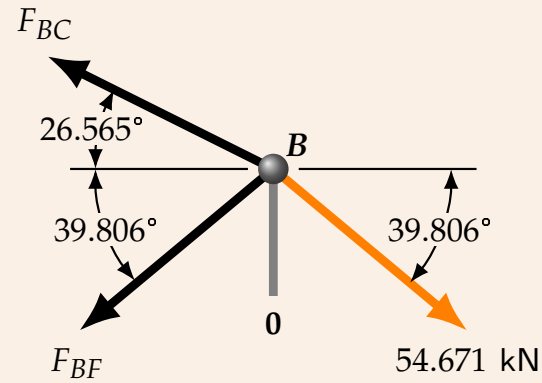


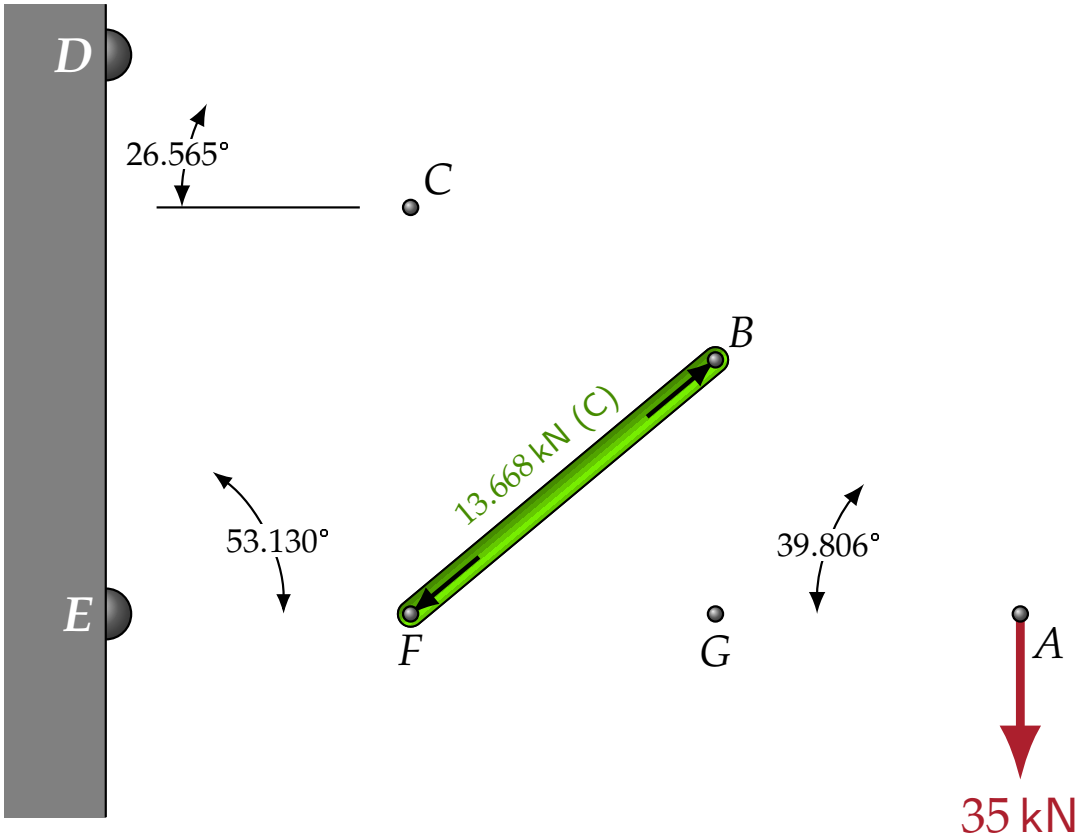
Free Body Diagram: B



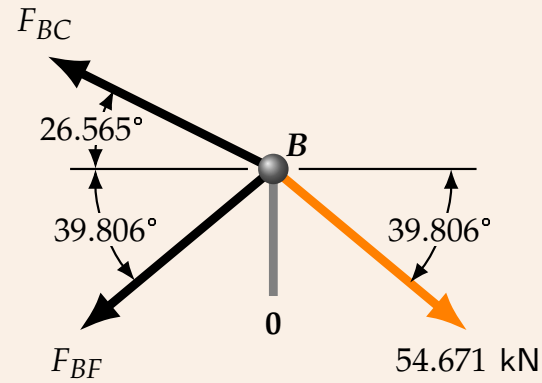


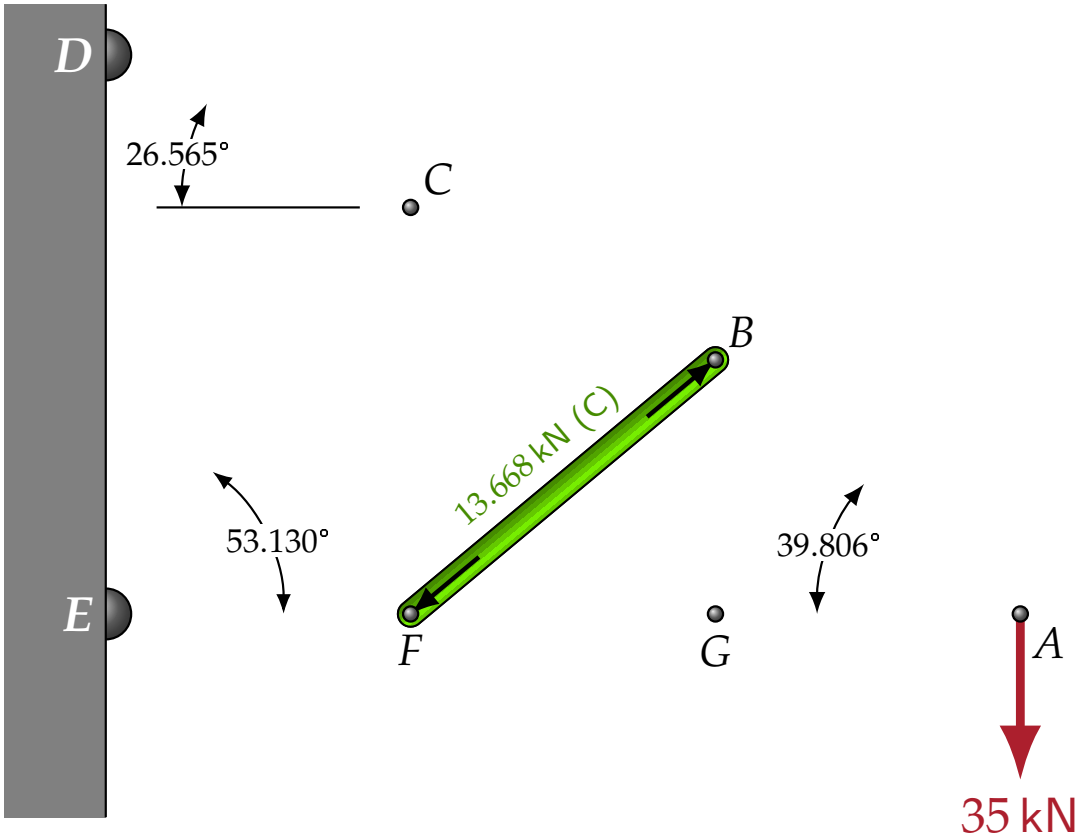
Free Body Diagram: B

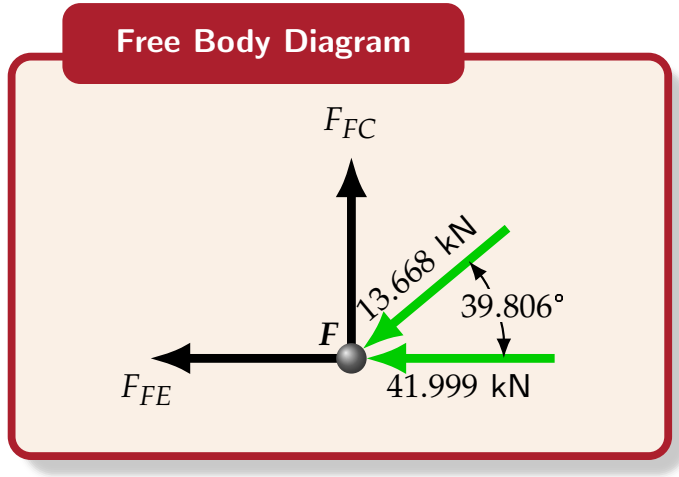


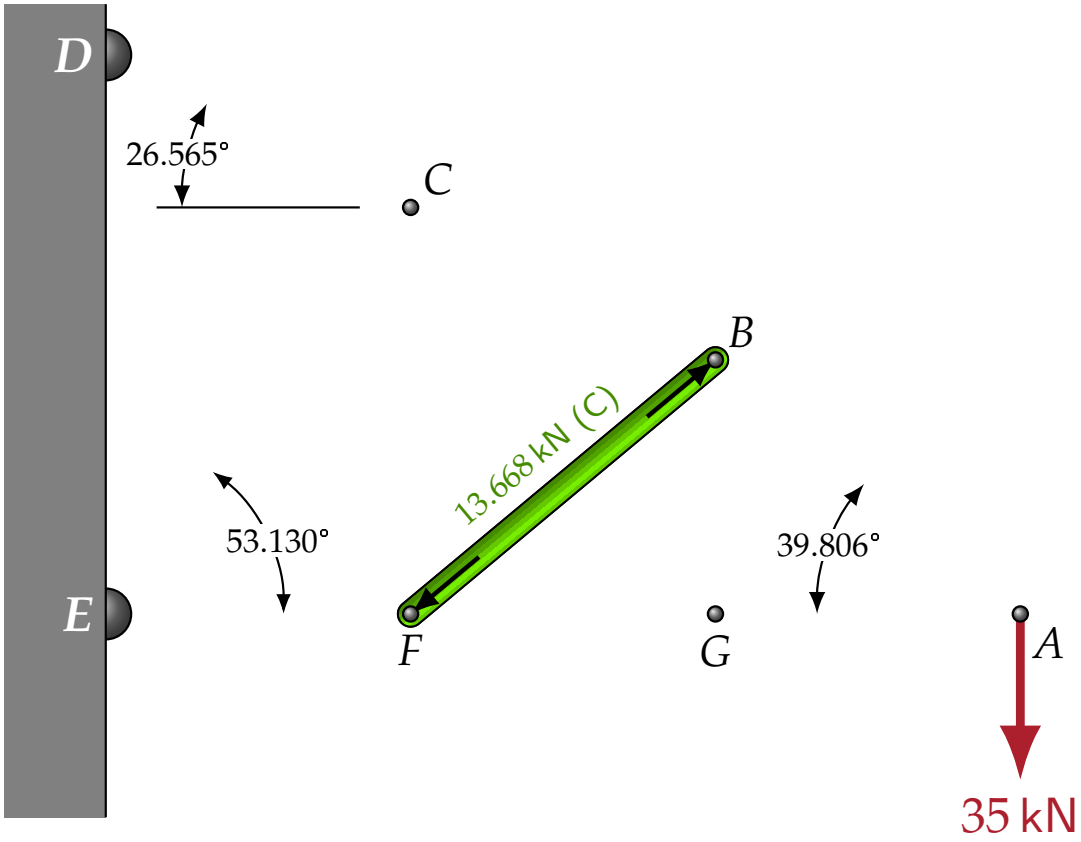


Free Body Diagram: B

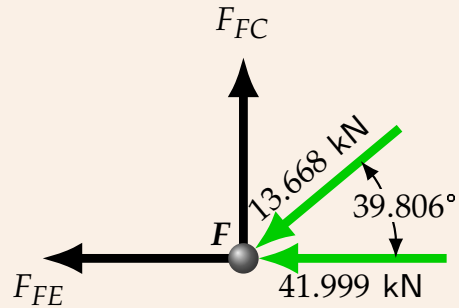



D
26.565°
C
B
13.668 kN (C)
53.130°
39.806°
E
F
G
A
35 kN


Free Body Diagram
F_{FC}
13.668 kN
39.806°
F
F_{FE}
41.999 kN



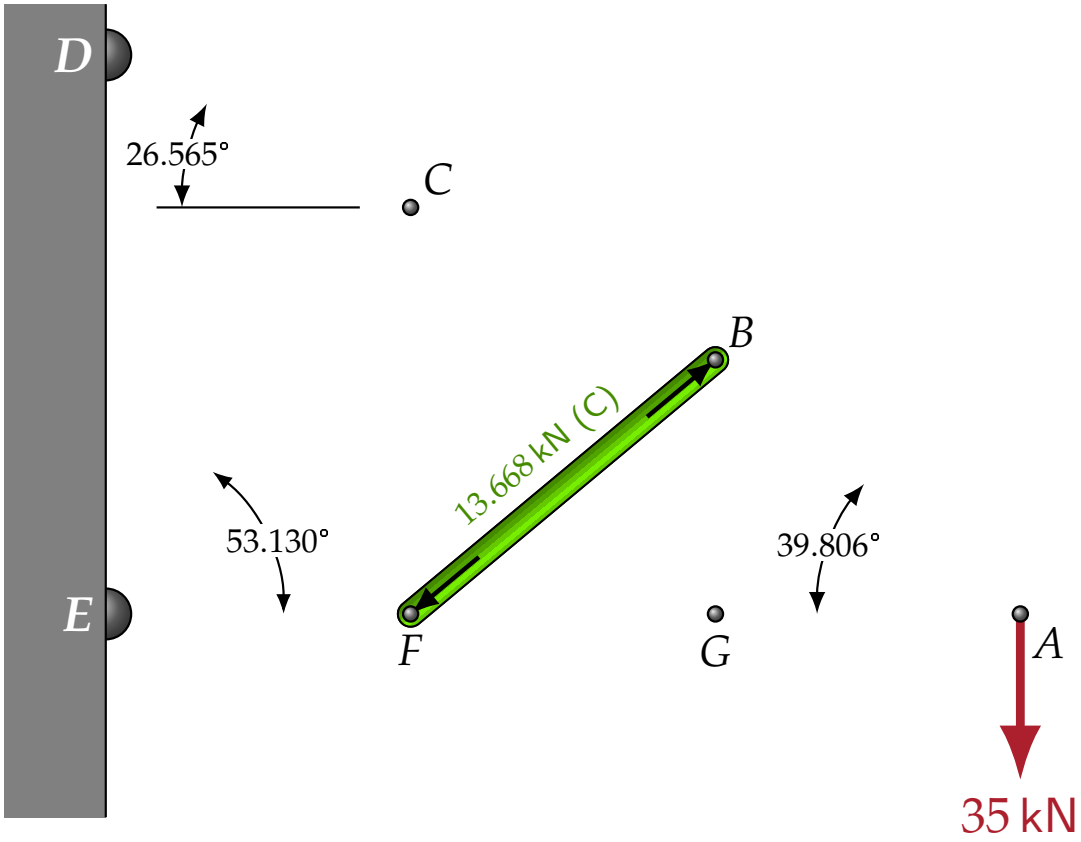
Free Body Diagram



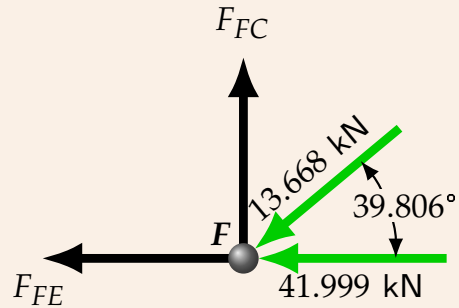
Joint F

$$\Sigma F_x = -F_{FE} - 13.668 \cos 39.806° \text{kN} - 41.999 \text{ kN} = 0$$

$$\Rightarrow F_{FE} = -52.499 \text{ kN}$$



Free Body Diagram



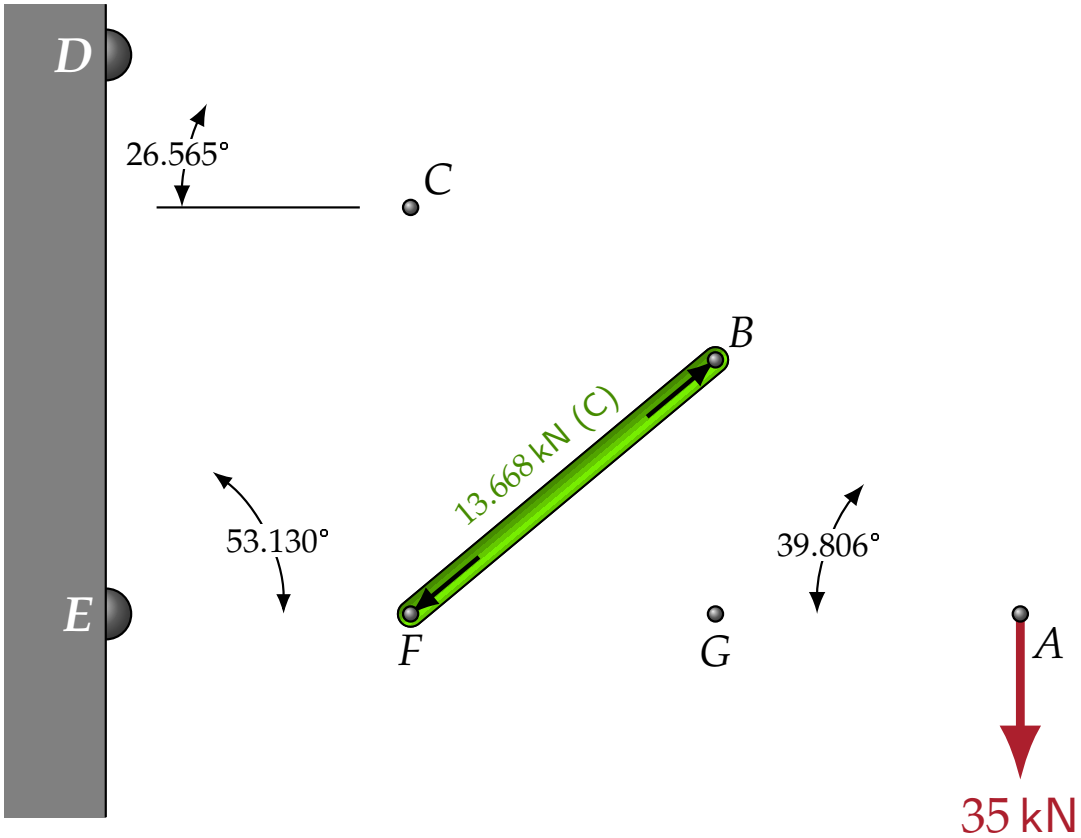
Joint F

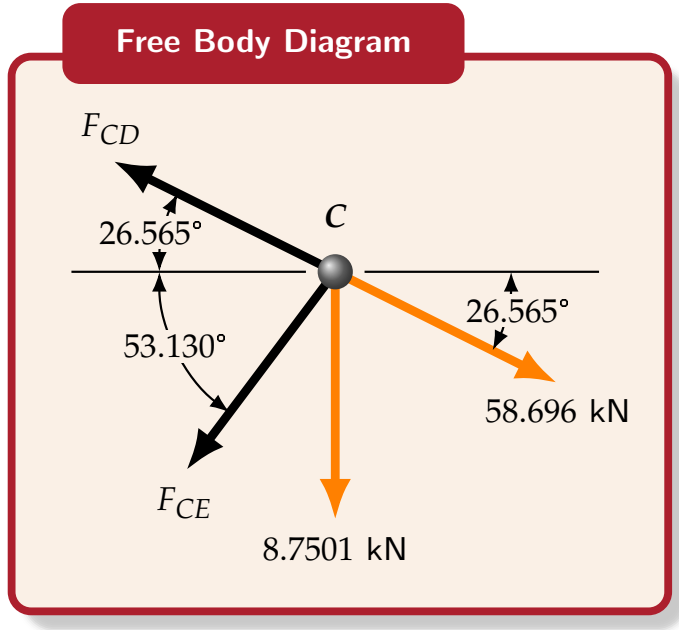
$$\Sigma F_x = -F_{FE} - 13.668 \cos 39.806° \text{kN} - 41.999 \text{ kN} = 0$$

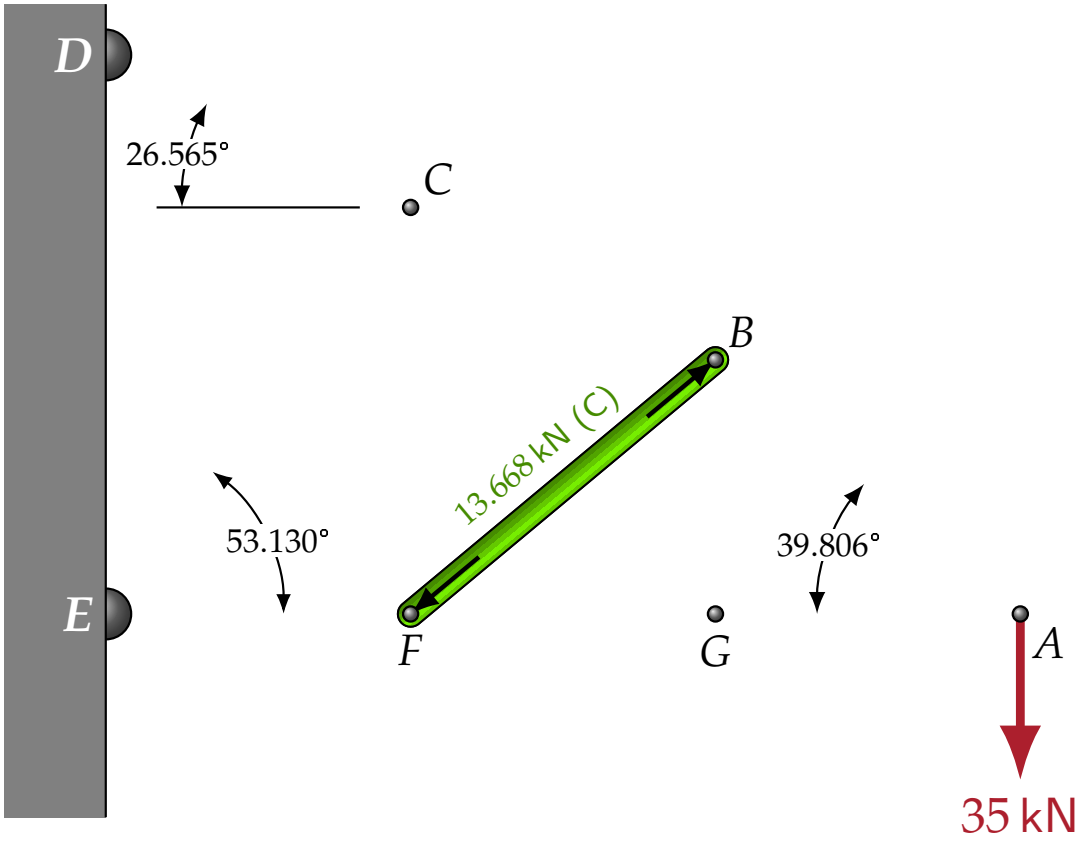
$$\Rightarrow F_{FE} = -52.499 \text{ kN}$$

$$\Sigma F_y = F_{FC} - 13.668 \sin 39.806° = 0$$

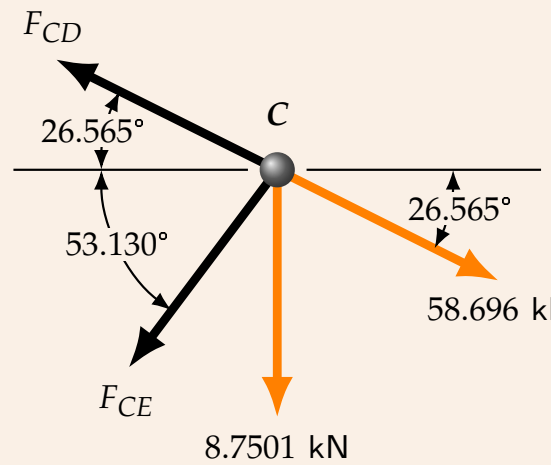
$$\Rightarrow F_{FC} = 8.7501 \text{ kN}$$


D
26.565°
C
B
13.668 kN (C)
53.130°
39.806°
E
F
G
A
35 kN


Free Body Diagram
F_{CD}
26.565°
C
26.565°
53.130°
58.696 kN
F_{CE}
8.7501 kN



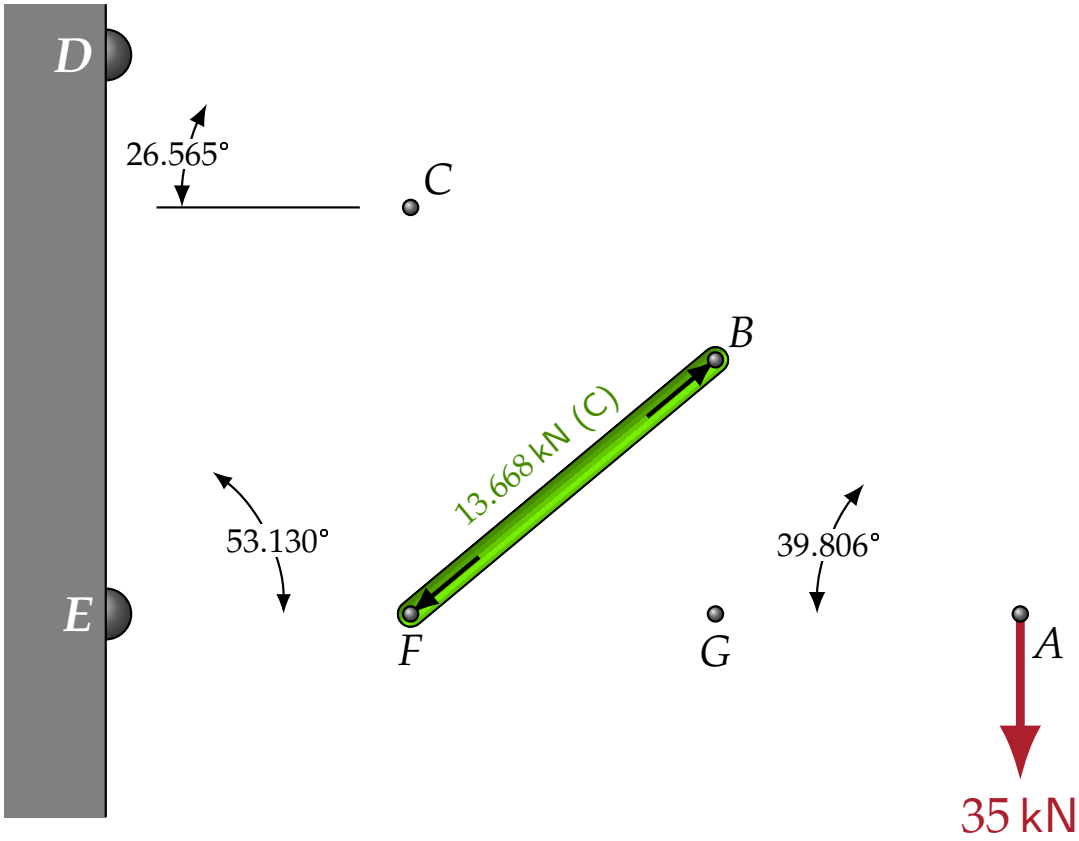
Free Body Diagram



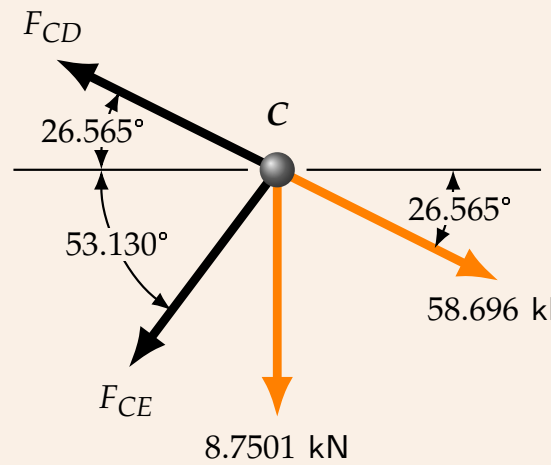
Joint C

$$\Sigma F_x = -F_{CD}\cos 26.565° - F_{CE}\cos 53.130° + 58.696\cos 26.565° = 0$$
$$\Rightarrow F_{CD}\cos 26.565° + F_{CE}\cos 53.130° = 52.499$$

$$\Sigma F_y = F_{CD}\sin 26.565° - F_{CE}\sin 53.130° - 8.7501 - 58.696\sin 26.565° = 0$$
$$\Rightarrow F_{CD}\sin 26.565° - F_{CE}\sin 53.130° = 34.999$$



Free Body Diagram

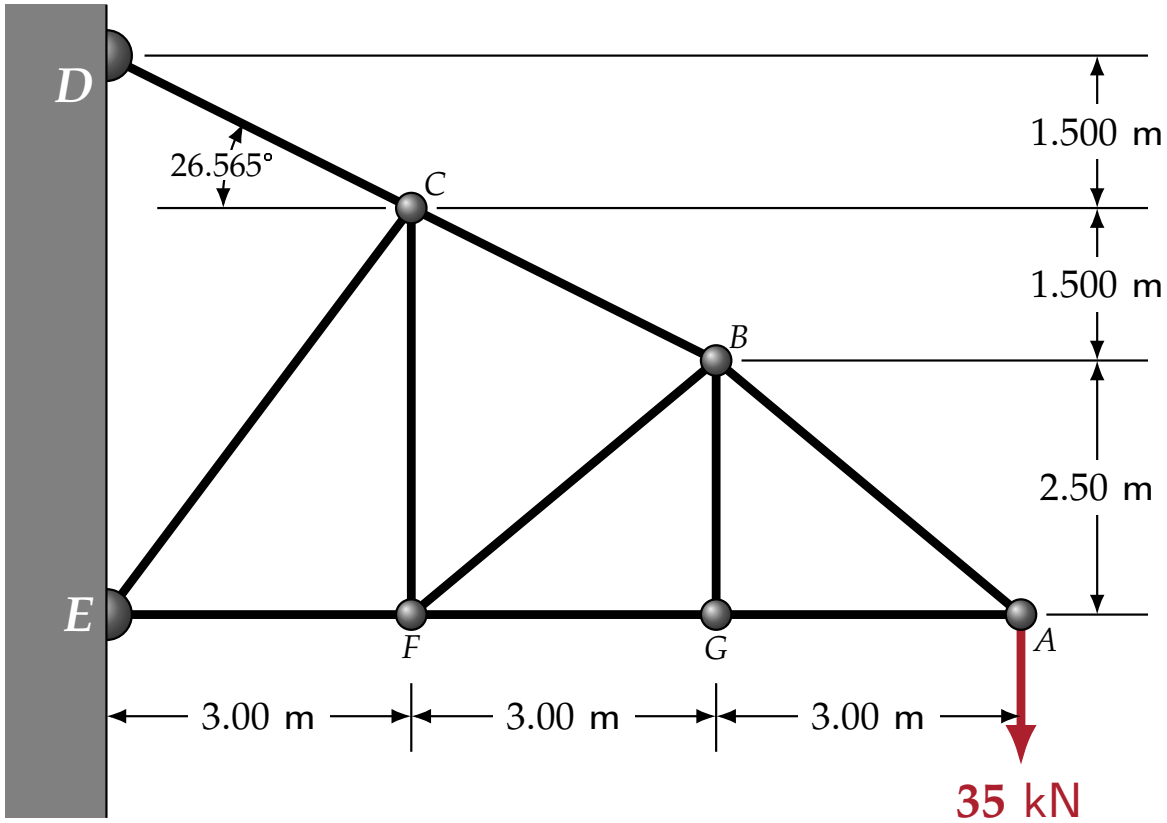


Joint C

$$\Sigma F_x = -F_{CD}\cos 26.565° - F_{CE}\cos 53.130° + 58.696\cos 26.565° = 0$$
$$\Rightarrow F_{CD}\cos 26.565° + F_{CE}\cos 53.130° = 52.499$$

$$\Sigma F_y = F_{CD}\sin 26.565° - F_{CE}\sin 53.130° - 8.7501 - 58.696\sin 26.565° = 0$$
$$\Rightarrow F_{CD}\sin 26.565° - F_{CE}\sin 53.130° = 34.999$$

From your calculator: $F_{CD} = 64.031$ kN, $F_{CE} = -7.9542$ kN



Finished. . .

$AB = 54.7$ kN (T)

$AG = 42.0$ kN (C)

$BC = 58.7$ kN (T)

$BF = 13.69$ kN (C)

$BG = 0$

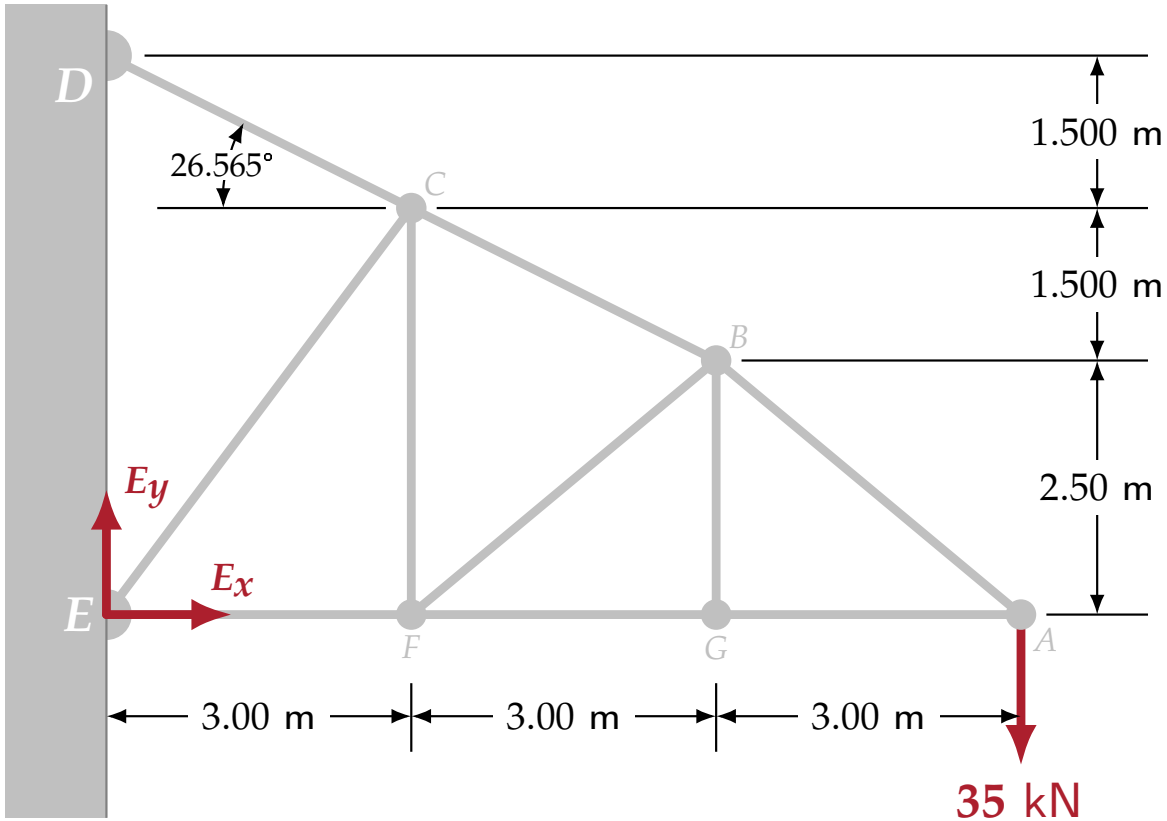
$CD = 64.0$ kN (T)

$CE = 7.95$ kN (C)

$CF = 8.75$ kN (T)

$EF = 52.5$ kN (C)

But are they correct?



Finished. . .

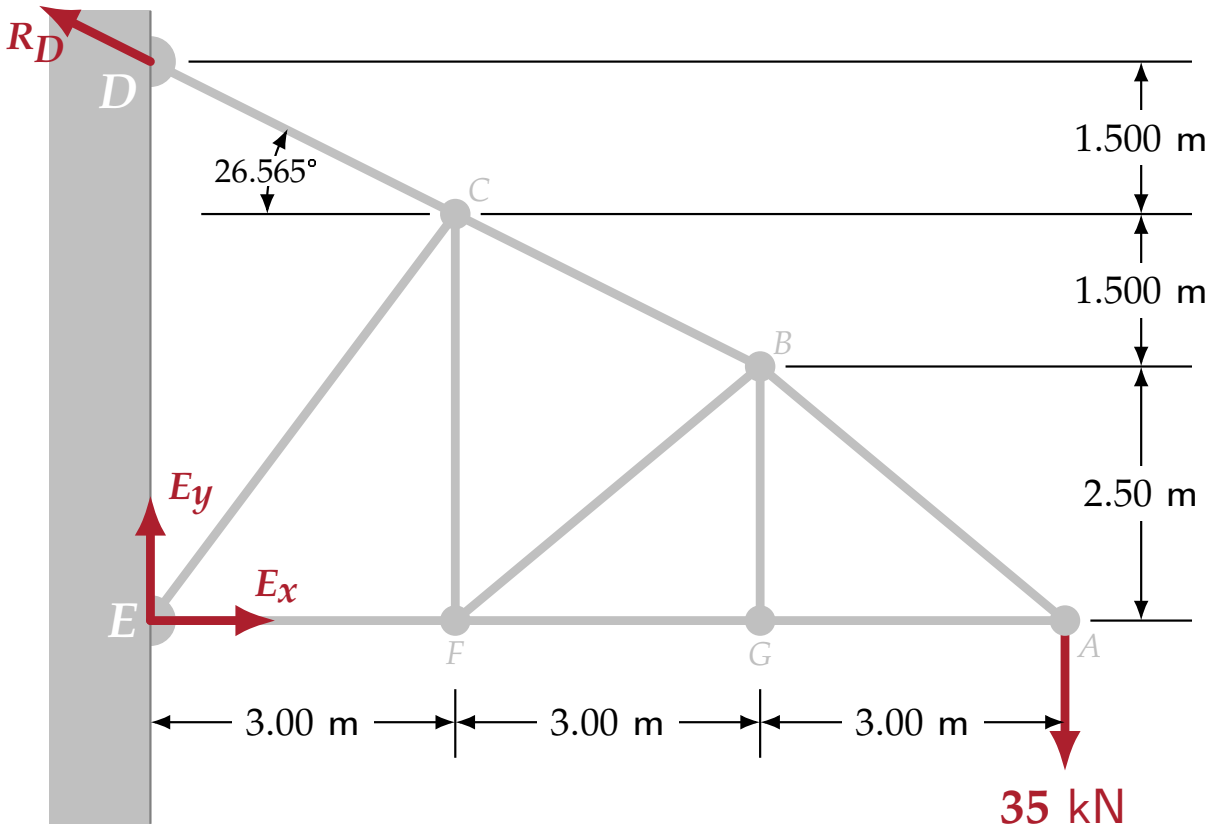
$AB = 54.7$ kN (T)
$AG = 42.0$ kN (C)
$BC = 58.7$ kN (T)
$BF = 13.69$ kN (C)
$BG = 0$
$CD = 64.0$ kN (T)
$CE = 7.95$ kN (C)
$CF = 8.75$ kN (T)
$EF = 52.5$ kN (C)

But are they correct?

Check The Results!

Consider only the external forces acting on the truss:

1. There is a reaction at the pinned connection at E,



Finished. . .

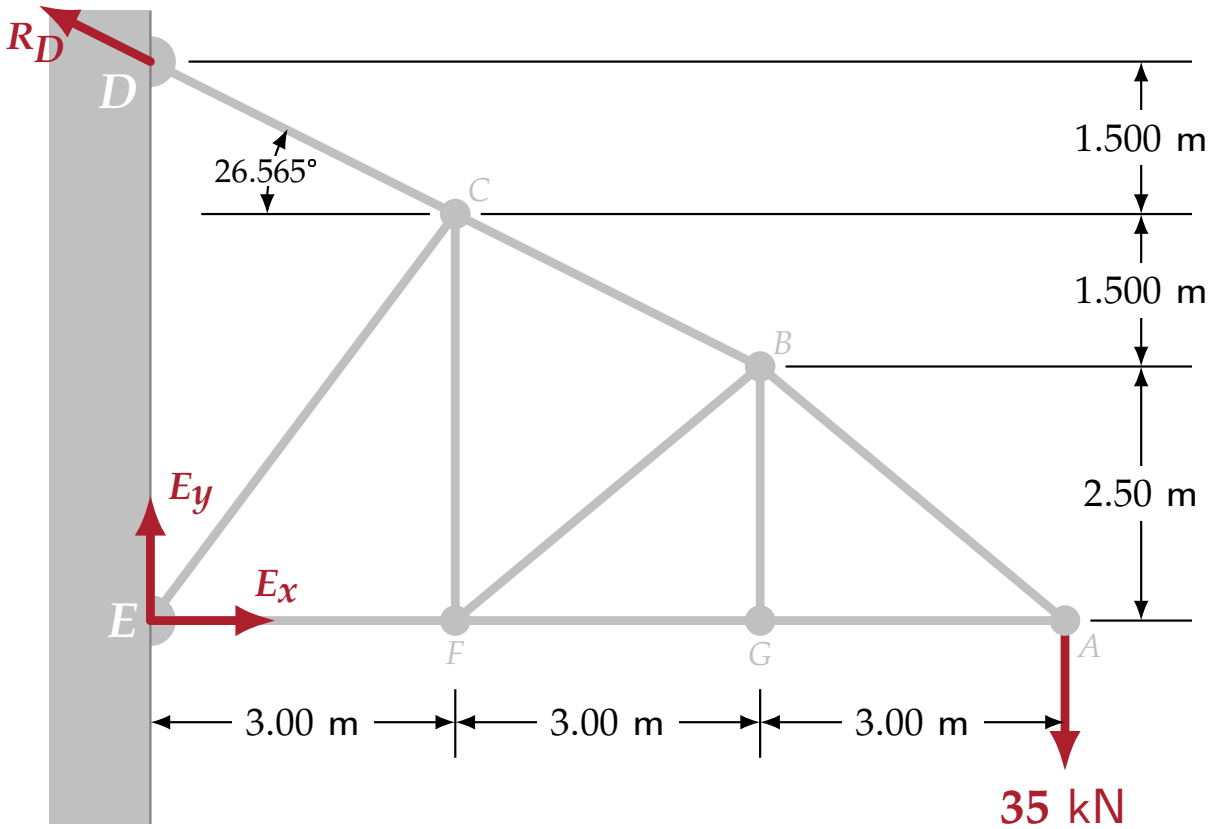
$AB = 54.7$ kN (T)
$AG = 42.0$ kN (C)
$BC = 58.7$ kN (T)
$BF = 13.69$ kN (C)
$BG = 0$
$CD = 64.0$ kN (T)
$CE = 7.95$ kN (C)
$CF = 8.75$ kN (T)
$EF = 52.5$ kN (C)

But are they correct?

Check The Results!

Consider only the external forces acting on the truss:

1. There is a reaction at the pinned connection at E,
2. There is a connection at D with known direction (CD is a two-force member so the reaction at D has the same line of action as CD.)



Finished. . .

$AB = 54.7$ kN (T)

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$BC = 58.7$ kN (T)

$BF = 13.69$ kN (C)

$BG = 0$

$CD = 64.0$ kN (T)

$CE = 7.95$ kN (C)

$CF = 8.75$ kN (T)

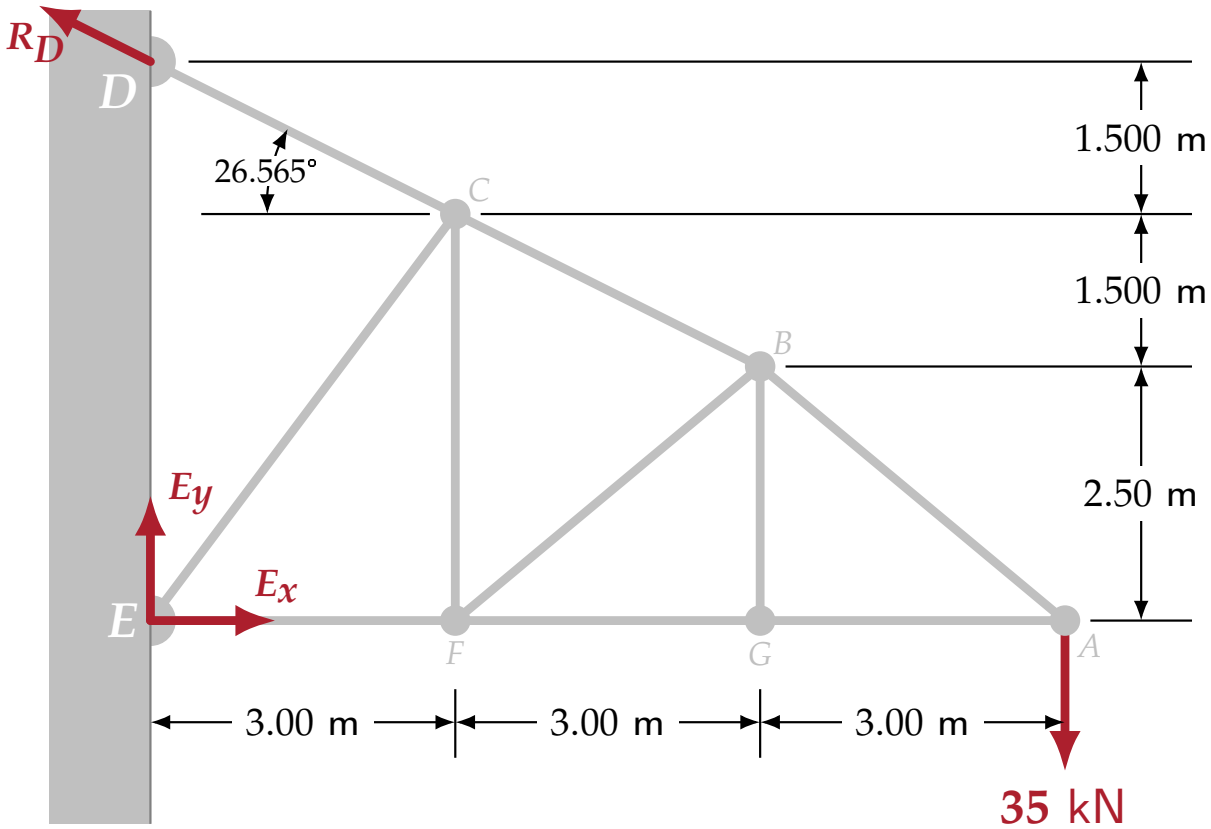
$EF = 52.5$ kN (C)

But are they correct?

Check The Results!

Consider only the external forces acting on the truss:

1. There is a reaction at the pinned connection at E,
2. There is a connection at D with known direction (CD is a two-force member so the reaction at D has the same line of action as CD.)
3. There is a 35 kN load at A.



Finished. . .

$AB = 54.7$ kN (T)
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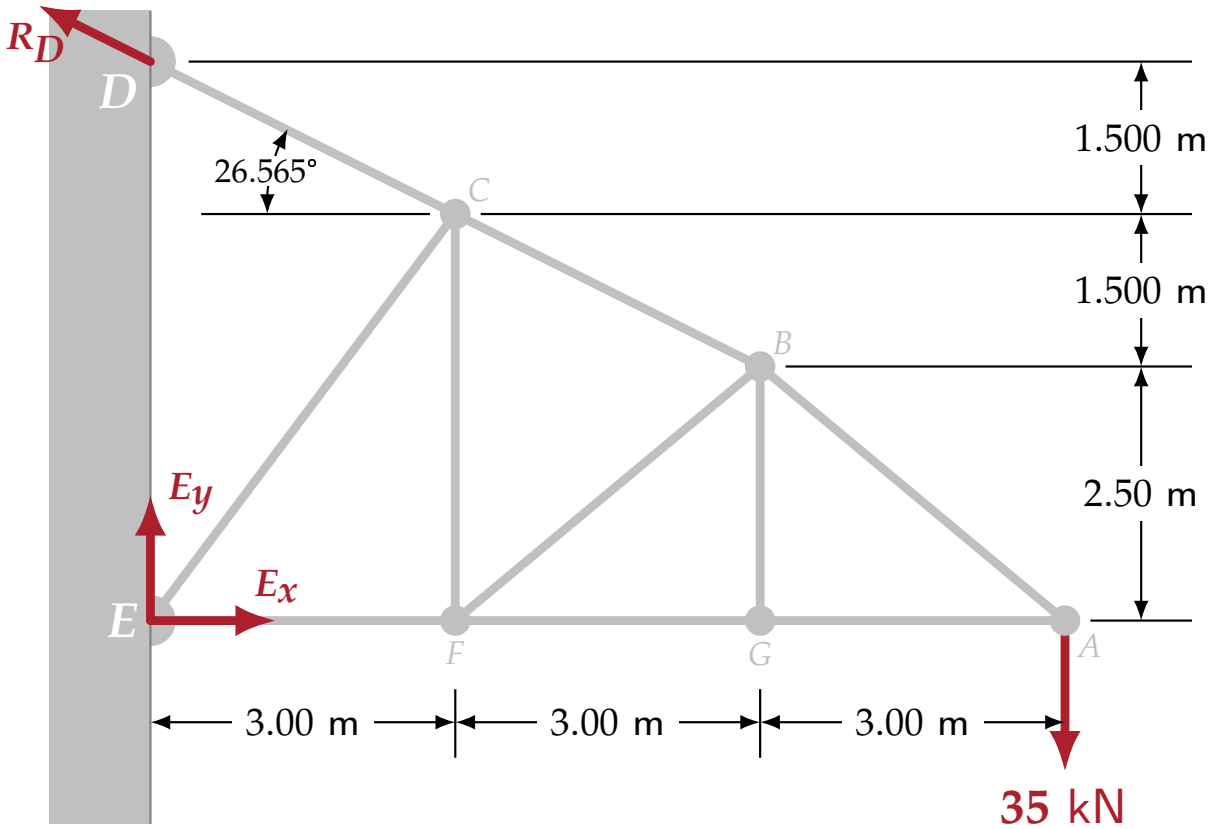
$BG = 0$
$CD = 64.0$ kN (T)
$CE = 7.95$ kN (C)
$CF = 8.75$ kN (T)
$EF = 52.5$ kN (C)

But are they correct?

$\Sigma M_E = R_D \cos 26.565° \times 5.50 \text{ m} - 35 \text{ kN} \times 9.00 \text{ m} = 0$
$\Rightarrow R_D = 64.033$ kN

$R_D = 64.033$ kN which makes it equal (apart from a rounding error) and opposite to F_{CD}, the tensile force in CD so $\Sigma F_D = 0$. ✓



Finished. . .

$AB = 54.7$ kN (T)
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$BF = 13.69$ kN (C)
$BG = 0$
$CD = 64.0$ kN (T)
$CE = 7.95$ kN (C)
$CF = 8.75$ kN (T)
$EF = 52.5$ kN (C)

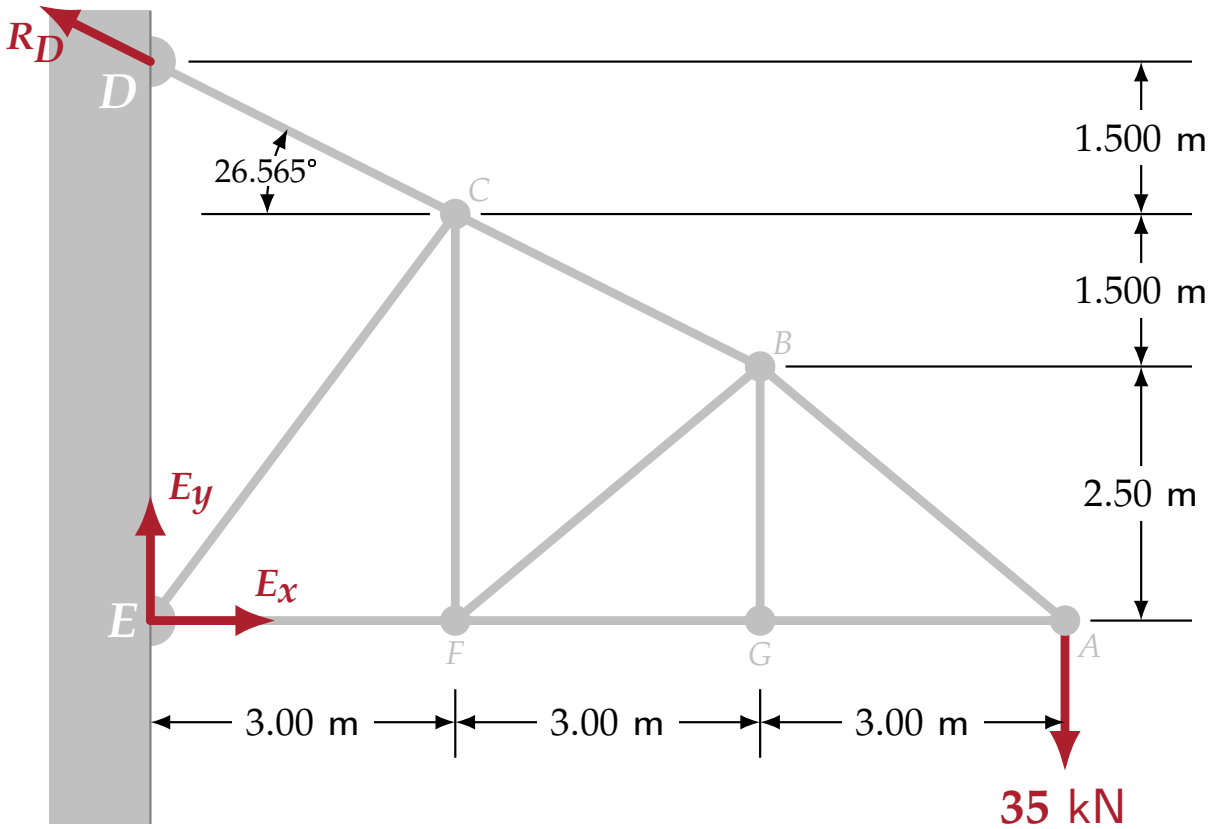
But are they correct?

$$\Sigma M_E = R_D \cos 26.565° \times 5.50 \text{ m} - 35 \text{ kN} \times 9.00 \text{ m} = 0$$
$$\Rightarrow R_D = 64.033 \text{ kN}$$

$R_D = 64.033$ kN which makes it equal (apart from a rounding error) and opposite to F_{CD}, the tensile force in CD so $\Sigma F_D = 0$. ✓

$$\Sigma F_x = E_x - R_D \cos 26.565° = 0$$
$$\Rightarrow E_x = 57.273 \text{ kN}$$

$$\Sigma F_y = E_y + R_D \sin 26.565° - 35 \text{ kN} = 0$$
$$\Rightarrow E_y = 6.3636 \text{ kN}$$



Finished. . .

$AB = 54.7$ kN (T)
$AG = 42.0$ kN (C)
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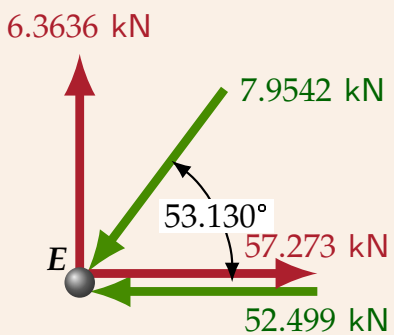
$BG = 0$
$CD = 64.0$ kN (T)
$CE = 7.95$ kN (C)
$CF = 8.75$ kN (T)
$EF = 52.5$ kN (C)

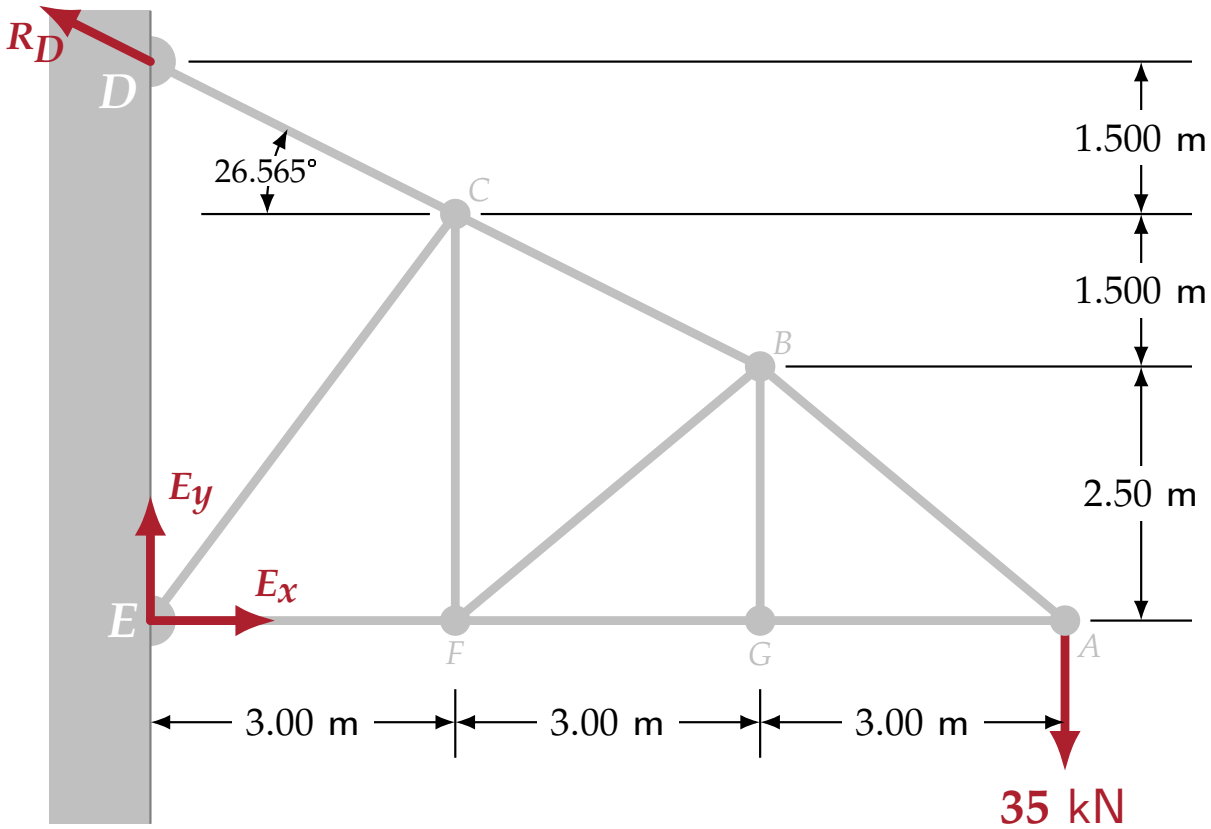
But are they correct?

Free Body Diagram



$$\Sigma F_x = E_x - R_D \cos 26.565° = 0$$
$$\Rightarrow E_x = 57.273 \text{ kN}$$

$$\Sigma F_y = E_y + R_D \sin 26.565° - 35 \text{ kN} = 0$$
$$\Rightarrow E_y = 6.3636 \text{ kN}$$



Finished...

$AB = 54.7$ kN (T)

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$BC = 58.7$ kN (T)

$BF = 13.69$ kN (C)

$BG = 0$

$CD = 64.0$ kN (T)

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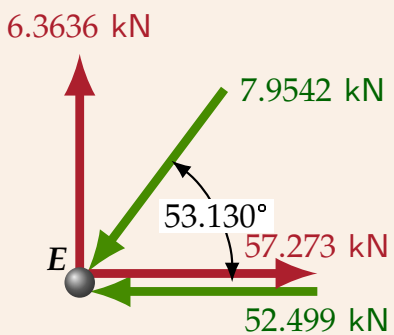
$CF = 8.75$ kN (T)

$EF = 52.5$ kN (C)

But are they correct?

Free Body Diagram



Joint E

$$\Sigma F_x = 57.273 \text{ kN} - 52.499 \text{ kN} - 7.9542 \cos 39.806° \text{kN}$$
$$= 0.00147 \text{ kN} \approx 0 \quad \checkmark$$
$$\Sigma F_y = 6.3636 \text{ kN} - 7.9542 \sin 53.130° \text{ kN}$$
$$= 0.000249 \text{ kN} \approx 0 \quad \checkmark$$