Solution 4.28

**PROBLEM STATEMENT**

Determine the reactions at A and C when (a) \( \alpha = 0 \), (b) \( \alpha = 30^\circ \).

(a) \( \alpha = 0 \) From F.B.D. of member ABC:

\[ + \sum M_C = 0: \quad (300 \text{ N})(0.2 \text{ m}) + (300 \text{ N})(0.4 \text{ m}) - A(0.8 \text{ m}) = 0 \]

\[ A = 225 \text{ N} \quad \text{or} \quad A = 225 \text{ N} \uparrow \]

\[ + \sum F_y = 0: \quad C_y + 225 \text{ N} = 0 \]

\[ C_y = -225 \text{ N} \quad \text{or} \quad C_y = 225 \text{ N} \downarrow \]

\[ + \sum F_x = 0: \quad 300 \text{ N} + 300 \text{ N} + C_x = 0 \]

\[ C_x = -600 \text{ N} \quad \text{or} \quad C_x = 600 \text{ N} \rightarrow \]

Then

\[ C = \sqrt{C_x^2 + C_y^2} = \sqrt{(600)^2 + (225)^2} = 640.80 \text{ N} \]

and

\[ \theta = \tan^{-1} \left( \frac{C_y}{C_x} \right) = \tan^{-1} \left( \frac{-225}{-600} \right) = 20.556^\circ \]

\[ \text{or} \quad C = 641 \text{ N} \rightarrow 20.6^\circ \uparrow \]

(b) \( \alpha = 30^\circ \)

From F.B.D. of member ABC:

\[ + \sum M_C = 0: \quad (300 \text{ N})(0.2 \text{ m}) + (300 \text{ N})(0.4 \text{ m}) - (A \cos 30^\circ)(0.8 \text{ m}) \\
+ (A \sin 30^\circ)(20 \text{ in.}) = 0 \]

\[ A = 365.24 \text{ N} \quad \text{or} \quad A = 365 \text{ N} \nearrow 60.0^\circ \uparrow \]

\[ + \sum F_x = 0: \quad 300 \text{ N} + 300 \text{ N} + (365.24 \text{ N}) \sin 30^\circ + C_x = 0 \]

\[ C_x = -782.62 \]

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\[ \Sigma F_y = 0: \quad C_y + (365.24 \text{ N})\cos 30^\circ = 0 \]

\[ C_y = -316.31 \text{ N} \quad \text{or} \quad C_y = 316 \text{ N} \downarrow \]

Then

\[ C = \sqrt{C_x^2 + C_y^2} = \sqrt{(782.62)^2 + (316.31)^2} = 884.12 \text{ N} \]

and

\[ \theta = \tan^{-1}\left(\frac{C_y}{C_x}\right) = \tan^{-1}\left(\frac{-316.31}{-782.62}\right) = 22.007^\circ \]

or

\[ C = 884 \text{ N} \left\langle 22.0^\circ \right\rangle \]
**PROBLEM 4.36**

A light bar $AD$ is suspended from a cable $BE$ and supports a 20-kg block at $C$. The ends $A$ and $D$ of the bar are in contact with frictionless vertical walls. Determine the tension in cable $BE$ and the reactions at $A$ and $D$.

**SOLUTION**

Free-Body Diagram:

\[
W = (20 \text{ kg})(9.81 \text{ m/s}^2) = 196.20 \text{ N}
\]

\[
\Sigma F_x = 0: \quad A = D
\]

\[
\Sigma F_y = 0: \quad T_{BE} = W \quad T_{BE} = 196.2 \text{ N}
\]

We note that the forces shown form two couples.

\[
\sum M_A = 0: \quad A(200 \text{ mm}) - (196.20 \text{ N})(75 \text{ mm}) = 0
\]

\[
A = 73.575 \text{ N}
\]

\[
A = 73.6 \text{ N} \quad \text{and} \quad D = 73.6 \text{ N}
\]
**PROBLEM 4.67**

Determine the reactions at B and D when \( b = 60 \text{ mm} \).

**SOLUTION**

Since \( CD \) is a two-force member, the line of action of reaction at \( D \) must pass through Points \( C \) and \( D \).

**Free-Body Diagram:**

(Three-force body)

Reaction at \( B \) must pass through \( E \), where the reaction at \( D \) and the 80-N force intersect.

\[
\tan \beta = \frac{220 \text{ mm}}{250 \text{ mm}} \\
\beta = 41.348^\circ
\]

**Force triangle**

Law of sines:

\[
\frac{80 \text{ N}}{\sin 3.652^\circ} = \frac{B}{\sin 45^\circ} = \frac{D}{\sin 131.348^\circ}
\]

\( B = 888.0 \text{ N} \)

\( D = 942.8 \text{ N} \)

\( \mathbf{B} = 888 \text{ N} \uparrow 41.3^\circ \quad \mathbf{D} = 943 \text{ N} \uparrow 45.0^\circ \)