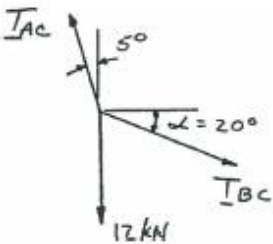


PROBLEM 2.45

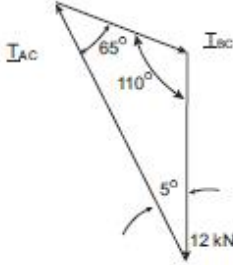
Knowing that $\alpha = 20^\circ$, determine the tension (a) in cable AC, (b) in rope BC.

SOLUTION

Free-Body Diagram



Force Triangle



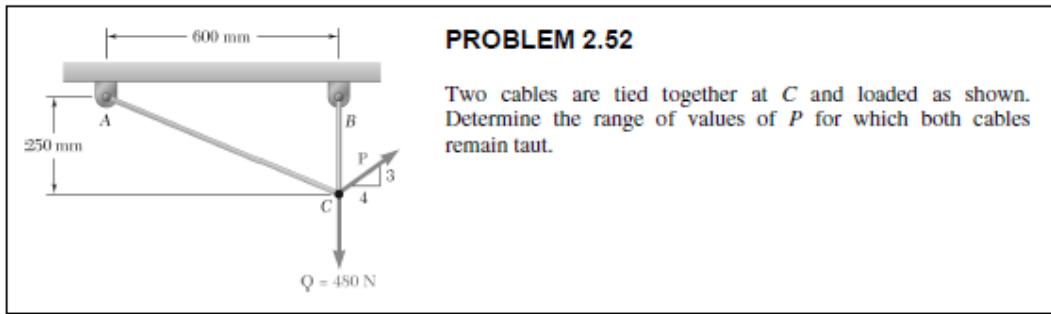
Law of sines:

$$\frac{T_{AC}}{\sin 110^\circ} = \frac{T_{BC}}{\sin 5^\circ} = \frac{12 \text{ kN}}{\sin 65^\circ}$$

(a) $T_{AC} = \frac{12 \text{ kN}}{\sin 65^\circ} \sin 110^\circ$ $T_{AC} = 12 \text{ kN} \blacktriangleleft$

(b) $T_{BC} = \frac{12 \text{ kN}}{\sin 65^\circ} \sin 5^\circ$ $T_{BC} = 1.15 \text{ kN} \blacktriangleleft$

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SOLUTION

Free Body: C

$$\Sigma F_x = 0: -\frac{12}{13}T_{AC} + \frac{4}{5}P = 0$$

$$T_{AC} = \frac{13}{15}P \tag{1}$$

$$\Sigma F_y = 0: \frac{5}{13}T_{AC} + T_{BC} + \frac{3}{5}P - 480 \text{ N} = 0$$

Substitute for T_{AC} from (1):

$$\left(\frac{5}{13}\right)\left(\frac{13}{15}\right)P + T_{BC} + \frac{3}{5}P - 480 \text{ N} = 0$$

$$T_{BC} = 480 \text{ N} - \frac{14}{15}P \tag{2}$$

From (1), $T_{AC} > 0$ requires $P > 0$.

From (2), $T_{BC} > 0$ requires $\frac{14}{15}P < 480 \text{ N}$, $P < 514.29 \text{ N}$

Allowable range: $0 < P < 514 \text{ N} \blacktriangleleft$

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PROBLEM 2.60

For the structure and loading of Problem 2.46, determine (a) the value of α for which the tension in cable BC is as small as possible, (b) the corresponding value of the tension.

SOLUTION

T_{BC} must be perpendicular to F_{AC} to be as small as possible.

Free-Body Diagram: C

Force Triangle is a right triangle

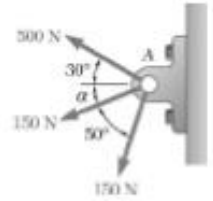
To be a minimum, T_{BC} must be perpendicular to F_{AC} .

(a) We observe: $\alpha = 90^\circ - 30^\circ$ $\alpha = 60.0^\circ$ ◀

(b) $T_{BC} = (300 \text{ N}) \sin 50^\circ$

or $T_{BC} = 229.81 \text{ N}$ $T_{BC} = 230 \text{ N}$ ◀

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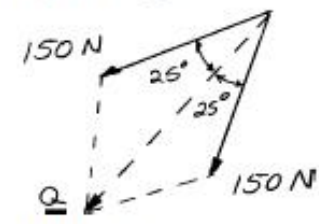


PROBLEM 2.65

Three forces are applied to a bracket as shown. The directions of the two 150-N forces may vary, but the angle between these forces is always 50° . Determine the range of values of α for which the magnitude of the resultant of the forces acting at A is less than 600 N.

SOLUTION

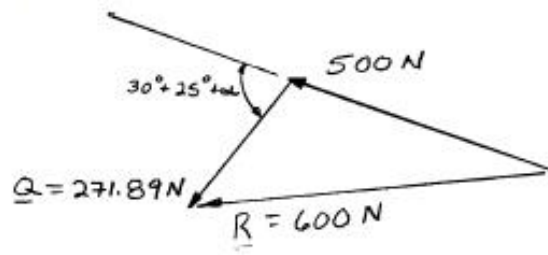
Combine the two 150-N forces into a resultant force Q :



$$Q = 2(150 \text{ N}) \cos 25^\circ$$

$$= 271.89 \text{ N}$$

Equivalent loading at A:



Using the law of cosines:

$$(600 \text{ N})^2 = (500 \text{ N})^2 + (271.89 \text{ N})^2 + 2(500 \text{ N})(271.89 \text{ N}) \cos(55^\circ + \alpha)$$

$$\cos(55^\circ + \alpha) = 0.132685$$

Two values for α :

$$55^\circ + \alpha = 82.375$$

$$\alpha = 27.4^\circ$$

or

$$55^\circ + \alpha = -82.375^\circ$$

$$55^\circ + \alpha = 360^\circ - 82.375^\circ$$

$$\alpha = 222.6^\circ$$

For $R < 600 \text{ N}$: $27.4^\circ < \alpha < 222.6^\circ$ ◀

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