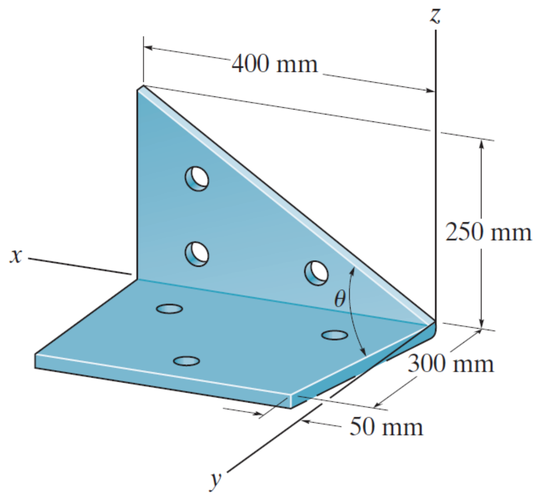
Problem R2-7

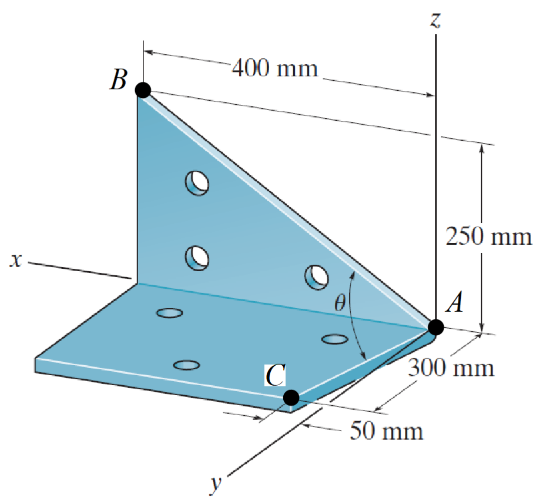
Determine the angle θ between the edges of the sheet-metal bracket.



Prob. R2–7

Solution

Label the sheet-metal bracket as follows.



Write the position vectors to points A, B, and C.

$$\mathbf{r}_A = \langle 0, 0, 0 \rangle \text{ mm}$$

$$\mathbf{r}_B = \langle 400, 0, 250 \rangle \text{ mm}$$

$$\mathbf{r}_C = \langle 50, 300, 0 \rangle \text{ mm}$$

The unit vector going from A to B is

$$\hat{\mathbf{u}}_{AB} = \frac{\mathbf{r}_B - \mathbf{r}_A}{|\mathbf{r}_B - \mathbf{r}_A|} = \frac{\langle 400, 0, 250 \rangle}{\sqrt{(400)^2 + (0)^2 + (250)^2}},$$

and the unit vector going from A to C is

$$\hat{\mathbf{u}}_{AC} = \frac{\mathbf{r}_C - \mathbf{r}_A}{|\mathbf{r}_C - \mathbf{r}_A|} = \frac{\langle 50, 300, 0 \rangle}{\sqrt{(50)^2 + (300)^2 + (0)^2}}.$$

Take the dot product of these unit vectors to find the angle between them.

$$\cos\theta = \hat{\mathbf{u}}_{AB} \cdot \hat{\mathbf{u}}_{AC} = \frac{\langle 400, 0, 250 \rangle}{\sqrt{(400)^2 + (0)^2 + (250)^2}} \cdot \frac{\langle 50, 300, 0 \rangle}{\sqrt{(50)^2 + (300)^2 + (0)^2}} = \frac{8}{\sqrt{3293}}$$

Therefore,

$$\theta = \cos^{-1}\left(\frac{8}{\sqrt{3293}}\right) \approx 82.0^\circ.$$