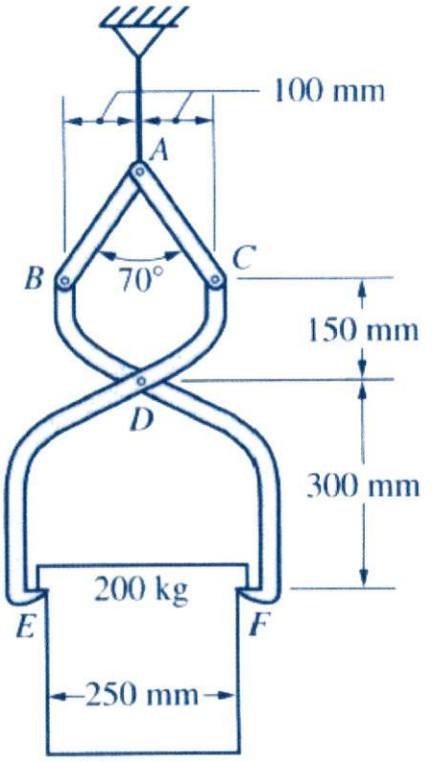
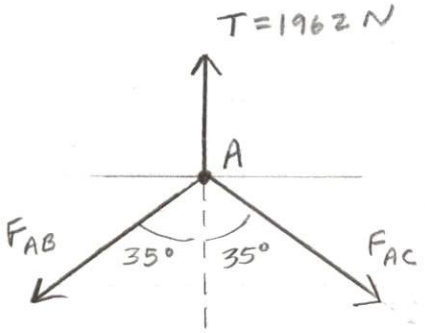
4-44 A 200-kg mass is supported by a pair of tongs, as shown in Fig. P4-44. Determine the forces acting on tong CDE.

Solution.

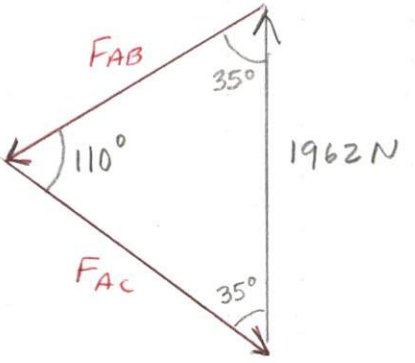


Joint A



FBD - Joint A

$$T = mg = 200\,kg\,(9.81\,m/s^2) = 1962\,N\ (T)$$

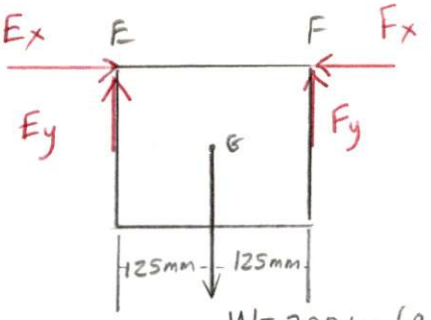


Force - Triangle

$$\frac{F_{AC}}{\sin 35^\circ} = \frac{F_{AB}}{\sin 35^\circ} = \frac{1962\,N}{\sin 110^\circ}$$

$$F_{AC} = F_{AB} = \frac{\sin 35^\circ\,(1962\,N)}{\sin 110^\circ} = 1198\,N$$

Block



$W = 200\,kg\,(9.81\,m/s^2)$
$= 1962\,N$

FBD - Block

Equilibrium Equations

$[\Sigma M_E = 0]\quad -1962\,N(1.25m) + f_y(2.5m) = 0$

$F_y = \frac{2452.5\,N\cdot m}{2.5m}$

$= \underline{981\,N}\ \uparrow$

$(\Sigma F_y = 0)\quad E_y + f_y - 1962\,N = 0$

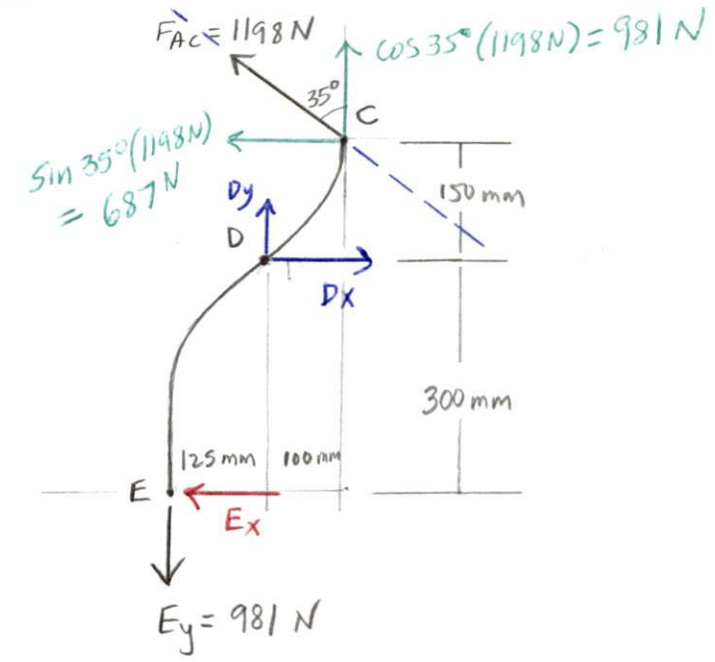
$E_y = 1962\,N - 981\,N$

$= \underline{981\,N}\ \uparrow$

$[\Sigma F_x = 0]\quad E_x - F_x = 0 \quad (EQN\ 1)$

c.s.y.

Member CDE



FBD - member CDE

Equilibrium Equations

$[\Sigma M_D = 0]\quad 981N(0.125m) - E_x(0.3m) + 687N(0.15m) + 981N(0.1m) = 0$

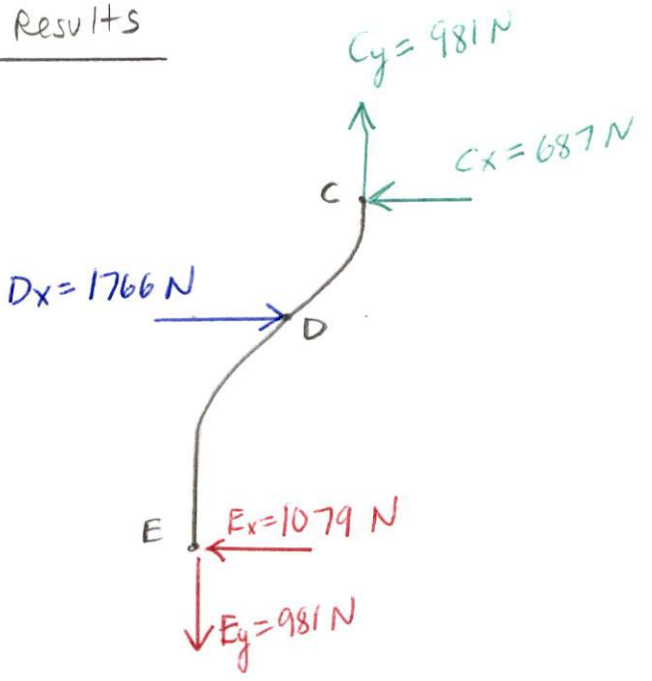
$E_x = \frac{323.775\,N\cdot m}{0.3m} = \underline{1079\,N}\ \leftarrow$

$[\Sigma F_x = 0]\quad -E_x + D_x - 687N = 0$

$D_x = 687N + 1079N = \underline{1766\,N}\ \rightarrow$

$[\Sigma F_y = 0]\quad -981N + D_y + 981N = 0 \Rightarrow D_y = 0$

Summarize Results



member CDE

$(\Sigma F_x = 0)$ $\quad 1766N - 1079N - 687N = 0$

$0 = 0$ ✓

$(\Sigma F_y = 0)$ $\quad -981N + 981N = 0$

$0 = 0$ ✓