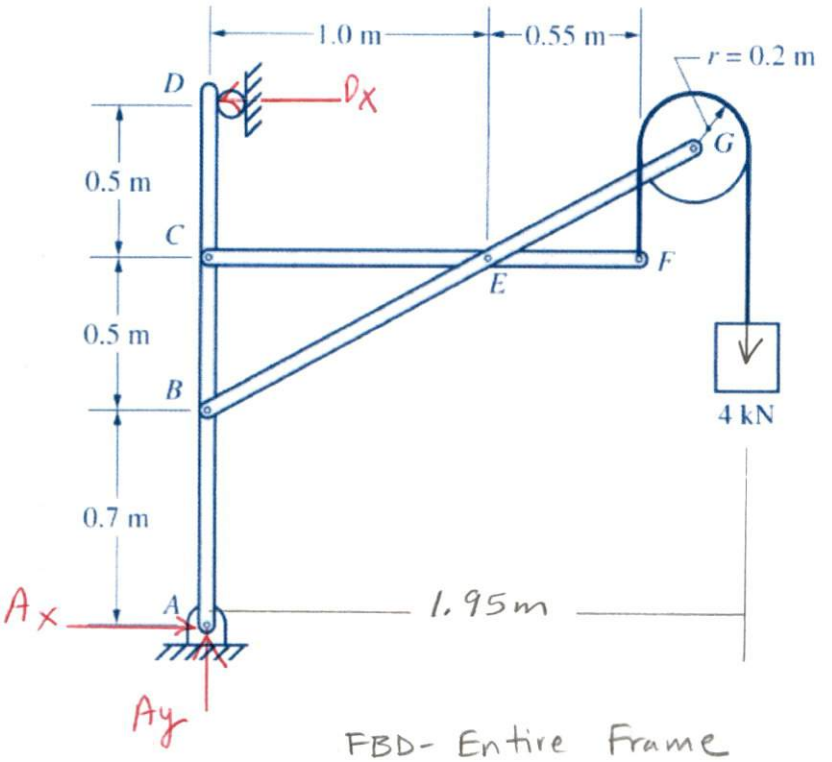
4-34 Refer to Fig. P4-34. Determine the forces acting on each member of the frame due to the 4-kN load shown. Neglect the weights of all members.

Solution.



FBD- Entire Frame

Equilibrium Equations

ccw +M ↺
cw -M ↻

$[\Sigma M_A = 0]$ $D_x(1.7\text{m}) - 4\text{kN}(1.95\text{m}) = 0$

$$D_x = \frac{7.8\ \text{kN}\cdot\text{m}}{1.7\text{m}} = 4.59\ \text{kN} \leftarrow$$

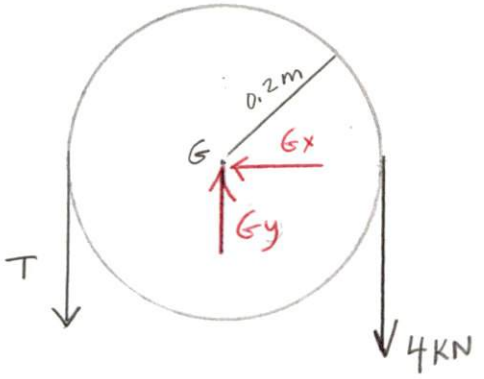
$[\Sigma F_x = 0]$ $A_x - D_x = 0$

$$A_x = 4.59\ \text{kN} \rightarrow$$

$[\Sigma F_y = 0]$ $A_y - 4\text{kN} = 0$

$$A_y = 4\ \text{kN} \uparrow$$

Pulley



FBD- Pulley

Equilibrium Equations

$[\Sigma F_x = 0]$ $\quad G_x = 0$

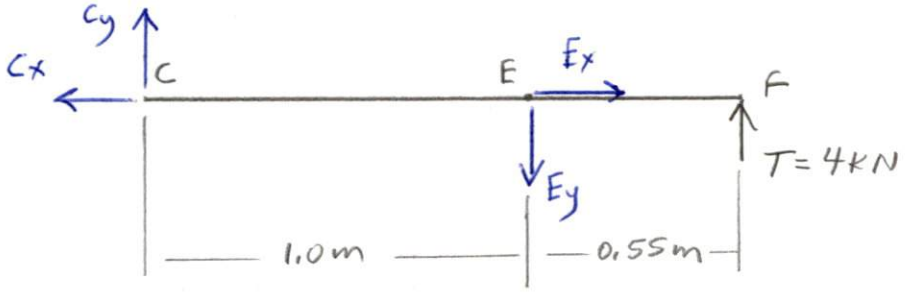
$(\Sigma M_G = 0)$ $\quad -4kN(0.2m) + T(0.2m) = 0$

$$T = \frac{4kN(0.2m)}{0.2m} = \underline{\underline{4kN}} \downarrow$$

$[\Sigma F_y = 0]$ $\quad -T + G_y - 4kN = 0$

$$G_y = 4kN + 4kN = \underline{\underline{8kN}} \uparrow$$

Member CEF



FBD - member CEF

Equilibrium Equations

$[\Sigma M_E = 0]$ $\quad -C_y(1.0m) + 4kN(0.55m) = 0$

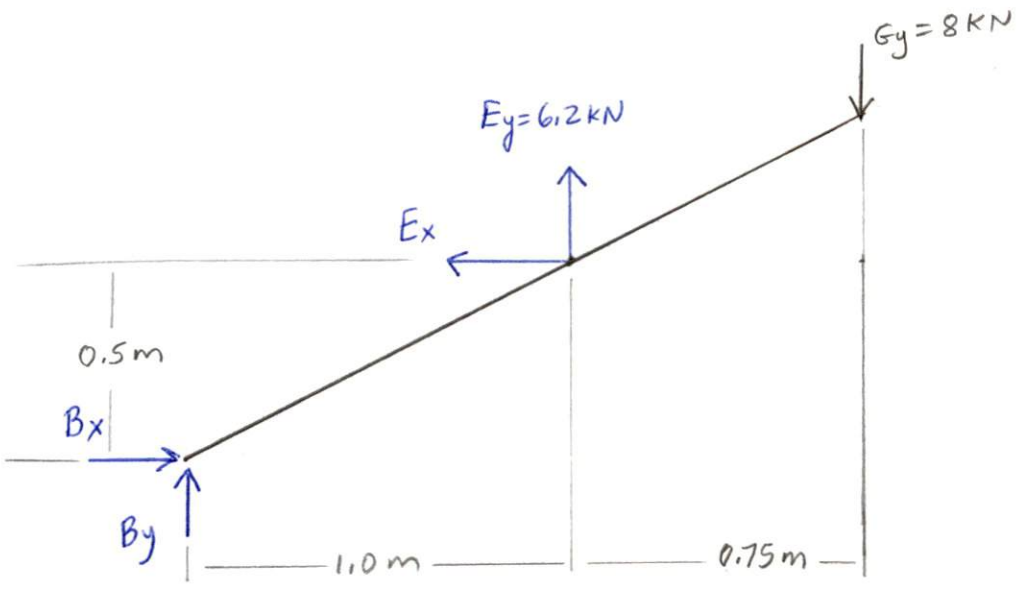
$$C_y = \frac{2.2kN \cdot m}{1.0m} = \underline{\underline{2.2\ kN}} \uparrow$$

$[\Sigma F_y = 0]$ $\quad C_y - E_y + 4kN = 0$

$$E_y = 2.2kN + 4kN = \underline{\underline{6.2\ kN}} \downarrow$$

$[\Sigma F_x = 0]$ $\quad -C_x + E_x = 0$ $\quad$ (Eqn 1) C.S.Y

Member BEG



FBD- Member BEG

ccw + M ↺
cw - M ↻

Equilibrium Equations

$[\Sigma M_B = 0]$ $E_x(0.5m) + 6.2kN(1.0m) - 8kN(1.75m) = 0$

$$E_x = \frac{7.8\ kN.m}{0.5m} = \underline{15.6\ kN} \leftarrow$$

$[\Sigma F_x = 0]$ $B_x - E_x = 0$

$$B_x = \underline{15.6\ kN} \rightarrow$$

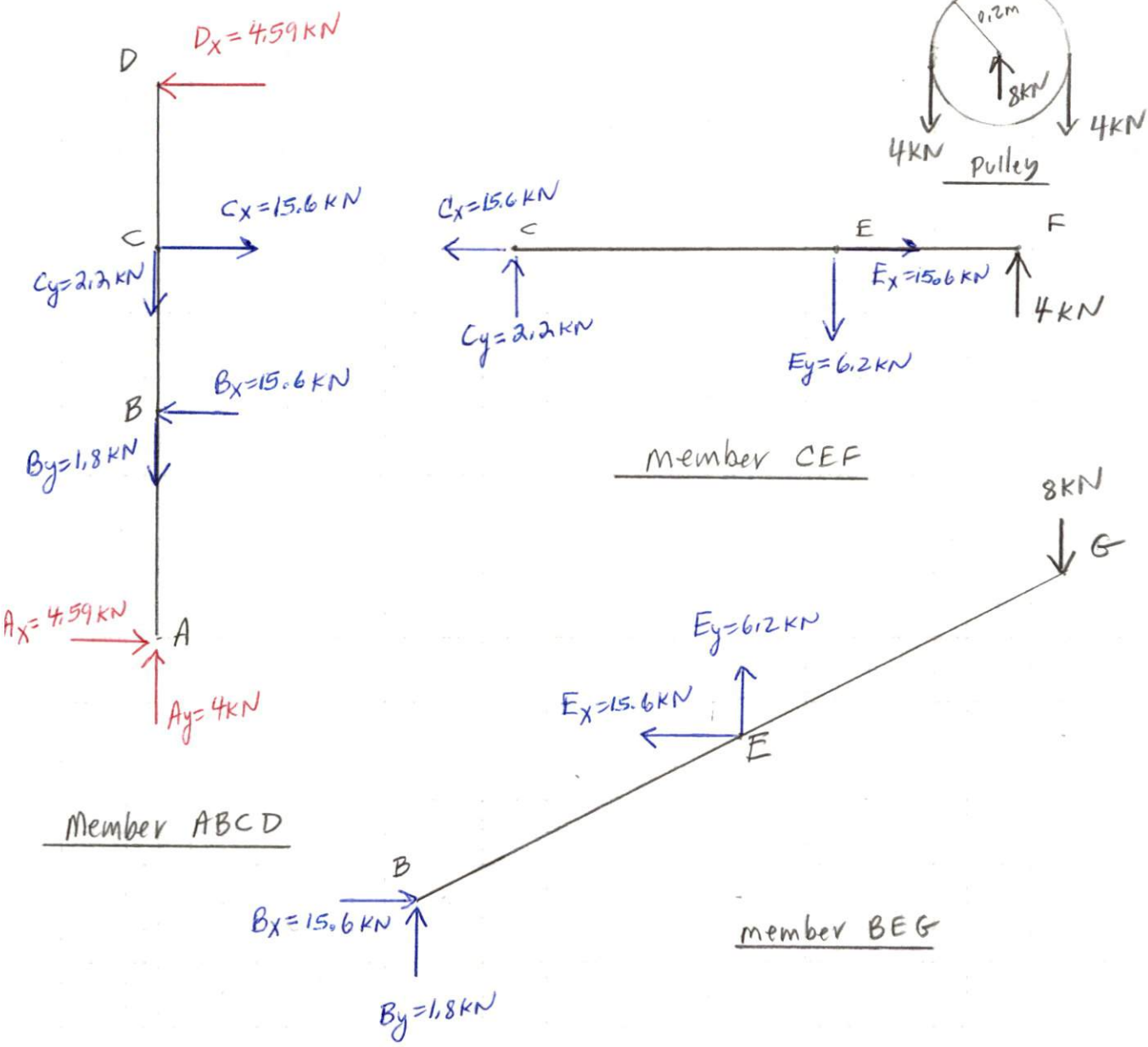
$[\Sigma F_y = 0]$ $B_y + 6.2kN - 8kN = 0$

$$B_y = \underline{1.8\ kN} \uparrow$$

From EQN1

$$C_x = E_x = \underline{15.6\ kN} \leftarrow$$

Summarize Results



All members are in equilibrium ✓