Sample Problem 4.7

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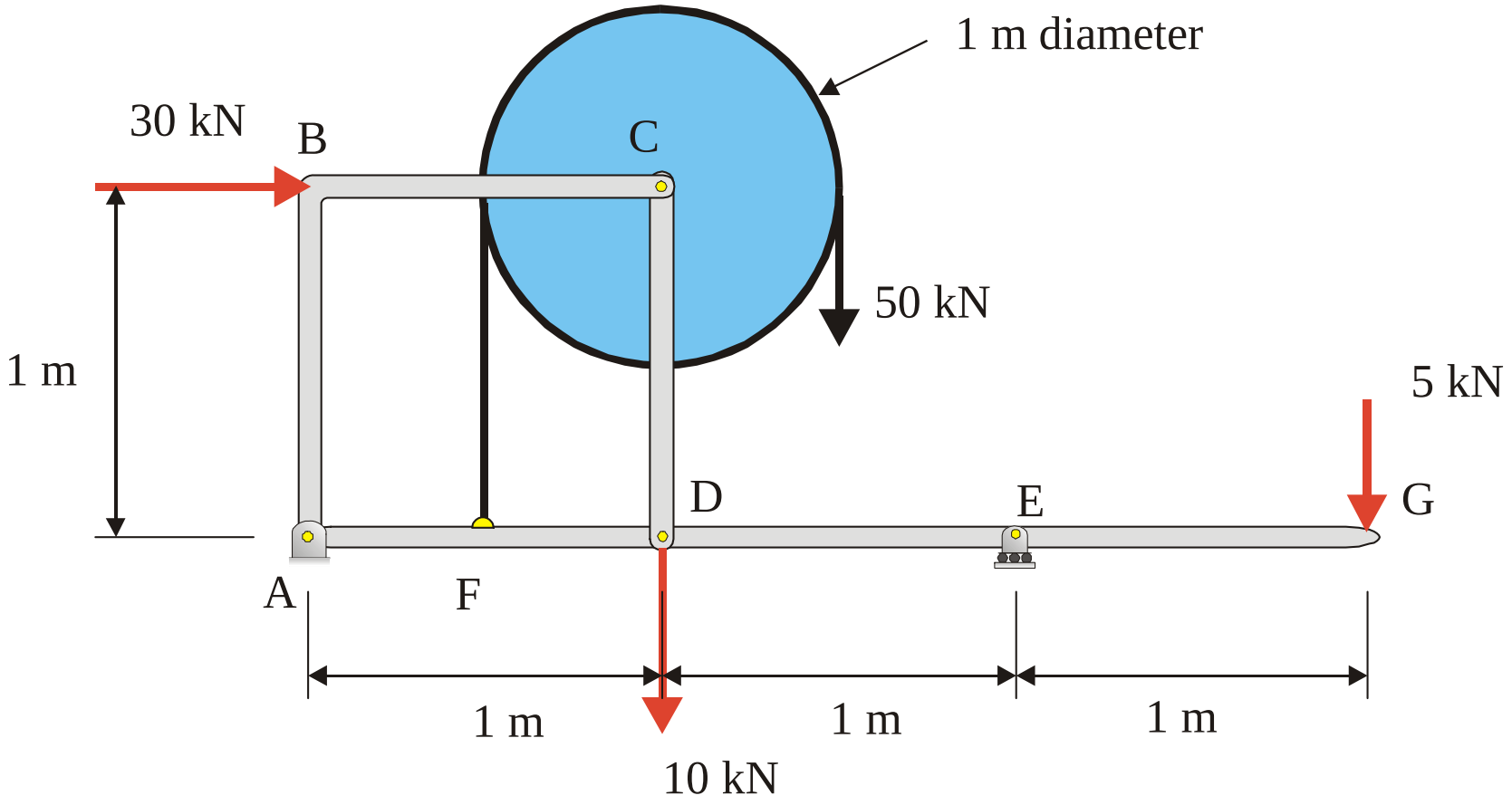
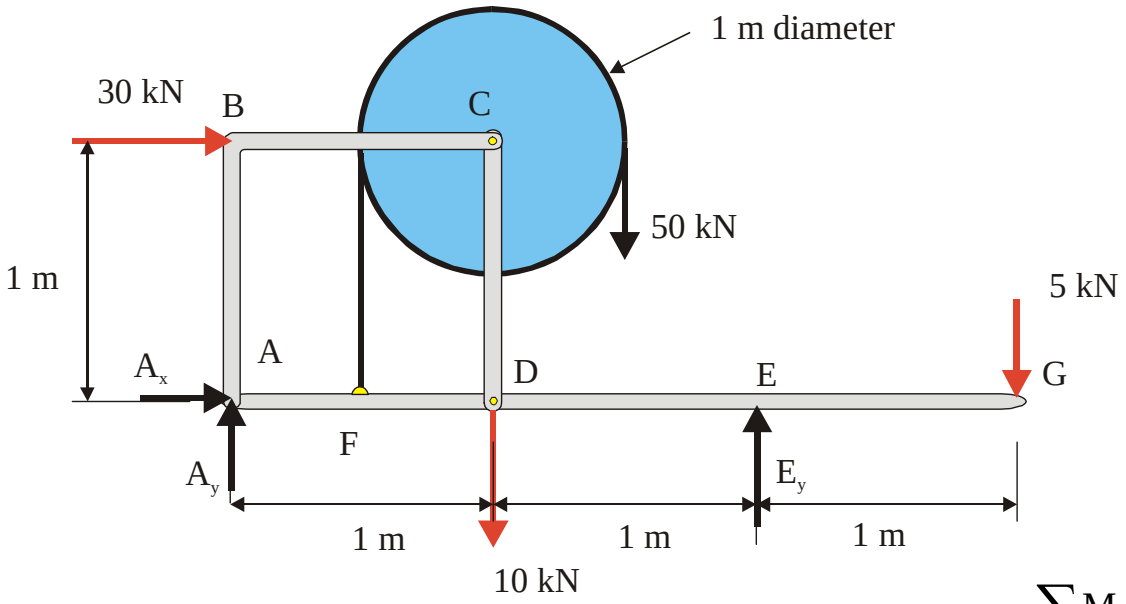
Determine the forces on member ADEG and ABC.





Free-Body Diagram of Entire Frame

$$\sum M_A = 0 \circlearrowleft$$

$$-30(1) - 10(1) - 50(1.5) + E_y(2) - 5(3) = 0$$

$$E_y = +65 \text{ kN} \quad \therefore \ \mathbf{E_y} = 65 \text{ kN} \uparrow$$

$$\sum F_y = 0 +$$

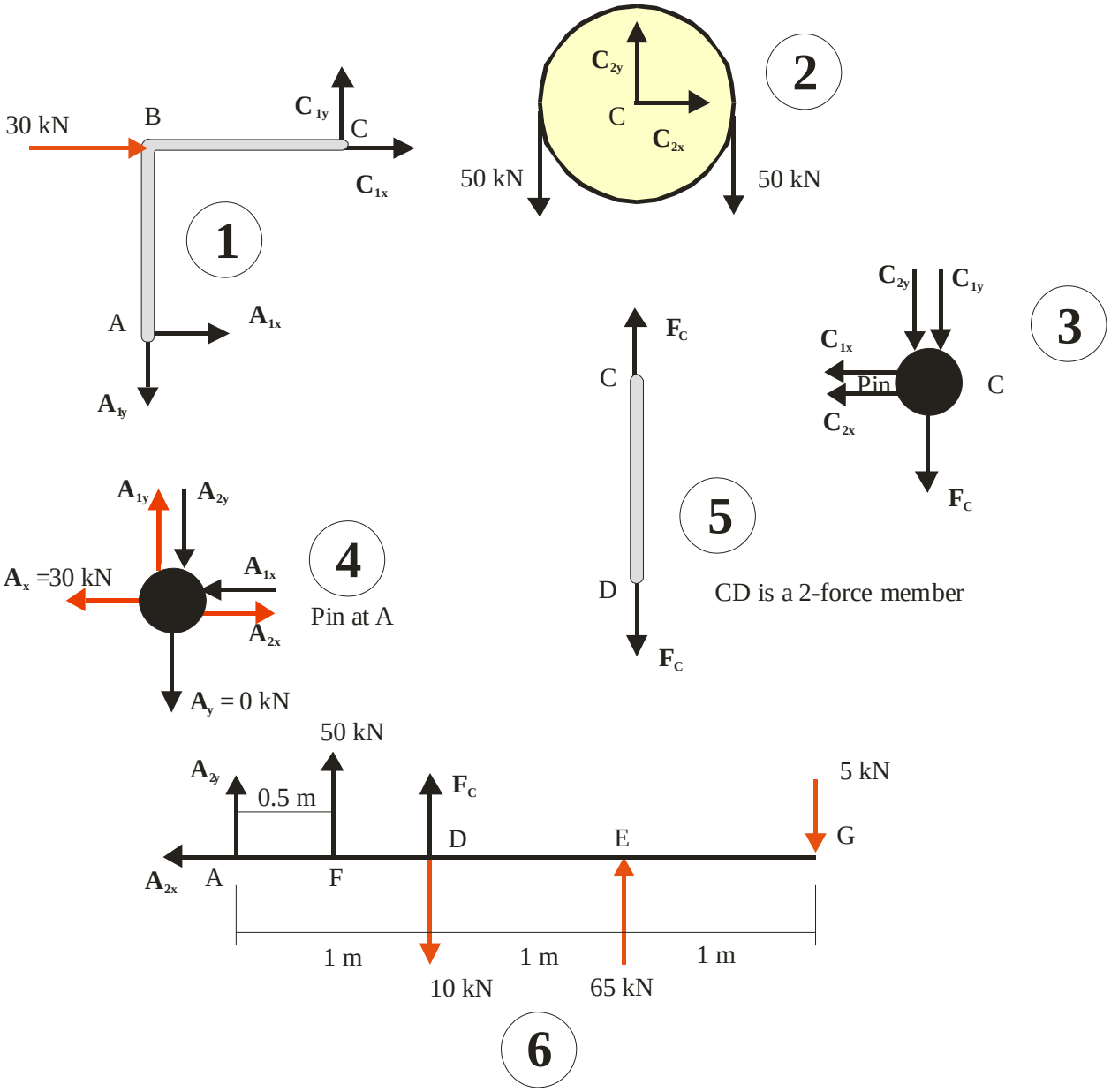
$$A_y - 10 - 50 + 65 - 5 = 0 \quad \mathbf{A_y} = 0 \text{ kN}$$

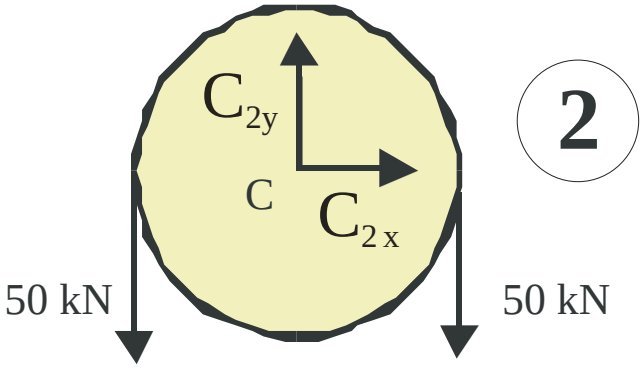
$$\sum F_x = 0 \rightarrow$$

$$A_x + 30 = 0$$

$$A_x = -30 \text{ kN} \quad \therefore \ \mathbf{A_x} = 30 \text{ kN} \leftarrow$$

Substructure:





From FBD (2):

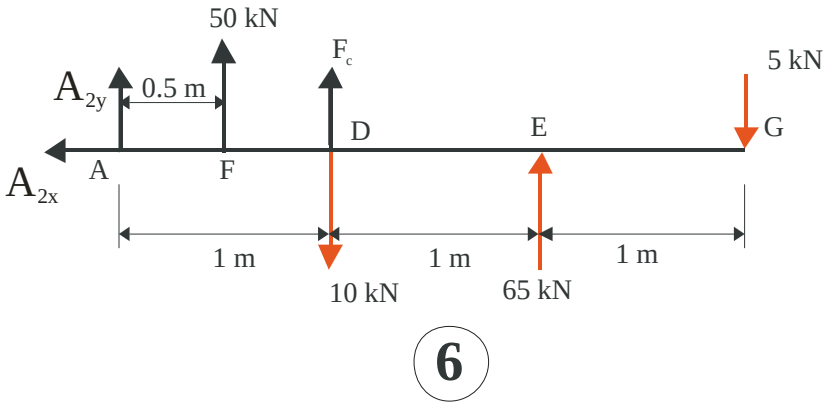
$$\sum F_x = 0 \rightarrow$$

$$\mathbf{C_{2x}} = 0$$

$$\sum F_y = 0 \uparrow$$

$$C_{2y} - 50 - 50 = 0 \qquad C_{2y} = +100 \text{ kN}$$

$$\therefore \ \mathbf{C_{2y}} = 100 \text{ kN} \uparrow \text{ on the pulley}$$



From FBD (6):

$$\sum M_A = 0 \circlearrowleft$$

$$50(0.5) + F_C(1) - 10(1) + 65(2) - 5(3) = 0$$

$$F_C = -130 \text{ kN} \qquad \therefore \ \mathbf{F_C} = 130 \text{ kN} \downarrow \text{ on ADEH}$$

$$\sum F_y = 0 \uparrow$$

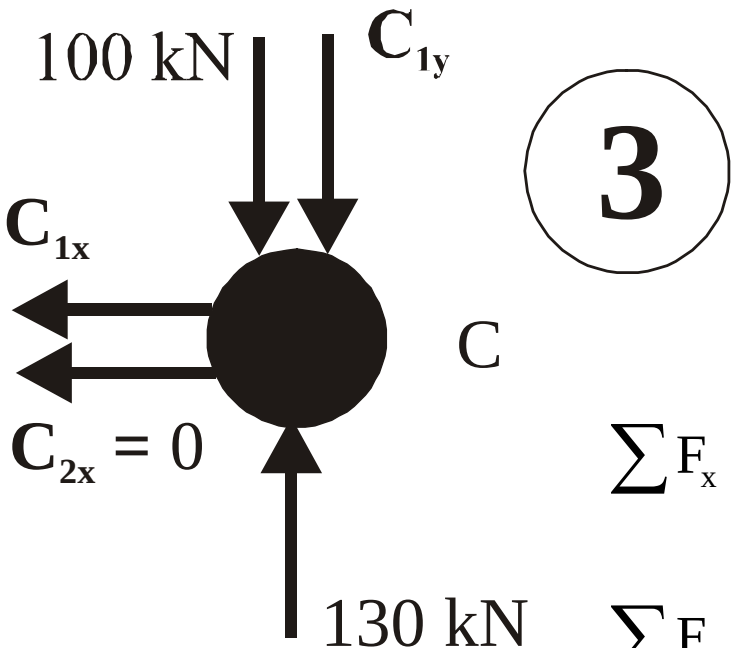
$$A_{2y} + 50 + (-130) - 10 + 65 - 5 = 0 \qquad A_{2y} = +30 \text{ kN}$$

$$\therefore \ \mathbf{A_{2y}} = 30 \text{ kN} \uparrow \text{ on ADEH}$$

$$\sum F_x = 0 \rightarrow$$

$$\mathbf{A_{2x}} = 0$$

From FBD (3):
(We re-draw FBD (3) indicating all known forces.)



$$\sum F_x = 0 \rightarrow$$

$$\mathbf{C_{1x}} = 0$$

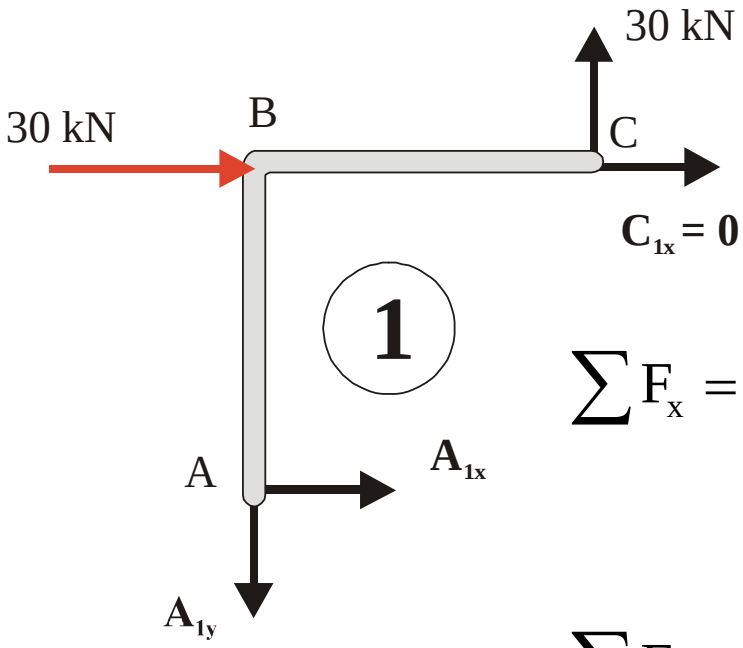
$$\sum F_y = 0 \uparrow$$

$$130 - \mathbf{C_{1y}} - 100 = 0 \qquad C_{1y} = +30 \text{ kN}$$

$$\therefore \ \mathbf{C_{1y}} = 30 \text{ kN} \downarrow \text{ on the pin at C}$$

From FBD (1):

(We re-draw FBD (1) indicating all known forces.)



$$\sum F_x = 0 \rightarrow$$

$$A_{1x} + 30 = 0 \qquad A_{1x} = -30 \text{ kN}$$

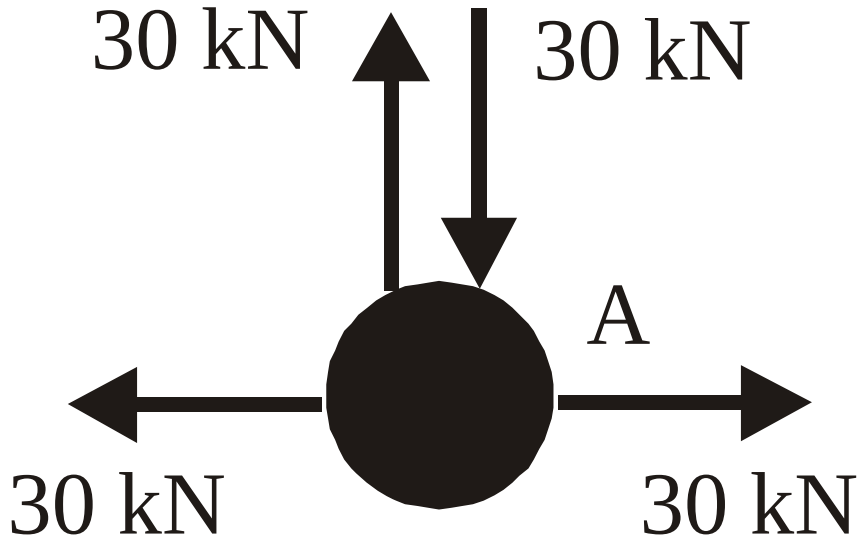
$$\therefore \ \mathbf{A_{1x}} = 30 \text{ kN} \leftarrow \text{on ABC}$$

$$\sum F_y = 0 \uparrow$$

$$A_{1y} + 30 = 0 \qquad A_{1y} = -30 \text{ kN}$$

$$\therefore \ \mathbf{A_{1y}} = 30 \text{ kN} \downarrow \text{on ABC}$$

Final FBD of Pin at A:



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