



3.3 Equilibrium of Coplanar Parallel Force system

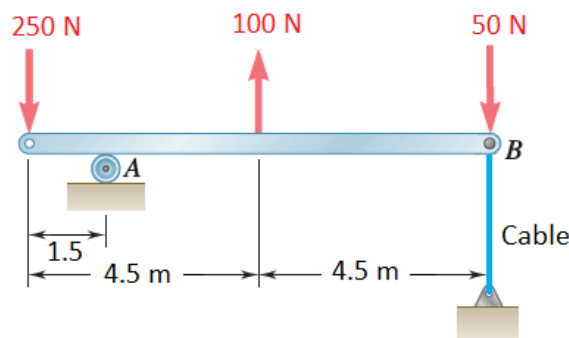
To achieve the equilibrium,

$$\sum F_i = 0 \dots\dots\dots (1)$$

$$\sum M = 0 \dots\dots\dots (2)$$

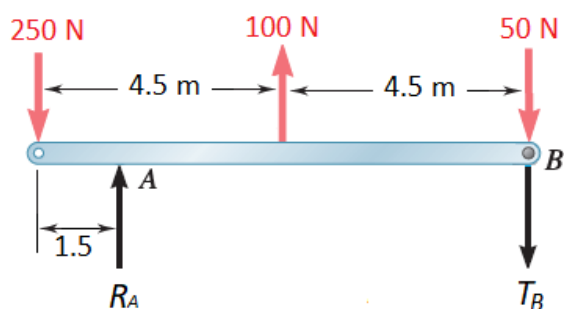
Only two unknowns can be determined

Example No. 1: Determine the reaction A and tension force at B to maintain the system in equilibrium.



Solution:

Draw F.B.D. for beam AB:



$$\sum M_A = 0$$

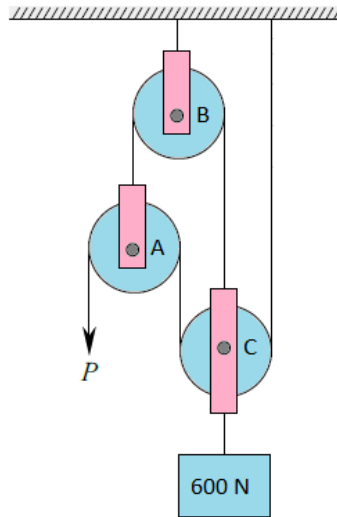
$$-250 \times 1.5 - 100 \times (4.5 - 1.5) + 50 \times (9 - 1.5) + T_B \times (9 - 1.5) = 0$$

$$T_B = 40 \text{ N } \downarrow$$

$$\sum F_y = 0$$

$$R_A - 250 + 100 - 50 - 40 = 0 \quad \rightarrow \quad R_A = 240 \text{ N } \uparrow$$

Example No. 2: The weight of the pulleys may be neglected and assuming the pulleys to be frictionless. Determine the force P necessary to maintain the system in equilibrium.



Solution:

Draw F.B.D. for pulleys system, since the pulleys are frictionless, the tension remains the same in the rope, thus $T_1 = P$

at Pulleys A:

$$\uparrow^+ \sum F_y = 0$$

$$T_2 - P - P = 0$$

$$T_2 = 2P$$

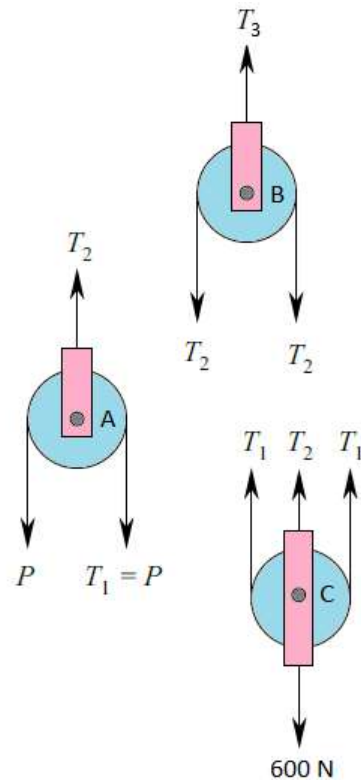
at Pulleys C:

$$\uparrow^+ \sum F_y = 0$$

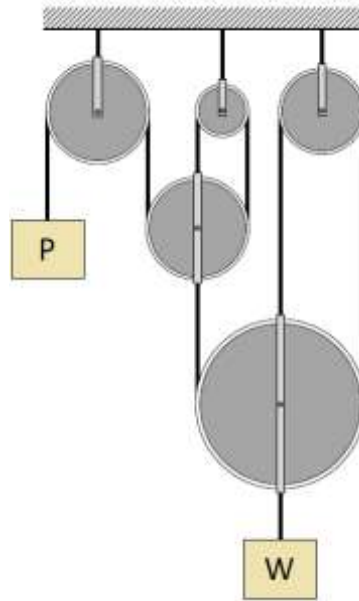
$$T_2 + 2T_1 - 600 = 0$$

$$2P + 2P = 600$$

$$\therefore P = 150 \text{ N}$$



Example No. 3: For the system of pulleys shown in Figure, determine the value of W so that the system to maintain equilibrium if value of P is 50 N. Neglect friction and the weights of the pulleys.



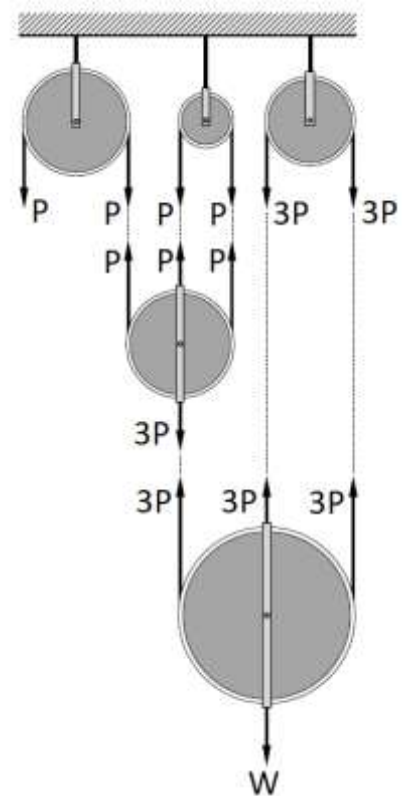
Solution:

Draw F.B.D. for pulleys system, since the pulleys are frictionless, the tension remains the same in the rope.

$$\uparrow^+ \sum F_y = 0$$

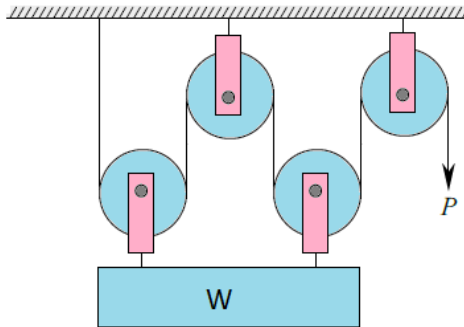
$$3P + 3P + 3P - W = 0$$

$$W = 9P = 9 \times 50 = 450 \text{ N}$$



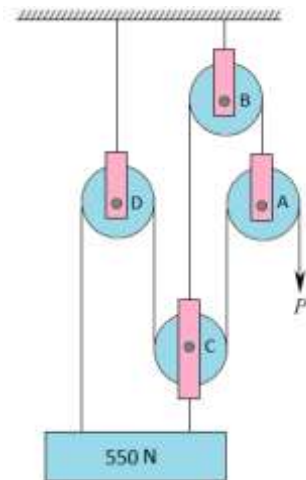
Problem:

1. Determine the value of W if force $P = 100\text{ N}$ necessary to maintain the system in equilibrium. Neglect friction and the weights of the pulleys.



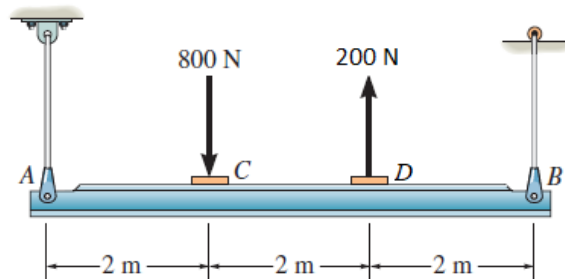
Answer: $W = 400\text{ N}$

2. Determine the force P necessary to maintain the system in equilibrium. The weight of the pulleys may be neglected and assuming the pulleys to be frictionless.



Answer: $P = 110\text{ N}$

3. The horizontal beam is supported by cables at its ends. Determine the required force of the cable at A and B so that if the beam remains in the horizontal position.



Answer: $T_A = 466.67\text{ N } \uparrow$, $T_B = 133.33\text{ N } \uparrow$