3.3 Equilibrium of Coplanar Parallel Force system

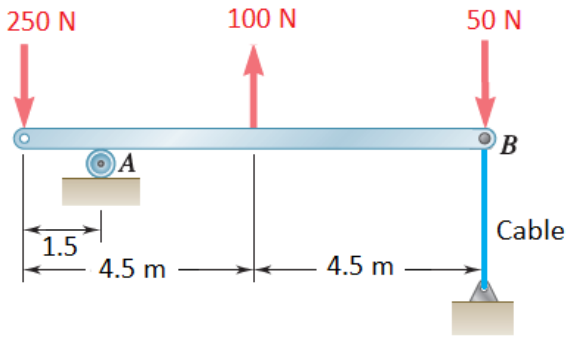
To achieve the equilibrium,

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

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

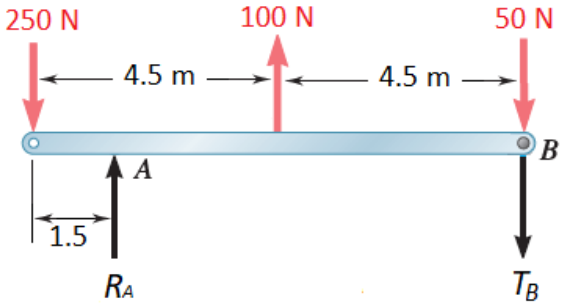
Only two unknowns can be determined

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:



$$\circlearrowleft^{+} \sum M_A = 0$$

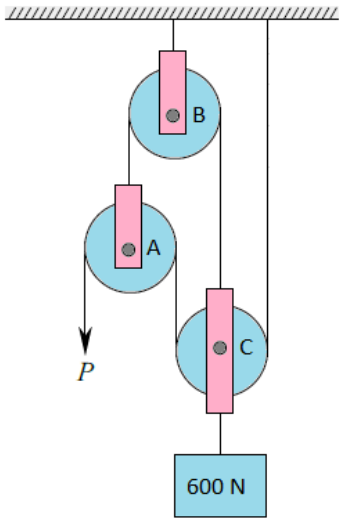
$$-250 \times 1.5 - 100 \times (4.5 - 1.5) + 50 \times (9 - 1.5) + T_B \times (9 - 1.5) = 0$$

$$T_B = 40\ N\ \downarrow$$

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

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

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 $T_1 = P$

<u>at Pulleys A:</u>

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

$$T_2 - P - P = 0$$

$$T_2 = 2P$$

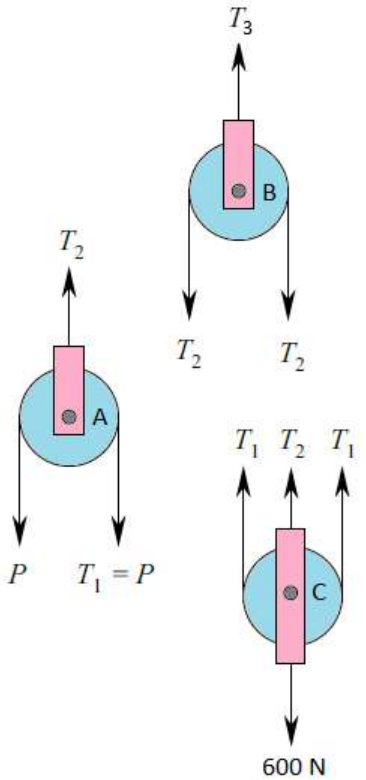
<u>at Pulleys C:</u>

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

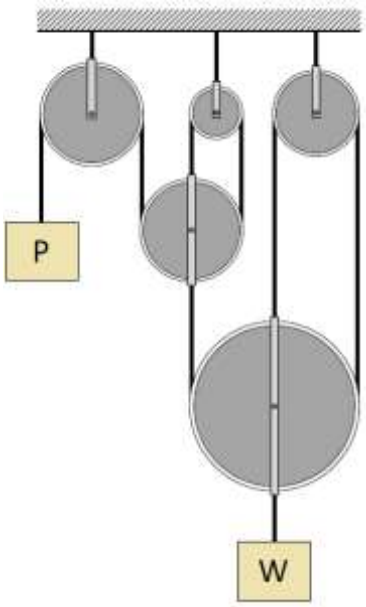
$$T_2 + 2T_1 - 600 = 0$$

$$2P + 2P = 600$$

$$\therefore P = 150\ N$$



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.



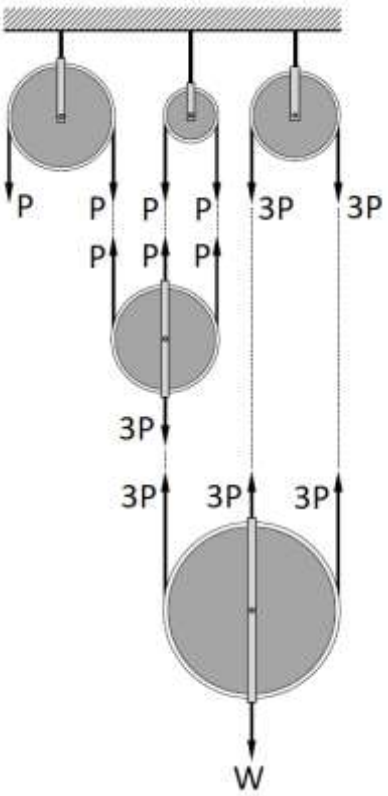
Solution:

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

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

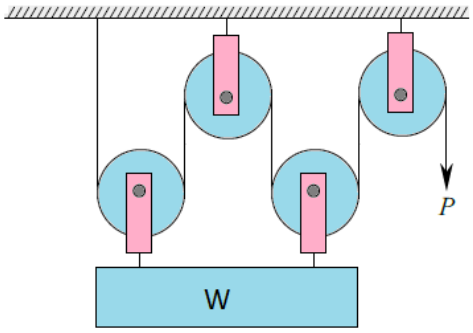
$$3P + 3P + 3P - W = 0$$

$$W = 9P = 9 \times 50 = 450\ N$$



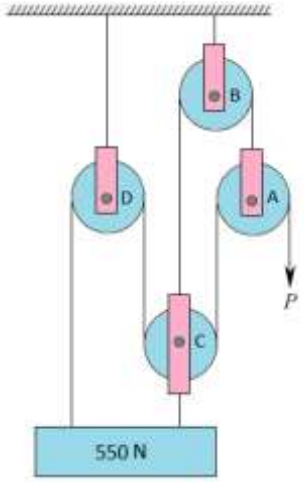
Problem:

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



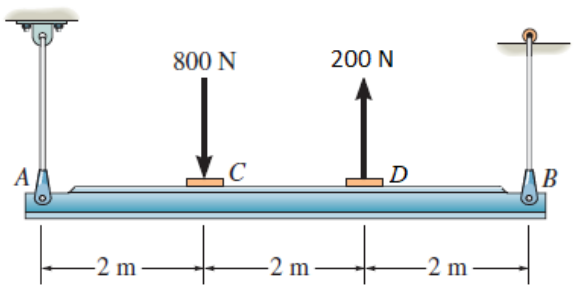
Answer: $W = 400\ N$

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: $P = 110\ N$

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: $T_A = 466.67\ N\ \uparrow,\ \ T_B = 133.33\ N\ \uparrow$