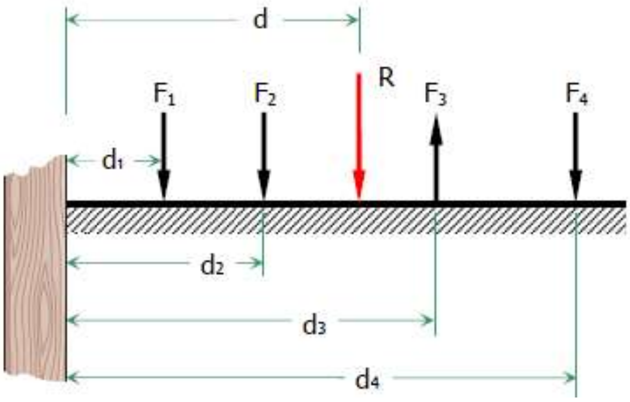
2.2 Resultant of Coplanar Parallel Force System

Parallel forces can be in the same or in opposite directions. The magnitude of the parallel resultant force R is the magnitude of the algebraic sum of the given forces.



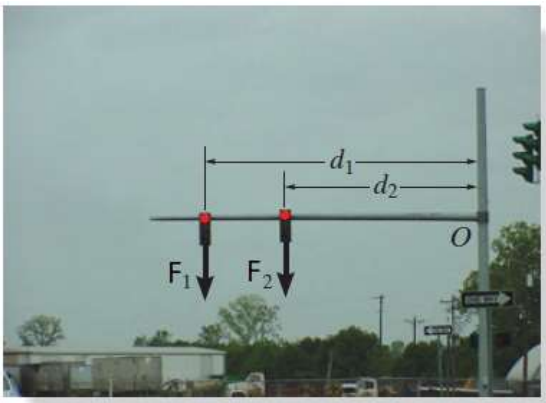
$$\uparrow^{+} R = \sum F_i$$

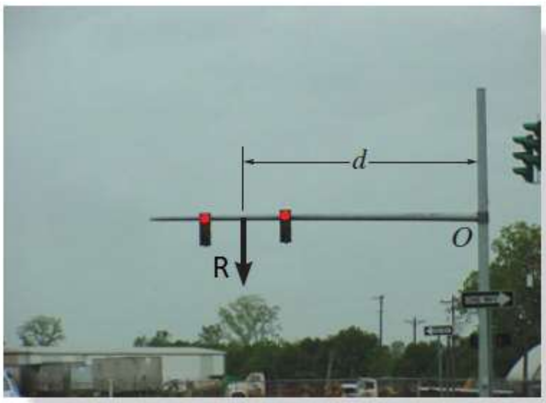
$$R = -F_1 - F_2 + F_3 - F_4$$

The position of the resultant can be determined according to the principle of moments.

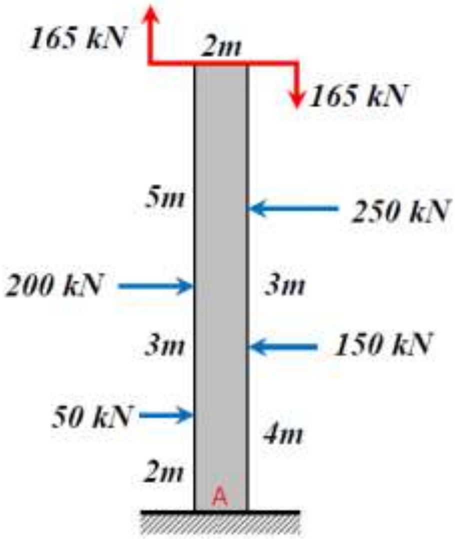
$$\circlearrowright^{+} M_R = R \cdot d = \sum F_i \cdot d_i$$

$$R \cdot d = F_1 \cdot d_1 + F_2 \cdot d_2 - F_3 \cdot d_3 + F_4 \cdot d_4$$





Example No. 1: For the force system shown in figure, determine the magnitude and position of the resultant with respect to point A.



Solution:

$$M_{couple} = 165 \times 2 = 330\ kN.m \ \circlearrowright$$

$$\xrightarrow{+}\ R = \sum F_i$$

$$R = 200 + 50 - 250 - 150$$

$$R = -150\ kN = 150\ kN\ \leftarrow$$

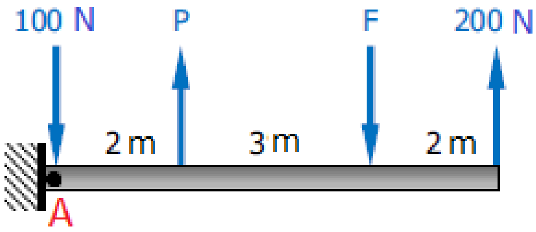
$$\circlearrowright^{+}\ R \cdot d = \sum F_i \cdot d_i \quad (\text{Respect to } A)$$

$$-150 \cdot d = 200 \times 5 + 50 \times 2 - 250 \times 7 - 150 \times 4 + 330$$

$$d = \frac{-920}{-150}$$

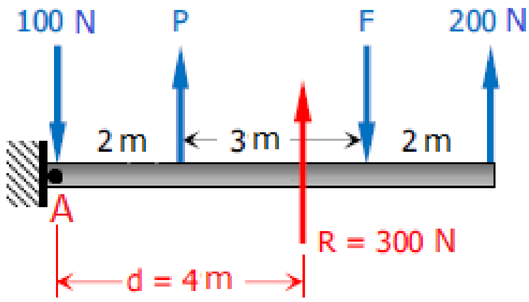
$$d = 6.13\ m$$

Example No. 2: Find the value of P and F so that the four forces shown in Figure produce an upward resultant of 300 N acting at 4 m from point A.



Solution:

$\uparrow^{+}\ R = \sum F_i$



$300 = -100 + P - F + 200$

$P = 200 + F \ \ldots\ldots\ldots (1)$

$\circlearrowright^{+}\ R \cdot d = \sum F_i \cdot d_i \quad (respect\ to\ A)$

$-300 \times 4 = 100 \times 0 - P \times 2 + F \times 5 - 200 \times 7$

$-2P + 5F - 200 = 0 \ldots\ldots\ldots (2)$

Sub eq. (1) in eq. (2) to get:

$-2(200 + F) + 5F - 200 = 0$

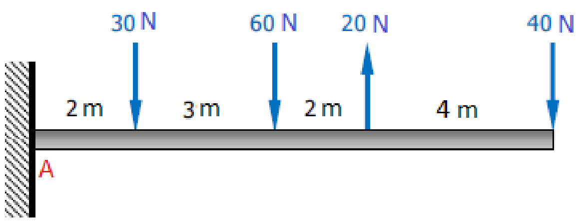
$F = 200\ N\ \downarrow,$

Sub value of (F) in eq. (1) to get;

$P = 400\ N\ \ \uparrow$

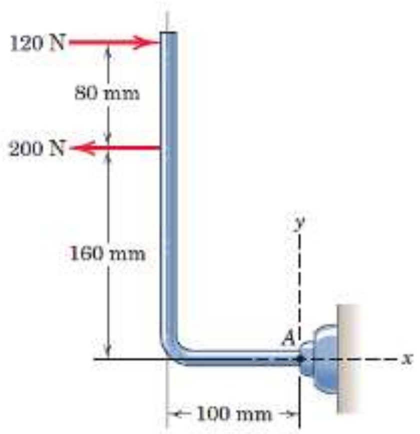
Problems:

1. A parallel force system acts on the cantilever beam shown in Figure. Determine the magnitude and position of the resultant.



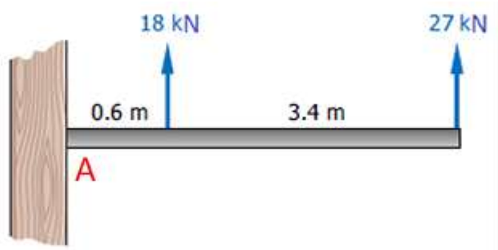
Answer: $R = 110\ N\ \downarrow$, $d = 6\ m$ from point A

2. Compute the magnitude and position of the resultant of the two forces acting on a beam with respect to point A as shown in Figure.



Answer: $R = 80\ N\ \leftarrow$, $d = 40\ mm$ up point A

3. The resultant of three parallel loads (one is missing in Figure below) is 13.6 kN acting up at 3 m to the right of A. Compute the magnitude and position of the missing load.



Answer: $F = 31.4\ kN\ \downarrow$ at $2.48\ m$ to the right of A