Topic: Center of mass of the system, x-axis

Question: Find the center of mass of the system.

Answer choices:

A (45,0)

B (0,2)

C (60,0)

D (2,0)

Solution: D

Since moments of the system are used in the formulas for center of mass, we need to calculate moments first.

To calculate the moments of a system we'll use the formulas

$$M_y = m_1(x_1) + m_2(x_2) + m_3(x_3)$$

and

$$M_x = m_1(y_1) + m_2(y_2) + m_3(y_3)$$

where m_1, m_2 and m_3 are the given masses and $P_1(x_1, y_1)$, $P_2(x_2, y_2)$ and $P_3(x_3, y_3)$ are the points associated with those masses.

In this problem the masses are located on a real number line. However, we calculate the moments of the system in the same manner as we would if the masses were located somewhere in the quadrant plane. We consider the real number line to be the x-axis. This means that the masses are on points in which the y-coordinate is 0.

Therefore, the masses and their locations are

$$m_1 = 15$$

$$P_1 = (-3,0)$$

and

$$m_2 = 20$$

$$P_2 = (2,0)$$

and

$$m_3 = 25$$

$$P_3 = (5,0)$$

We'll plug the values we've been given into the formulas for M_y and M_x.

$$M_y = (15)(-3) + (20)(2) + (25)(5)$$

$$M_y = -45 + 40 + 125$$

$$M_y = 120$$

and

$$M_x = (15)(0) + (20)(0) + (25)(0)$$

$$M_x = 0 + 0 + 0$$

$$M_x = 0$$

The moments of the system are $M_y = 120$ and $M_x = 0$.

We need to use these values, plus the total mass of the system, in order to find the coordinates for the center of mass. To find total mass, we'll add all three masses together.

$$m_T = m_1 + m_2 + m_3$$

$$m_T = 15 + 20 + 25$$

$$m_T = 60$$

To find the center of mass of a system we'll use the formulas

$$\bar{x} = \frac{M_y}{m_T}$$

and

$$\bar{y} = \frac{M_x}{m_T}$$

where $(\bar{x}, \bar{y})$ is the coordinate point that represents the center of mass, where M_x and M_y are the moments of the system, and where m_T is the total mass of the system.

We'll plug the values we've been given into the formulas for $\bar{x}$ and $\bar{y}$.

$$\bar{x} = \frac{120}{60} = 2$$

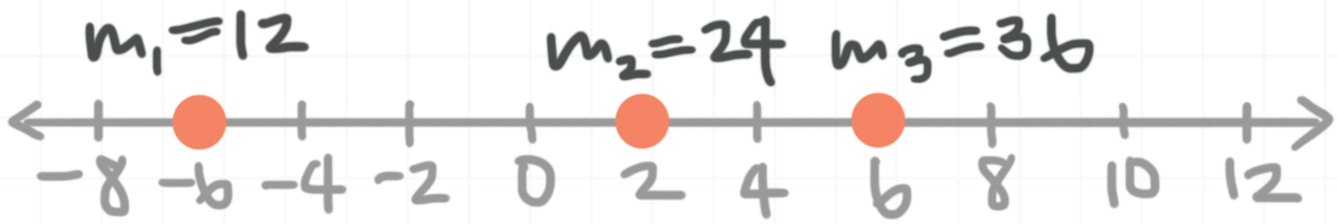
and

$$\bar{y} = \frac{0}{60} = 0$$

The center of mass of the system is $(2,0)$.

Topic: Center of mass of the system, x-axis

Question: Find the center of mass of the system.



Answer choices:

A $(8,0)$

B $\left(\frac{8}{3},0\right)$

C $\left(0,\frac{8}{3}\right)$

D $(0,8)$

Solution: B

Since moments of the system are used in the formulas for center of mass, we need to calculate moments first.

To calculate the moments of a system we'll use the formulas

$$M_y = m_1(x_1) + m_2(x_2) + m_3(x_3)$$

and

$$M_x = m_1(y_1) + m_2(y_2) + m_3(y_3)$$

where m_1, m_2 and m_3 are the given masses and $P_1(x_1, y_1)$, $P_2(x_2, y_2)$ and $P_3(x_3, y_3)$ are the points associated with those masses.

In this problem the masses are located on a real number line. However, we calculate the moments of the system in the same manner as we would if the masses were located somewhere in the quadrant plane. We consider the real number line to be the x-axis. This means that the masses are on points in which the y-coordinate is 0.

Therefore, the masses and their locations are

$$m_1 = 12$$

$$P_1 = (-6,0)$$

and

$$m_2 = 24$$

$$P_2 = (2,0)$$

and

$$m_3 = 36$$

$$P_3 = (6,0)$$

We'll plug the values we've been given into the formulas for M_y and M_x.

$$M_y = (12)(-6) + (24)(2) + (36)(6)$$

$$M_y = -72 + 48 + 216$$

$$M_y = 192$$

and

$$M_x = (12)(0) + (24)(0) + (36)(0)$$

$$M_x = 0 + 0 + 0$$

$$M_x = 0$$

The moments of the system are $M_y = 192$ and $M_x = 0$.

We need to use these values, plus the total mass of the system, in order to find the coordinates for the center of mass. To find total mass, we'll add all three masses together.

$$m_T = m_1 + m_2 + m_3$$

$$m_T = 12 + 24 + 36$$

$$m_T = 72$$

To find the center of mass of a system we'll use the formulas

$$\bar{x} = \frac{M_y}{m_T}$$

and

$$\bar{y} = \frac{M_x}{m_T}$$

where $(\bar{x}, \bar{y})$ is the coordinate point that represents the center of mass, where M_x and M_y are the moments of the system, and where m_T is the total mass of the system.

We'll plug the values we've been given into the formulas for $\bar{x}$ and $\bar{y}$.

$$\bar{x} = \frac{192}{72} = \frac{8}{3}$$

and

$$\bar{y} = \frac{0}{72} = 0$$

The center of mass of the system is $\left(\frac{8}{3}, 0\right)$.