Center of Mass

Looking at Multiple Masses.

or System of Masses.

Set up a coordinate system

(if not already given one

$$M x_{cm} = \sum_{i=1}^{n} m_i x_{cm_i}$$

M → Total Mass $= \sum_{i=1}^{n} m_i$

&

$$M y_{cm} = \sum_{i=1}^{n} m_i y_{cm_i}$$

$m_1 = 5\text{kg}$ @ $(3, 5)$

$m_2 = 17\text{kg}$ @ $(-4, 10)$

$m_3 = 1\text{kg}$ @ $(7, 15)$

$M = 23\text{kg}$ $\quad 23 x_{cm_{sys}} = 5(3) + 17(-4) + 1(7)$

$15 - 68 + 7$

$23 x_{cm} = -46$

$x_{cm} = -2$

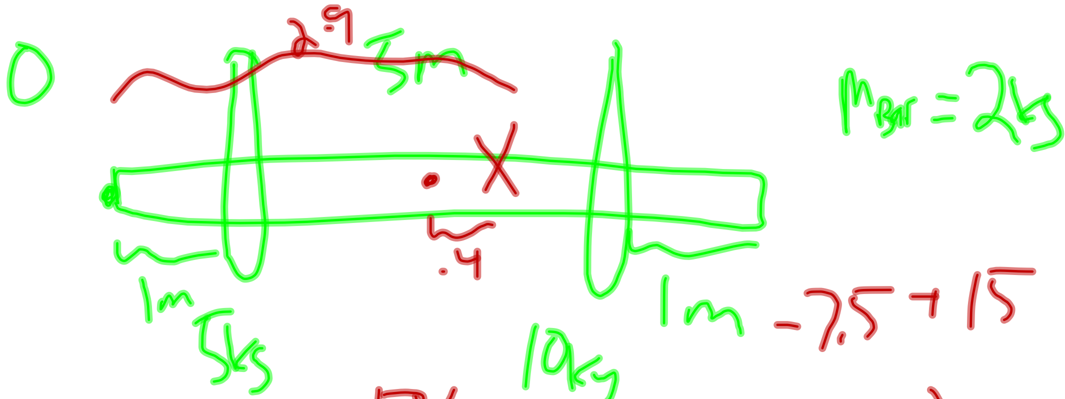
$23 y_{cm} = 5(5) + 17(10) + 1(15)$

$25 + 170 + 15$

$23 y_{cm} = 210$

$y_{cm} = \frac{210}{23}$

$\left(-2, \frac{210}{23}\right)_{cm_{sys.}}$



$$17X_{cm} = 2(0) + 5(-1.5) + 10(1.5)$$

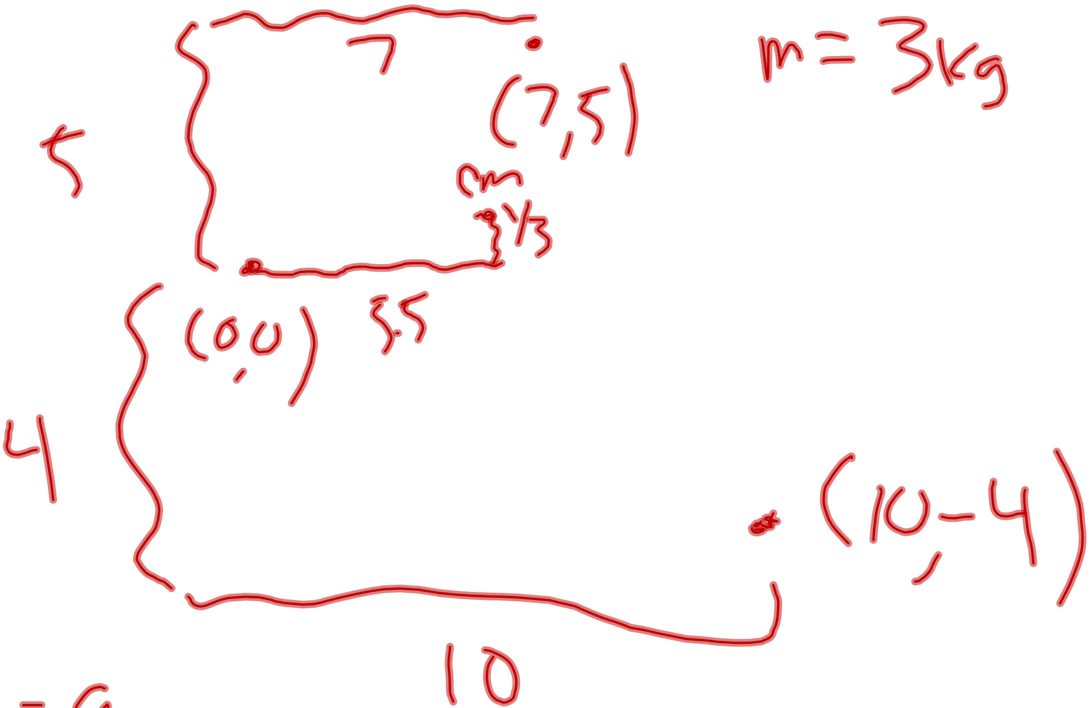
$$M = 17 \qquad X_{cm} = 5(1) + 2(2.5) + 10(4)$$

$$x = \frac{7.5}{17} = .4$$

$$17X_{cm} = 50$$

$$x_{cm} = \frac{50}{17} = 2.9$$

$m = 3\,kg$



$M = 9$ $\quad x_{cm} = 3(7) + 3(10)$ $\quad y_{cm} = 3(5) + 3(-4)$

$21 \quad 30 \qquad 15 - 12$

3

$x_{cm} \ \frac{51}{9}$ $\qquad y_{cm} = \frac{3}{9} = \frac{1}{3}$

$$M\vec{r}_{cm} = \int \vec{r}\,dm$$

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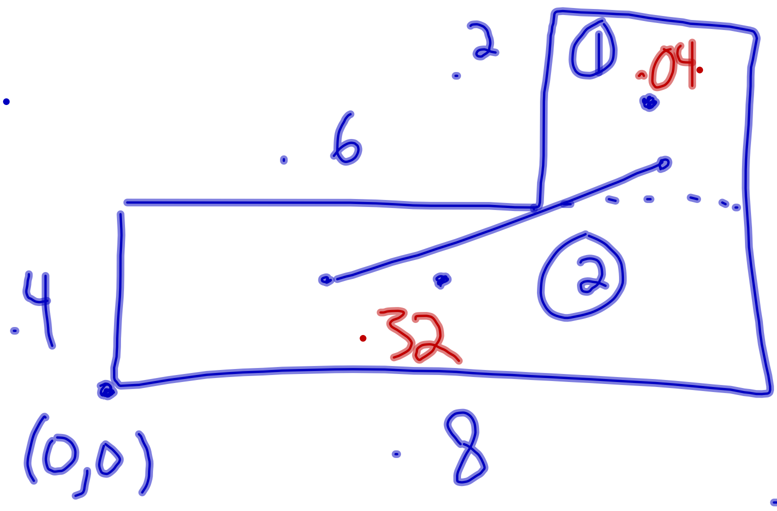
C.M.



$\delta = \frac{M}{A}$ $M = \delta A$

$\delta = \frac{m}{A}$

$\delta = \frac{m_1}{A_1} = \frac{m_2}{A_2}$

$\frac{A_1}{A_2} = \frac{m_1}{m_2}$

$M x_{cm} = m_1 x_{cm_1} + m_2 x_{cm_2}$

$\frac{A_1}{A} = \frac{m_1}{M}$

$A x_{cm} = A_1 x_{cm_1} + A_2 x_{cm_2}$

$(.04)(.7) \quad (.32)(.4)$

$(.36) x_{cm} = .028 + .128 = .156$

$\delta A x_{cm} = \delta A_1 x_{cm_1} + \delta A_2 x_{cm_2}$

$x_{cm} = .43 m$

$(.36) y_{cm} = (.04)(.5) + (.32)(.2)$

$.02 + .064 = \frac{.084}{.36}$

$y_{cm} = .23 m$

Equilibrium

$$\sum F = 0$$

Equilibrant

↳ Equilibrium causing Force