Center of Mass

Total of all Masses = M

x_{cm} = $x_{center\ of\ mass}$

Look for symmetry and or uniformity

For simplicity - set origin @ one of the masses

Reality checks - x_{cm} should be towards larger mass

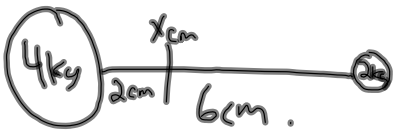
- Think of "balance point"

$$M x_{cm} = m_1 x_1 + m_2 x_2 + m_3 x_3 \ldots$$

practice 5-7

4kg m @ origin

2kg m @ 6cm (on x-axis)



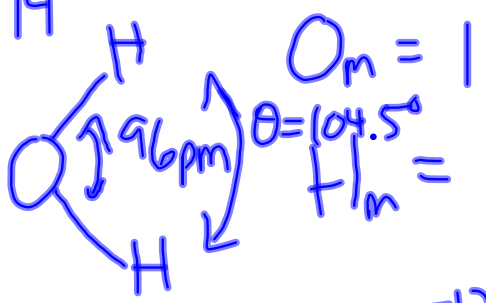
$$(4+2)x_{cm} = 4(0) + 2(6)$$

$$\frac{6x_{cm}}{6} = \frac{12}{6}$$

$$x_{cm} = 2cm$$

$$M\vec{r}_{cm} = m_1\vec{r}_1 + m_2\vec{r}_2 + \ldots$$

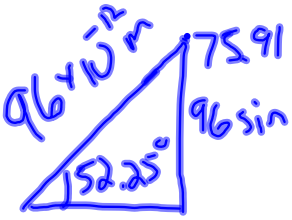
Example 5.14



$O_m = 16u$

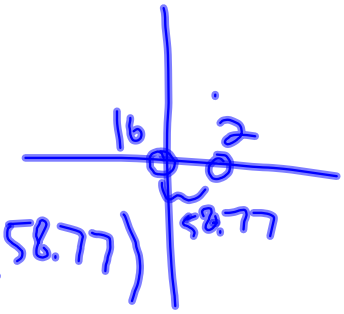
$H_m = 1u$

$\rho = x10^{-12}$



$CM = ?$

$X_{cm} = ?$ $\quad Y_{cm} = ?$



$$M x_{cm} = 16(0) + (1)(58.77) + 1(58.77)$$

$$18 x_{cm} = 117.54 \qquad x_{cm} = 6.53 pm$$

$$M y_{cm} = 16(0) + (1)(75.91) + (1)(-75.91)$$

$$y_{cm} = 0 \qquad CM = (6.53, 0)$$

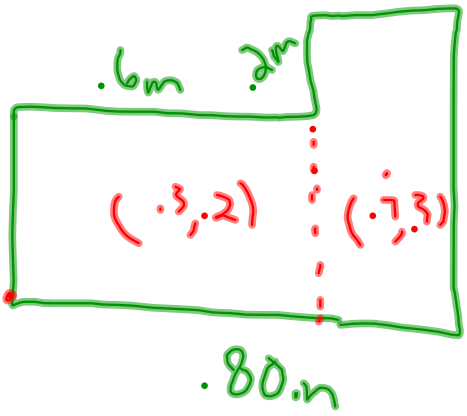
$D = \frac{m}{V}$

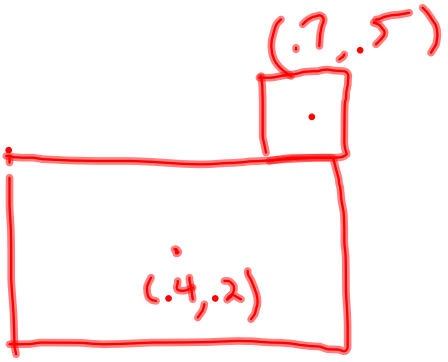
$D = \text{const.}$

$m = DV$

$m \cong DA$

$m \propto A$





$M X_{cm} = m_1 x_1 + m_2 x_2$

$= ? M$

$X_{cm} = \frac{A_1}{A} x_1 + \frac{A_2}{A} x_2 \cdots$

cansay

$X_{cm} = \frac{m_1}{M} x_1 + \frac{m_2}{M} x_2 \text{ etc.}$

$A = (.8)(.4) + (.2)(.2)$

$.32 + .04$

$= .36 m^2$

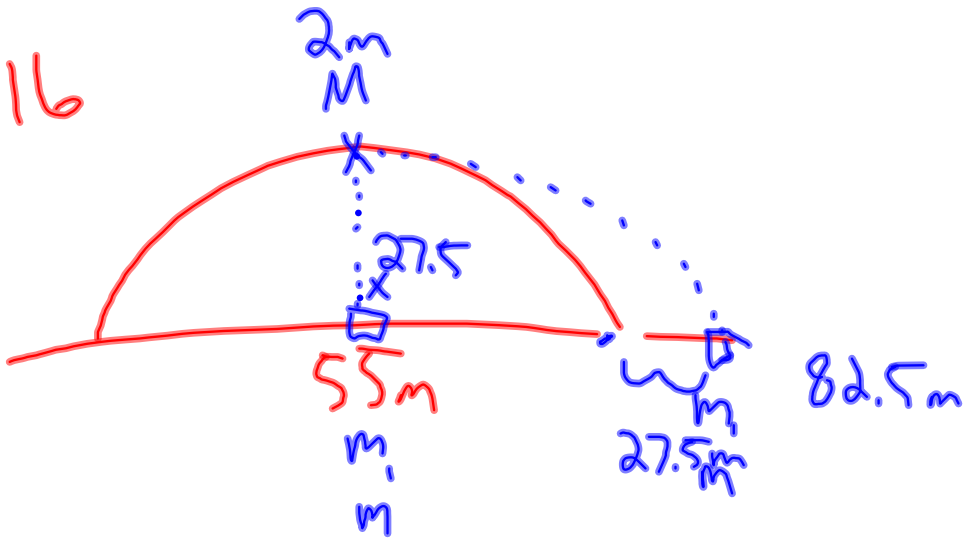
$X_{cm} = \frac{.32}{.36}(.4) + \frac{.04}{.36}(.7)$

$=$

For multiple body or part system

$$F_{net} = \sum F_{ext} = Ma_{cm}$$

Ex 5.16



$$M x_{cm} = m x_{cm_1} + m x_{cm_2}$$

$$(2m)(x_{cm}) = m x_{cm_1} + m x_{cm_2}$$