Center of Mass (CM) and Momentum - 1

CM of Earth-Moon (1):

$$x_{\rm cm} = \frac{m_1\,x_1 + m_2\,x_2}{m_1 + m_2}\,.$$

Choose $x_{\rm cm} = 0$ and m_1 to be the larger mass. Then $x = x_2 - x_1$ given allows to solve for x_1 (negative). Enter the absolute value of x_1.

Point masses in a plane: CM (2.

$$x_{\rm cm} = \frac{1}{M}\sum_{i=1}^{3} m_i\,x_i\,, \quad y_{\rm cm} = \frac{1}{M}\sum_{i=1}^{3} m_i\,y_i\,, \quad M = \sum_{i=1}^{3} m_i\,.$$

CM of three equal Masses (3):

$$\frac{1}{3}\,(a_1 + a_2 + a_3)\,\hat{i} + \frac{1}{3}\,(b_1 + b_2 + b_3)\,\hat{j}\,.$$

Then:

$$\vec{v} = \frac{d\,\vec{r}}{d\,t}\,, \quad \vec{a} = \frac{d\,\vec{v}}{d\,dt}\,.$$

Center of Mass (CM) and Momentum - 2

Nonuniform Rod (4):

$$M_{\mathrm{rod}} = \int_0^L dx\, \mu(x) = ?\,, \quad x_{\mathrm{cm}} = \frac{1}{M_{\mathrm{rod}}} \int_0^L dx\, \mu(x)\, x = ?$$

Two Blocks on a Compressed Spring (5):

$$m_1\, v_1 = m_2\, v_2\,, \quad \frac{k}{2}\, (\triangle x)^2 = m_1\, \frac{v_1^2}{2} + m_2\, \frac{v_2^2}{2}\,.$$

Impulse on a Golf Ball (6):

$$p = m\, v\,, \quad f = m\, \frac{v}{t}\,.$$

Space Walker (7). Sign convention: v negative.

$$m\, v = m_1\, v_1 + m_2\, v_2\,.$$