

Phys101 Quiz # 6 (Ch.9) sec # 38

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1- Two masses, 5 kg has velocity $\vec{V}_1 = (12 \hat{i} - 16 \hat{j})$ m/s and 10 kg has velocity $\vec{V}_2 = (-20 \hat{i} + 13 \hat{j})$.

Determine the speed of their center of mass.

$$\begin{aligned} \vec{v}_{\text{com}} &= \frac{\vec{P}}{M_{\text{tot}}} = \frac{\vec{P}_1 + \vec{P}_2}{m_1 + m_2} = \frac{m_1 \vec{v}_1 + m_2 \vec{v}_2}{m_1 + m_2} \\ &= \frac{5(12 \hat{i} - 16 \hat{j}) + 10(-20 \hat{i} + 13 \hat{j})}{5 + 10} \\ &= \frac{60 \hat{i} - 80 \hat{j} - 200 \hat{i} + 130 \hat{j}}{15} \\ &= \frac{-140 \hat{i} + 50 \hat{j}}{15} = (-9.3 \hat{i} + 3.3 \hat{j}) \frac{\text{m}}{\text{s}} \end{aligned}$$

$$\text{speed} = |\vec{v}_{\text{com}}| = \sqrt{(-9.3)^2 + (3.3)^2} \approx 9.9 \frac{\text{m}}{\text{s}}$$

2- A 4.0 kg mass has a velocity of $(4.0 \hat{i})$ m/s, when it explodes into two 2.0 kg masses. After the explosion, one of the masses has a velocity of 3.0 m/s making an angle of 60 degrees with the +x axis. What is the velocity of the other mass after the explosion?

$$\vec{P}_i = \vec{P}_f$$

$$4(4) \hat{i} = 2(3 \cos 60 \hat{i} + 3 \sin 60 \hat{j}) + 2 \vec{v}_2$$

$$16 \hat{i} = 6 \cos 60 \hat{i} + 6 \sin 60 \hat{j} + 2 \vec{v}_2$$

$$\vec{v}_2 = \frac{16 \hat{i} - 6 \cos 60 \hat{i} - 6 \sin 60 \hat{j}}{2}$$

$$\vec{v}_2 = \left(\frac{16 - 6 \cos 60}{2} \right) \hat{i} - \left(\frac{6 \sin 60}{2} \right) \hat{j}$$

$$\vec{v}_2 = 6.5 \hat{i} - 2.6 \hat{j}$$

