

Phys101 Quiz # 6 (Ch.9) sec # 39

Name:

Key

ID #

1- A 2.0-kg particle has a velocity of 4.0 m/s in the positive x direction and a 3.0-kg particle has a velocity of 5.0 m/s in the positive y direction. What is the speed of their center of mass?

$$\begin{aligned} \vec{v}_{\text{com}} &= \frac{\vec{P}}{M_{\text{tot}}} = \frac{\vec{P}_1 + \vec{P}_2}{m_1 + m_2} = \frac{m_1 \vec{v}_1 + m_2 \vec{v}_2}{m_1 + m_2} \\ &= \frac{2(4)\hat{i} + 3(5)\hat{j}}{2 + 3} = \frac{8\hat{i} + 15\hat{j}}{5} = \left(\frac{8}{5}\hat{i} + 3\hat{j}\right) \frac{\text{m}}{\text{s}} \end{aligned}$$

$$\text{Speed} = |\vec{v}_{\text{com}}| = \sqrt{\left(\frac{8}{5}\right)^2 + 3^2} = 3.4 \frac{\text{m}}{\text{s}}$$

2- A 3.0 kg object, initially at rest explodes into three pieces of equal mass. Two pieces move perpendicular to each other, each with a speed of 10 m/s. What is the speed of the third piece?

$$\vec{P}_i = \vec{P}_f \quad \text{and} \quad P_i = 0 \quad (\text{at rest}).$$

$$0 = m_1 \vec{v}_1 + m_2 \vec{v}_2 + m_3 \vec{v}_3$$

$$0 = 1(10\hat{i}) + 1(10\hat{j}) + 1 * \vec{v}_3$$

$$\vec{v}_3 = -10\hat{i} - 10\hat{j}$$

$$\text{Speed} = |\vec{v}_3| = \sqrt{(-10)^2 + (-10)^2} = \sqrt{200} \frac{\text{m}}{\text{s}} = 14.1 \frac{\text{m}}{\text{s}}$$