Phys101 Quiz # 6 (Ch.9) sec # 37

Name: Key ID #

1- Two masses, 5 kg each, have velocities (in m/s): $\mathbf{V_1} = 12\,\mathbf{i} + 16\,\mathbf{j}$ and $\mathbf{V_2} = -20\,\mathbf{i} + 14\,\mathbf{j}$. Determine the speed of their center of mass.

$$\vec{v}_{com} = \frac{\vec{P}}{M_{tot}} = \frac{\vec{P}_1 + \vec{P}_2}{m_1 + m_2} = \frac{m_1\vec{v}_1 + m_2\vec{v}_2}{m_1 + m_2}$$

$$= \frac{5(12\hat{i} + 16\hat{j}) + 5(-20\hat{i} + 14\hat{j})}{5+5}$$

$$= \frac{60\hat{i} + 80\hat{j} - 100\hat{i} + 70\hat{j}}{10}$$

$$= \frac{-40\hat{i} + 150\hat{j}}{10} = (-4\hat{i} + 15\hat{j})\ \frac{m}{s}$$

$$\text{speed} = |v_{com}| = \sqrt{(-4)^2 + (15)^2} = 15.5\ \frac{m}{s}.$$

2- A 10 kg bomb at rest explodes, breaking into three pieces of masses 2.0 kg, 2.0 kg, and 6.0 kg. The two 2.0 kg pieces fly off perpendicular to each other, one along the +x-axis and the other along the +y-axis, with the same speed 30 m/s. Find the speed of the 6.0 kg piece.

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

$$0 = m_1\vec{v}_{1f} + m_2\vec{v}_{2f} + m_3\vec{v}_{3f}$$

$$0 = 2(30)\hat{i} + 2(30)\hat{j} + 6\,\vec{v}_{3f}$$

$$\vec{v}_{3f} = \frac{-60\hat{i} - 60\hat{j}}{6} = (-10\hat{i} - 10\hat{j})\ \frac{m}{s}$$

$$\text{speed} = |\vec{v}_{3f}| = \sqrt{10^2 + 10^2} = \sqrt{200} = 14.1\ \frac{m}{s}.$$