

Chapter 9 (Center of Mass and Linear Momentum)

1- Three identical particles each of mass = 1 kg are placed in the xy plane. The position vector of the first is $\mathbf{r}_1 = (1\mathbf{i} + 4\mathbf{j})$ m and the second is $\mathbf{r}_2 = (3\mathbf{i} + 1\mathbf{j})$ m. What would be the position vector of the third particle if the center of mass of the three particles were at (3 m, 3 m)?

a. $\mathbf{r}_3 = (5\mathbf{i} + 4\mathbf{j})$ m, b. $\mathbf{r}_3 = (3\mathbf{i} - 1\mathbf{j})$ m, c. $\mathbf{r}_3 = (1\mathbf{i} + 2\mathbf{j})$ m, d. $\mathbf{r}_3 = (2\mathbf{i} - 6\mathbf{j})$ m, e. $\mathbf{r}_3 = (4\mathbf{i} + 3\mathbf{j})$ m

2- An object at rest explodes into three pieces A, B and C. After the explosion, A has a mass of 2.0 kg and velocity (3.0i) m/s, B has a mass of 3.0 kg and velocity (-1.0j) m/s, and C has a mass of 1.0 kg and velocity v. Find the velocity v.

a. $(-6\mathbf{i} + 3\mathbf{j})$ m/s, b. $(3\mathbf{i} + 6\mathbf{j})$ m/s, c. $(6\mathbf{i} - 3\mathbf{j})$ m/s, d. $(6\mathbf{i} + 3\mathbf{j})$ m/s, e. $(3\mathbf{i} - 6\mathbf{j})$ m/s

3- Three particles are placed in the xy plane. A 4-gram particle is located at (3, 4) m, and a 6-gram particle is located at (-2, -6) m. Where must a 2-gram particle be placed so that the center of mass of this three-particle system is located at the origin?

a. (0, 10) m, b. (6, -2) m, c. (5, 10) m, d. (9, 16) m, e. (-2, 4) m

4- 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?

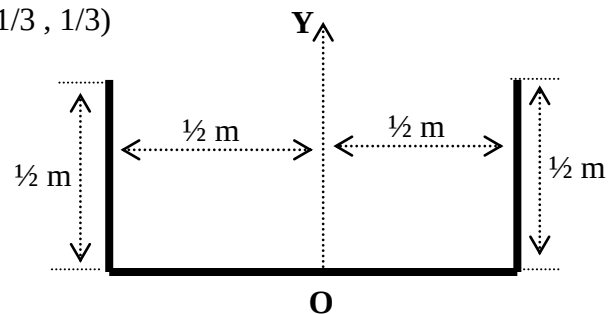
a. 3.4 m/s, b. 3.8 m/s, c. 5.0 m/s, d. 4.4 m/s, e. 4.6 m/s

5- 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 momentum of the center mass of the two masses (in kg m/s).

a. $-40\mathbf{i} - 10\mathbf{j}$, b. $160\mathbf{i} - 150\mathbf{j}$, c. $-40\mathbf{i} + 10\mathbf{j}$, d. $40\mathbf{i} - 10\mathbf{j}$, e. $-160\mathbf{i} + 150\mathbf{j}$

6- A uniform wire of mass M and length 2 m is bent to be all in one plane (see the figure). Find its center of mass with respect to point O.

a. $(0, 1/8)$, b. $(-1, 1/8)$, c. $(1/2, 1/3)$, d. $(1/8, 3/8)$, e. $(1/3, 1/3)$



Summary of Chapter 9 topics

- 1- Understanding the Center of mass, Newton's second law for a system of particles
- 2- Understanding the Linear momentum, collision, and impulse
- 3- Understanding the conservation of linear momentum, kinetic energy in a collision
- 4- Understanding the collisions in 1-D and 2-D