Answer on Question #40732, Physics, Mechanics | Kinematics | Dynamics

Consider a system of three equal mass particles moving in a plane; their positions are given by ai vectors and bi vectors.

For particle 1,a1=3t^2+4 b1=0

For particle 2,a2=7t+5 b2=2

For particle 3,a3=2t b3=3t+4

Determine the position and velocity of the center of mass as functions of time

Solution

For the 'a' component of the center of mass's position vector is R_a where:

$$R_a = \frac{\sum_i m_i a_i}{\sum_i m_i} = \frac{ma_1 + ma_2 + ma_3}{m + m + m} = \frac{1}{3}(a_1 + a_2 + a_3) = \frac{1}{3}(3\text{t}^2 + 4 + 7\text{t} + 5 + 2\text{t}) = t^2 + 3t + 3.$$

The 'a' component of the center of mass's velocity, V_a is found by differentiating with respect to time

$$V_a = \frac{dR_a}{dt} = 2t + 3.$$

For the 'b' component of the center of mass's position vector is R_b where:

$$R_b = \frac{\sum_i m_i b_i}{\sum_i m_i} = \frac{mb_1 + mb_2 + mb_3}{m + m + m} = \frac{1}{3}(b_1 + b_2 + b_3) = \frac{1}{3}(2 + 3\text{t} + 4) = t + 2.$$

The 'b' component of the center of mass's velocity, V_b is found by differentiating with respect to time

$$V_b = \frac{dR_b}{dt} = 1.$$

The position of the center of mass:

$$\vec{R} = (t^2 + 3t + 3)\vec{\imath} + (t + 2)\vec{\jmath}.$$

The velocity of the center of mass:

$$\vec{V} = (2t + 3)\vec{\imath} + \vec{\jmath}.$$