Answer on Question #66051-Physics-Mechanics-Relativity

The position vector of two particles of mass 4 kg and 2 kg are, respectively, r1 = 3t i^ + t j^ +2t2 k^ and r2 = 3 i^ +(t2-1)j^ +4t k^ where t is in seconds and the position in meters. Determine the position vector of the center of mass of the system, the velocity of the cm and the net force acting on the system

Solution

The position vector of the center of mass of the system is

$$\boldsymbol{r} = \frac{m_1\boldsymbol{r_1} + m_2\boldsymbol{r_2}}{m_1 + m_2} = \frac{1}{4+2}(4(3t) + 2(3); 4t + 2(\mathrm{t}^2 - 1); 4(2t^2) + 2(4t))$$
$$= \left(2t + 1; \frac{1}{3}(t^2 + 2t - 1); \frac{4}{3}(t^2 + t)\right) m.$$

The velocity of the cm:

$$\dot{\boldsymbol{r}} = \left(2; \frac{1}{3}(2t + 2); \frac{4}{3}(2t + 1)\right)\frac{m}{s}$$

The acceleration of cm:

$$\ddot{\boldsymbol{r}} = \left(0; \frac{2}{3}; \frac{8}{3}\right)\frac{m}{s^2}$$

The net force acting on the system is

$$\boldsymbol{F} = (m_1 + m_2)\ddot{\boldsymbol{r}} = 6\left(0; \frac{2}{3}; \frac{8}{3}\right) = (0; 4; 16)\ N.$$