Answer on Question #73860-Physics-Field Theory

Two particles are held 1.0 mm apart. One particle has a mass of 1.0 x 10-5 kg and a net charge of + 3.2 x 10-10 C. The other particle has a mass of 2.0 x 10-5 kg and a net charge of + 4.8 x10-10 C. If the two particles are released, what will their speeds be when they are 2.0 mm apart?

Solution

From the conservation of energy:

$$\frac{kq_1q_2}{r_1} = \frac{kq_1q_2}{r_2} + \frac{MV^2}{2}$$

$$\frac{\mu V^2}{2} = kq_1q_2\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

The speed of center of the mass is

$$V = \sqrt{(m_1 + m_2)\frac{2kq_1q_2}{m_1m_2}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)}$$

The speed of first particle is

$$v_1 = \frac{m_2}{(m_1 + m_2)}V = \sqrt{\frac{2kq_1q_2m_2}{(m_1 + m_2)m_1}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)}$$

$$= \sqrt{\frac{2(9 \cdot 10^9)(3.2 \cdot 10^{-10})(4.8 \cdot 10^{-10})(2 \cdot 10^{-5})}{(1 \cdot 10^{-5} + 2 \cdot 10^{-5})1 \cdot 10^{-5}}\left(\frac{1}{0.001} - \frac{1}{0.002}\right)} = 0.30\frac{m}{s}$$

The speed of second particle is

$$v_2 = \frac{m_1}{(m_1 + m_2)}V = \sqrt{\frac{2kq_1q_2m_1}{(m_1 + m_2)m_2}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)}$$

$$= \sqrt{\frac{2(9 \cdot 10^9)(3.2 \cdot 10^{-10})(4.8 \cdot 10^{-10})(1 \cdot 10^{-5})}{(1 \cdot 10^{-5} + 2 \cdot 10^{-5})2 \cdot 10^{-5}}\left(\frac{1}{0.001} - \frac{1}{0.002}\right)} = 0.15\frac{m}{s}$$