9. Two particles, with identical positive charges and a separation of 2.60 x 10^{-2} m, are released from rest. Immediately after the release, particle 1 has an acceleration $\overrightarrow{a_1}$ whose magnitude is $4.60\times10^{3}\ \mathrm{m/s^2}$, while particle 2 has an acceleration $\overrightarrow{a_2}$ whose magnitude is 8.50 x 10^3 m/s^2. Particle 1 has a mass of 6.00 x 10^{-6} kg. Find **(a)** the charge on each particle and **(b)** the mass of particle 2.

$$F_{12} = k\frac{q_1 q_2}{r_{12}^2} = m_1 a_1 = m_2 a_2 = k\frac{q^2}{r_{12}^2}$$

Solve for q

$$q^2 = r_{12}^2 \frac{m_1 a_1}{k}$$

$$q = r_{12}\sqrt{\frac{m_1 a_1}{k}} = (2.60\ x\ 10^{-2} m)\sqrt{\frac{(6.00\ x\ 10^{-6} kg)\left(4.60\ x\ 10^{3}\ {}^{m}/_{s^2}\right)}{8.99\ x\ 10^{9}\ {}^{Nm^2}/_{C^2}}}$$

$$q = (2.60\ x\ 10^{-2} m)\sqrt{3.070\ x\ 10^{-12}\ {}^{C^2}/_{m^2}} = (2.60\ x\ 10^{-2} m)\left(1.752\ x\ 10^{-6}\ {}^{C}/_{m}\right)$$

$$q = (2.60\ x\ 10^{-2} m)\left(1.752\ x\ 10^{-6}\ {}^{C}/_{m}\right) = 4.555\ x\ 10^{-8} C$$

Since

$$m_1 a_1 = m_2 a_2$$

$$m_2 = m_1\frac{a_1}{a_2} = (6.00\ x\ 10^{-6} kg)\frac{\left(4.60\ x\ 10^{3}\ {}^{m}/_{s^2}\right)}{\left(8.50\ x\ 10^{3}\ {}^{m}/_{s^2}\right)} = (6.00\ x\ 10^{-6} kg)(0.5412)$$

$$m_2 = (6.00\ x\ 10^{-6} kg)(0.5412) = 3.247\ x\ 10^{-6} kg$$

$$q = 4.56\ x\ 10^{-8} C = 45.6\ nC$$
$$m_2 = 3.25\ x\ 10^{-6} kg$$

Dr. Donovan's Classes Page	Dr. Donovan's PH 202 Homework Page
NMU Physics Department Web Page	NMU Main Page

Please send any comments or questions about this page to ddonovan@nmu.edu

This page last updated on January 7, 2021