

Answer on Question #46942, Physics, Electric Circuits

Question:

Two equally charged particles are held 3.2 103 m apart and then released from rest. The initial acceleration of the first particle is observed to be 7.0 m/s² and that of the second to be 9.0 m/s². If the mass of the first particle is 6.3 10⁷ kg, what are

- (a) the mass of the second particle
- (b) the magnitude of the charge of each particle?

Answer:

Newton's third law of motion:

$$F_{21} = F_{12} = F$$

- a) Newton's second law of motion:

$$F = m_1 a_1 = m_2 a_2$$

Therefore:

$$m_2 = m_1 \frac{a_1}{a_2} = 6.3 \cdot 10^7 \text{ kg} \frac{7}{9} = 4.9 \cdot 10^7 \text{ kg}$$

- b) Coulomb's law:

$$F = \frac{kq^2}{r^2}$$

From Newton's second law of motion

$$F = m_1 a_1$$

Therefore:

$$\frac{kq^2}{r^2} = m_1 a_1$$
$$q = \sqrt{\frac{m_1 a_1 r^2}{k}} = \sqrt{\frac{6.3 \cdot 10^7 \cdot 7 \cdot (3.2 \cdot 10^3)^2}{9 \cdot 10^9}} = 708 \text{ C}$$