p. 360 # 3, 4

3. Before:

$v_1 = v_2 = 0\ m/s$

$r = 5.0 \times 10^{-12}\ m$

$m = 9.11 \times 10^{-31}\ kg$

$q_1 = q_2 = 1.602 \times 10^{-19}\ C$

After:

$v_1' = v_2' = ?$

$r \to \infty \therefore E_e' = 0\ J$

$$E_i = E_f$$

$$E_e + E_{k1} + E_{k2} = E_e' + E_{k1}' + E_{k2}'$$

$$\frac{k q_1 q_2}{r} + \cancel{\frac{1}{2} m_1 v_1^2}^{\,0} + \cancel{\frac{1}{2} m_2 v_2^2}^{\,0} = \cancel{\frac{k q_1 q_2}{r'}}^{\,0} + \frac{1}{2} m_1 v_1'^2 + \frac{1}{2} m_2 v_2'^2$$

$$\therefore \frac{k q^2}{r} = m v^2 \quad \text{b/c } q_1 = q_2,\ v_1' = v_2',\ m_1 = m_2$$

$$\therefore v = \sqrt{\frac{k q^2}{m r}}$$

$$v = \sqrt{\frac{(9.0 \times 10^9\ Nm/C^2)(1.602 \times 10^{-19}\ C)^2}{(9.11 \times 10^{-31}\ kg)(5.0 \times 10^{-12}\ m)}}$$

$$v = 7.1 \times 10^6\ m/s.$$

p. 360 # 3, 4

4. Before:

$r \to \infty, \therefore E_e = 0\ J$

$m_1 = m_2 = 1.63 \times 10^{-27}\ kg$

$v_1 = 2.3 \times 10^6\ m/s$

$v_2 = 1.2 \times 10^6\ m/s$

$q_1 = q_2 = 1.602 \times 10^{-19}\ C$

After:

$v_1' = v_2' = 0\ m/s \Rightarrow E_{k1}' = E_{k2}' = 0\ J$

$r' = ?$

$$E_T = E_T'$$

$$E_e + E_{k1} + E_{k2} = E_e' + E_{k1}' + E_{k2}'$$

$$E_{k1} + E_{k2} = E_e'$$

$$\frac{1}{2} m v_1^2 + \frac{1}{2} m v_2^2 = \frac{k q_1 q_2}{r'}$$

$$\therefore r' = \frac{k q^2}{\frac{1}{2} m (v_1^2 + v_2^2)}$$

$$r' = \frac{(9.0 \times 10^9\ N m^2/C^2)(1.602 \times 10^{-19}\ C)^2}{\frac{1}{2}(1.63 \times 10^{-27}\ kg)\left[(2.3 \times 10^6\ m/s)^2 + (1.2 \times 10^6\ m/s)^2\right]}$$

$$r' = 4.2 \times 10^{-14}\ m/s$$