Elastic Collisions (1D)

In ***elastic collision*** both energy and momentum are conserved.

To find final velocities of colliding particles in 1D follow this algorithm:

1. Find the velocity of the Center of Mass

$$V_{CM} = \frac{\vec{P}_{total}}{M_{total}}$$

2. Switch to the Reference Frame of Center of Mass
3. Upon elastic collision, each particle simply changes sign of its velocity (with respect to the center of mass)
4. Go back to the original Reference Frame

Homework

Problem 1

Two balls of mass m_1 and m_2 are moving towards each other in 1D with speeds v_1 and v_2 respectively. Find their velocities after elastic collision. *Pay attention to signs of velocities*.

Problem 2

Two electrons of mass m each are moving toward each other with the same initial speed v. They elastically bounce from each other due to electrostatic repulsion. Find the minimal distance between them. Electrostatic potential energy between two electrons at distance r has the following form:

$$U(r) = \frac{k_e e^2}{r}$$

Here e is the electric charge of the electron, k_e is the Coulomb's constant, (this Potential Energy can be obtained by integration of Coulomb's formula for electrostatic force, $F=k_e e^2/r^2$). Note that U=0 when electrons are far away.
Hint: what is the velocity of each electron when they are at minimal separation?