Please answer the questions below to the best of your ability either in the space provided. Everything should be scanned or photographed and submitted through gradescope.com. See instructions for getting added to the gradescope class.

Objective: *I can use the electrostatic force to predict future motion in three dimensions.*

Objective: *I can use conservation of momentum to approach problems in which external forces are negligible.*

1. In the far flung future, the game of billiards has evolved! The balls now have varied masses and possess small amounts of charge. Take a situation where the cue ball (mass=500 g and charge=1 µC) is struck such that is is moving at a velocity of $\langle 70, 0, 60\rangle$ cm/s. It "collides" with a stationary 8-ball (mass=800 g and charge=8 µC). After the collision the velocity of the cue ball is $\langle 27.8, 0, -42.2\rangle$ cm/s. If you take the 8-ball to be at the origin, the cue ball is initially located at $\vec{\mathbf{r}} = \langle -1, 0, -1\rangle$ m.

(2) (a) List all assumptions or simplifications you make in solving the problem here.

(2) (b) What is the final velocity of the 8-ball?

(1) (c) Setup the situation in Glowscript with a timestep of 1 ms. Does the final velocity of the 8-ball match your value from b?

(4) (d) Determine the shortest distance between the two balls during the interaction (how close to they come to one another?). One method of doing this would be plotting the distance over time and then reading the smallest value off your plot. This should only take 2 extra lines of code, and this may be useful if you are unfamiliar with how to plot in Glowscript.