A proton of mass m moving with a speed v_0 approches a stationary proton that is free to move. Assume impact parameter to be zero, i.e., head-on collision. How close will the incident proton go to other proton?

a. $\dfrac{e^3}{\pi \varepsilon_0 m^2 v_0}$

b. $\dfrac{e^3}{\pi \varepsilon_0 m v_0}$

c. $\dfrac{e^2}{\pi \varepsilon_0 m v_0^2}$

d. None of the above

8. c. The protons move toward each other till their relative velocity becomes equal to zero. At the closest distance of approach, both the protons will be moving with the same velocity.
As coulombian repulsive force is internal for the system of protons, we can apply the law of conservation of momentum.

$$\therefore \quad mv_0 = 2mv$$

$$\text{Change in KE} = \frac{1}{2}mv_0^2 - 2 \times \frac{1}{2}m\left(\frac{v_0}{2}\right)^2$$

This change in energy is equal to the electrical potential energy

$$\frac{mv_0^2}{2} - m\left(\frac{v_0}{2}\right)^2 = \frac{e^2}{4\pi\varepsilon_0 r}$$

$$\therefore \quad r = \frac{e^2}{\pi\varepsilon_0 mv_0^2}$$

b. Kinet[illegible] being accelerated