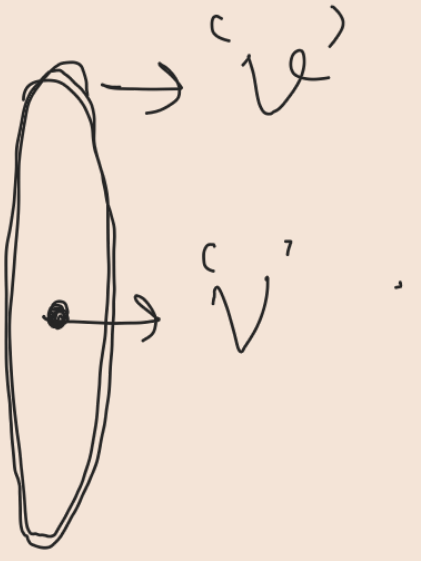
There can be three possible scenarios.

Case - I. Let the small particle be just able to reach centre of the ring.





By momentum conservation, $v = \frac{u}{2}$. However, for

this to happen, we have to apply energy 'cons' & find required value of 'u'.

$$\frac{KQq}{R} + \frac{1}{2}\times(2m)\frac{u^2}{4} = \frac{1}{2}mu^2$$

$$\frac{mu^2}{4} = \frac{Qq}{4\pi\epsilon_0 R} \quad \therefore \quad \text{So,}$$

$$u = \sqrt{\frac{Qq}{m\pi\epsilon_0 R}} \quad . \quad \text{Now,}$$

$$\text{if} \quad u < \sqrt{\frac{Qq}{m\pi\epsilon_0 R}}, \text{ then}$$

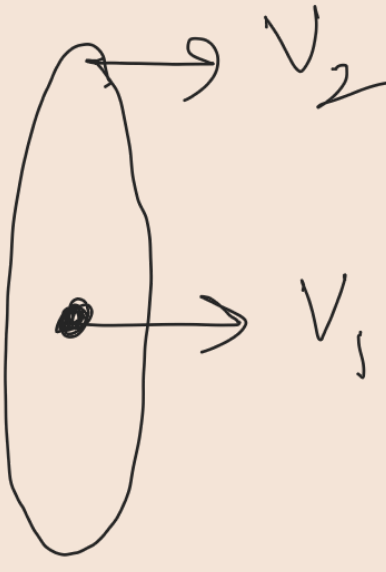
obviously particle is unable to reach centre of ring. In this case, due to repulsion, the final seperation will again become infinite. By energy & momentum 'cons' equation, we easily see that final velocity of particle = 0 & ring = 'u'. Now, if

$$u > \sqrt{\frac{Qq}{m\pi\epsilon_0 R}}$$

, particle

crosses ring centre. In this case, seperation again becomes impulse but particle starts accelerating after crossing centre & ring decelerating. Hence, max velocity of ring will be when particle is passing through its centre.

$V_1 + V_2 = u$.



$$\frac{1}{2}mu^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2 + \frac{kQq}{R}.$$

On solving for v_2, we get

$$V_2 = \frac{u}{2}\left[1 - \sqrt{1 - \frac{Qq}{\pi\epsilon_0 mRu^2}}\right]$$