

$$\xrightarrow{\gamma} E$$

$$\vec{a}_m = \left(\frac{qE}{m} - \frac{kq^2}{r^2 m}\right) \hat{i}$$

$$\vec{a}_M = \left(\frac{qE}{M} + \frac{kq^2}{r^2 M}\right) \hat{i}$$

$$\vec{a}_{M/m} = \left[qE\left(\frac{1}{M} - \frac{1}{m}\right) + \frac{kq^2}{r^2}\left(\frac{1}{M} + \frac{1}{m}\right)\right] \hat{i}$$

Now lets analyse the first condition, when $\vec{a}_{M/m} = 0$. Then,

$$\frac{qE}{\mu m}(M-m) = \frac{kq^2}{r^2}\left(\frac{M+m}{\mu m}\right)$$

$$r = \sqrt{\frac{q}{4\pi\epsilon_0 E}\frac{(M+m)}{(M-m)}} := l_0 \quad (\text{say})$$

If particles are released at seperation of 'l_0', then the distance between them will remain fixed at 'l_0'

If $l > l_0$, particles will eventually come closer due to lesser repulsion

& hence max distance between them will be 'l'.

If initial seperation is lesser than 'l$_0$', then the subsequent max seperation must be greater than 'l$_0$' by energy conservation, as 'l$_0$' will be that distance at which the kinetic energy of one particle wrt the other

is greatest. This answer given in the book seems ambigeous & needs to be rectified !!