CHARGED PARTICLES
EXTRA PRACTICE SUGGESTED SOLUTIONS
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P282 Q39

(a) Please note that for the electrons to just reach the plate RS, the vertical velocity must be zero. This means that there is still horizontal velocity in the electron when it just reach the plate RS.

$(\text{KE of electron})_{initial} = \frac{1}{2}mv^2$

We can see the problem as if electrons enters the plate perpendicularly with a velocity $v\sin 60°$ and they reach the plate at zero velocity,

$\Rightarrow \frac{1}{2}m(v\sin 60°)^2 = eV$ (CoE)

$\Rightarrow \frac{1}{2}mv^2 = \frac{eV}{(\sin 60°)^2}$

$= 2.13 \times 10^{-17}$ J //

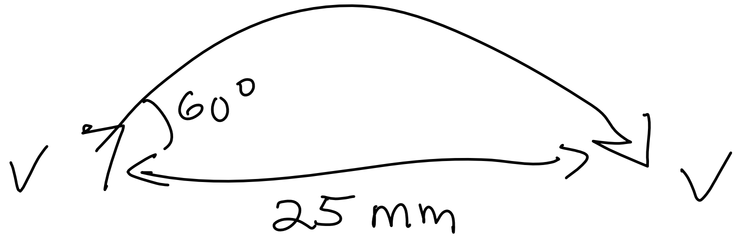
This is the KE of electrons at A that will just reach RS.

(b) Cannot use $\frac{1}{2}mv^2 = 2.13 \times 10^{-17}$

$\because m$ = mass of electrons

$\neq$ mass of an electron.

Have to use kinematics.



Horizontally, (using $s = ut$

$$0.025 = (V\cos 60^\circ)t$$

$$t = \frac{0.025}{V\cos 60^\circ}$$

$$a = \frac{F}{m} = \frac{qE}{m} = \frac{qV}{md}$$

Vertically, (using $v = u + at$)

$$-V\sin 60^\circ = V\sin 60^\circ + \left(-\frac{1.6\times10^{-19}}{9.1\times10^{-31}}\frac{(100)}{(0.015)}\right)t$$

$$2V\sin 60^\circ = 1.1722\times10^{15}\left(\frac{0.025}{V\cos 60^\circ}\right)$$

$$\Rightarrow V = 5.82\times10^{6}\ \text{ms}^{-1} \text{ at } 60^\circ \text{ to PQ}$$ //

This is not an easy qn. Well done if you can get it right!

P282 Q45(c)

(i)

1st 0.100m

$$a = \frac{eV}{md} \quad ; \quad eV = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2eV}{m}}$$

$$s = ut + \frac{1}{2}at^2$$

$$t_1 = \sqrt{\frac{2d}{eV/md}} = \sqrt{\frac{2d^2m}{eV}} = 3.37\ \text{nm}$$

Next 0.400 m

$$S = ut$$

$$t_2 = S/u$$

$$= 0.400 \Big/ \sqrt{\frac{2eV}{m}}$$

$$= 6.75 \text{nm}$$

$$t_{total} = t_1 + t_2$$

$$= 10.1 \text{ nm} \,//$$