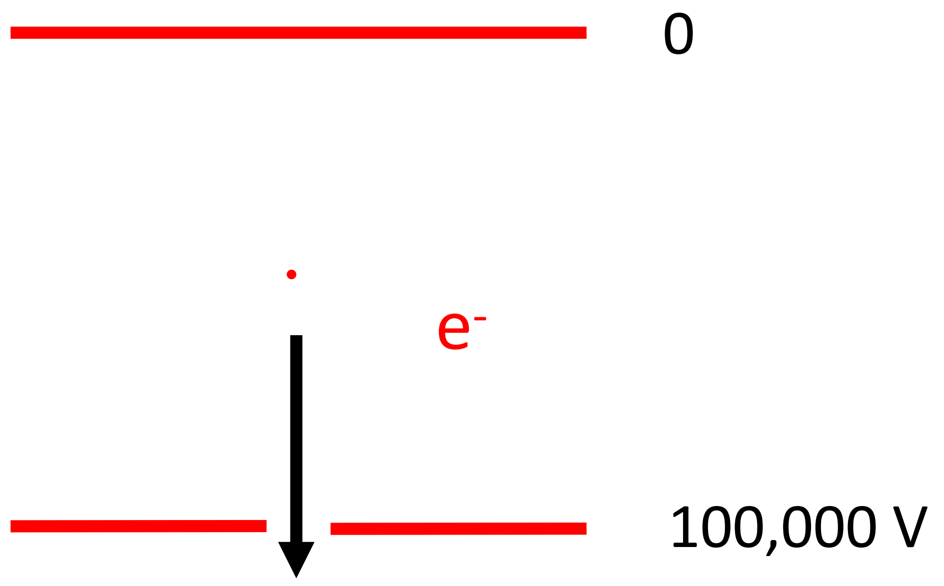
Electron velocity

To calculate the velocity we first need the energy of an electron that has accelerated through a potential of 10^5 Volts.



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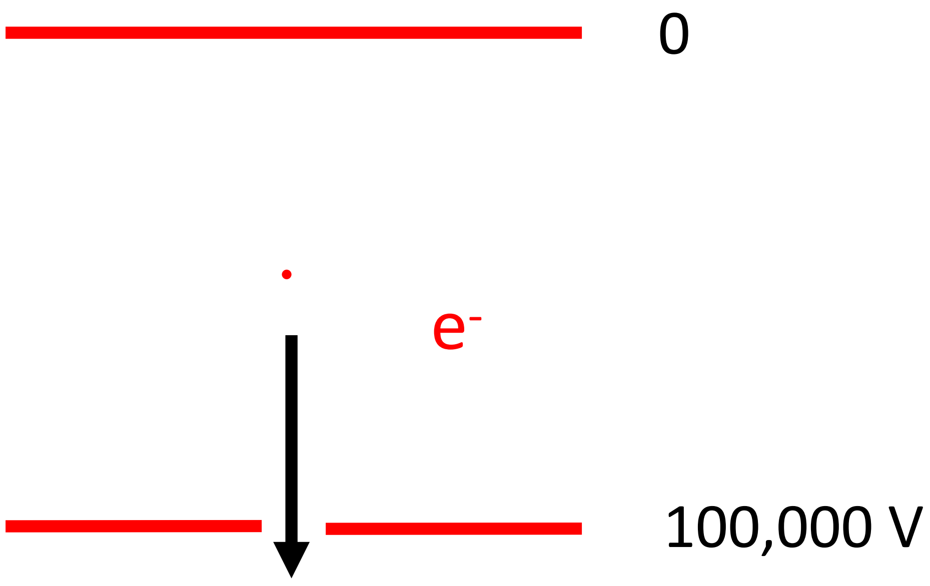
$$E = CV = (1.602\ x\ 10^{-19}\ C)(10^5\ V)$$

$$E = 1.602\ x\ 10^{-14}\ J$$



Electron acceleration

Then we need to solve for the velocity of the electron assuming that all of the energy is kinetic energy.

$$E = T \ (kinetic)$$

$$T = \frac{1}{2}mv^2$$

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Electron velocity

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$$T = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2(1.602\ x\ 10^{-14}\ J)}{9.1\ x\ 10^{-31}\ \ kg}}$$

Electron velocity

Then we need to solve for the velocity of the electron assuming that all of the energy is kinetic energy.

$$E = T\ (kinetic)$$

$$T = \frac{1}{2}mv^2$$

$$v = 1.876x\ 10^8\ m/s$$

Question: what fraction of the speed of light c is this?

Electron wave length

Once you have calculated the velocity you can calculate the wavelength using the DeBroglie relation. You will simply rearrange it to solve for wavelength.

Electron wave length

The DeBroglie relation solved for wavelength is:

$$\lambda = \frac{h}{p}$$

which gives

$$\lambda = \frac{h}{mv}$$

Electron wave length

The DeBroglie relation solved for wavelength is:

$$\lambda = \frac{h}{p}$$

which gives

$$\lambda = \frac{6.626\ x\ 10^{-34}\ Js}{(9.1\ x\ 10^{-31}\ kg)(1.876x\ 10^{8}\ m/s\ )}$$

$$\lambda = 3.88\ x\ 10^{-12}\ m = 3.88\ pm$$

Deflection angle

In practice we would rotate the crystal until we see the deflected electron beam. We know λ and d so we can find the angle from:

$$\theta = arcsin\left(\frac{\lambda}{2d}\right)$$

Since d = 3.9 Å and λ = 3.9 pm. We have

$$\theta = arcsin\left(\frac{1}{200}\right)$$

$$\theta = 0.0016^{o}$$