EEE105 Tutorial Question Set 1
Solutions

There are two possible approaches to this problem.

'Quick' Method

The electron drops through a potential difference of two volts. The energy difference for a charge q between two such potentials is simply qV. Thus in eV speak, the electron has dropped 2eV of potential energy and so must have gained this much kinetic energy. To convert to SI units we simply multiply by 1.6 X 10^{-19} to get a kinetic energy of $3.2x10^{-19}$ J . To get the velocity we then just need to note that this kinetic energy is = ½mv^2 and then rearrange. To convince you

$$\frac{1}{2}mv^2 = K.E. = 3.2x10^{-19}\,J$$

$$v^2 = \frac{3.2x10^{-19}x2}{9.1x10^{-31}} = 7x10^{11}$$

$$\therefore v = 8.4x10^5\,m/s$$

'Formal' Method

The force acting on the electron, F = qE (E is the electric field = V/L where L=0.1 mm). Thus the acceleration of the electron, **a = F/m = qV/Lm**.

You may know from the laws of motion that $s=ut+½at^2$.
In our case s is another name for L and the initial velocity u=0 so we can easily extract the time the electron takes to move the 0.1mm and therefore to drop through 2V

t^2=2L/a

Similarly, velocity is given by v=u+at.
Again u=0, we know a and t so we can get v. Actually it's easier to get v^2

$v^2=a^2t^2 = a^2.2L/a = 2aL = 2qV/m$ $=2x(1.6x10^{-19})x2/(9.1x10^{-31})$ m^2s^{-2}

which gives the same value as the 'quick' method above.

Since you now know the velocity you can work out the kinetic energy and should get the same answers as the first method.

The 'formal' method is more complex, and you need to remember the laws of motion. You should convince yourself that the two are equal. You should also try to remember the laws of motion as they are fairly intuitive and often useful.

You should also note that although the distance over which the electron dropped through the potential was given, you didn't actually need it. As engineers you will often need to determine what information is useful from all the data available. In your professional capacity you may even be missing some vital data and need to make educated guesses or try to find it out. (This is true for at least one question in a later set of Self Assessment Questions).