HW Number 2

1) On the microscopy Explore! Page at <http://myscope-explore.org/2_2_filament.html> there is the statement “When the wire gets hotter still, the electrons can even pop out of the wire.” Explain what this means, correcting any simplifications in this sentence.

2) Using the page [https://myscope.training/#](https://myscope.training/), explain the role of:

a) The Wehnelt

b) Image Deflectors

c) CCD camera

(Note: You may also need to consult other sources; if so, make sure they are trustworthy and cite them appropriately.)

3) View the video at <https://www.youtube.com/watch?v=zkr3JmhjKbg> then answer the following questions:

* 1. Why is the electron source normally at the top?
	2. In the video the sample holder is touched with hands -- is this a good idea?
	3. What is the lowest aperture used for?
	4. Before he adjusts the focus knob (~11:30 in the video), is the sample underfocused or overfocused?

4) On page <https://www.microscopemaster.com/transmission-electron-microscope.html> there is the statement “The image can be manipulated by adjusting the voltage of the gun to accelerate or decrease the speed of electrons as well as changing the electromagnetic wavelength via the solenoids.” Comment on this, explaining in more detail. (Caution: while this page has useful information, do not assume that everything in it is correct.)

5) Assume that the microscope room is 5º C warmer than the microscope, and that the sample holder is initially at the same temperature as the room. Estimate the total distance the sample will drift as it cools down after insertion in the microscope assuming a thermal expansion coefficient of 1.7x10-5 C-1 (phosphor bronze).

6) Estimate the full-width half-maximum of the coherence in mRad for a field-emission source for 300kV electrons, approximating the emission from the source as a two-dimensional Gaussian exp(-ar2) where r is the distance from the center. Note: you will need to look up the typical size of the source, and you should assume no magnification/demagnification. (Hint: the answer involves a simple Fourier Transform relationship.)