Photoelectric Effect
In class activity

Useful equations: $E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34}\ Js)\left(2.998 \times 10^{8}\frac{m}{s}\right)}{\lambda} = \frac{\mathbf{1.986\times10^{-25}}\boldsymbol{Jm}}{\boldsymbol{\lambda}}$

$$1\ eV = 1.60\ \times\ 10^{-19}\ J$$

$$K.E. = \frac{1}{2}mv^2$$

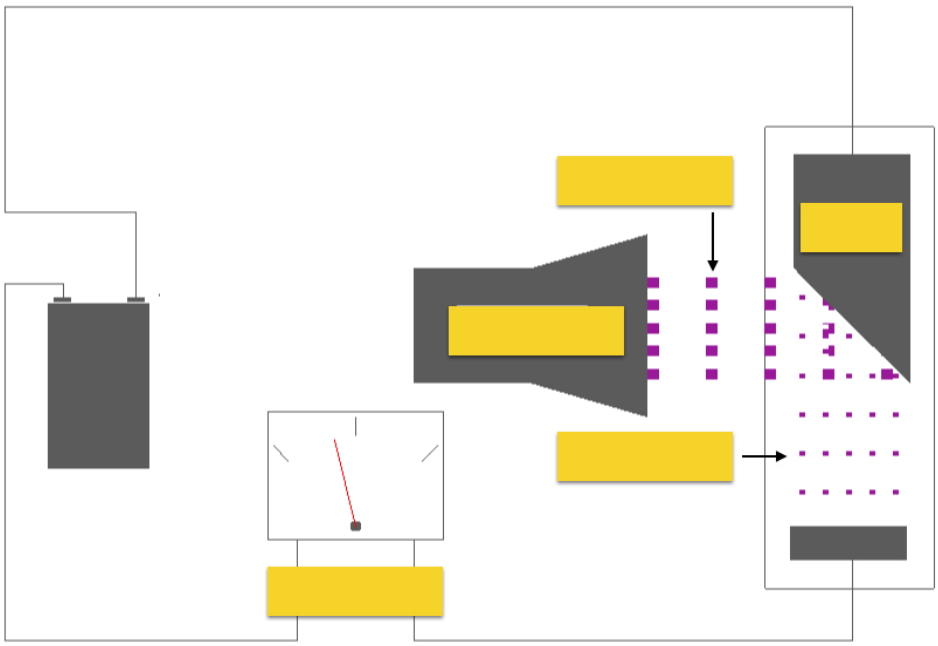
$$m_e = 9.11 \times 10^{-31} kg$$

$$h\nu_{photon} = \Phi_{\text{metal}} + K.E.$$

https://switkes.chemistry.ucsc.edu/teaching/JAVA/TestWebStart/photel_new.jnlp
or: https://switkes.chemistry.ucsc.edu/teaching/CHEM1B/DEMOS/photel_new.html **MOZILLA ONLY**

Part II: Experiment 1: Observations

1. Label the following diagram.



2. What are the different experimental parameters that you might modify in this simulation?

3. Start the simulation with following parameters selected: metal = iron, λ = 700 nm and intensity set to low. Press the start button. What do you see? Using the slider, decrease the wavelength and describe any observed changes. What is the threshold frequency (ν_o) for iron? What happens as you increase ν beyond ν_0 ?

4. Change the intensity setting to 'High' and test different frequencies. Does the threshold frequency (ν_0) change with increased intensity? Give a reason for your answer.

Intensity questions

5. Is there a difference between the high and low intensity of incident light in terms of the energy of electrons coming off the metal surface? Explain.

6. Does the ammeter change between high and low intensity? What do you think the ammeter is measuring?

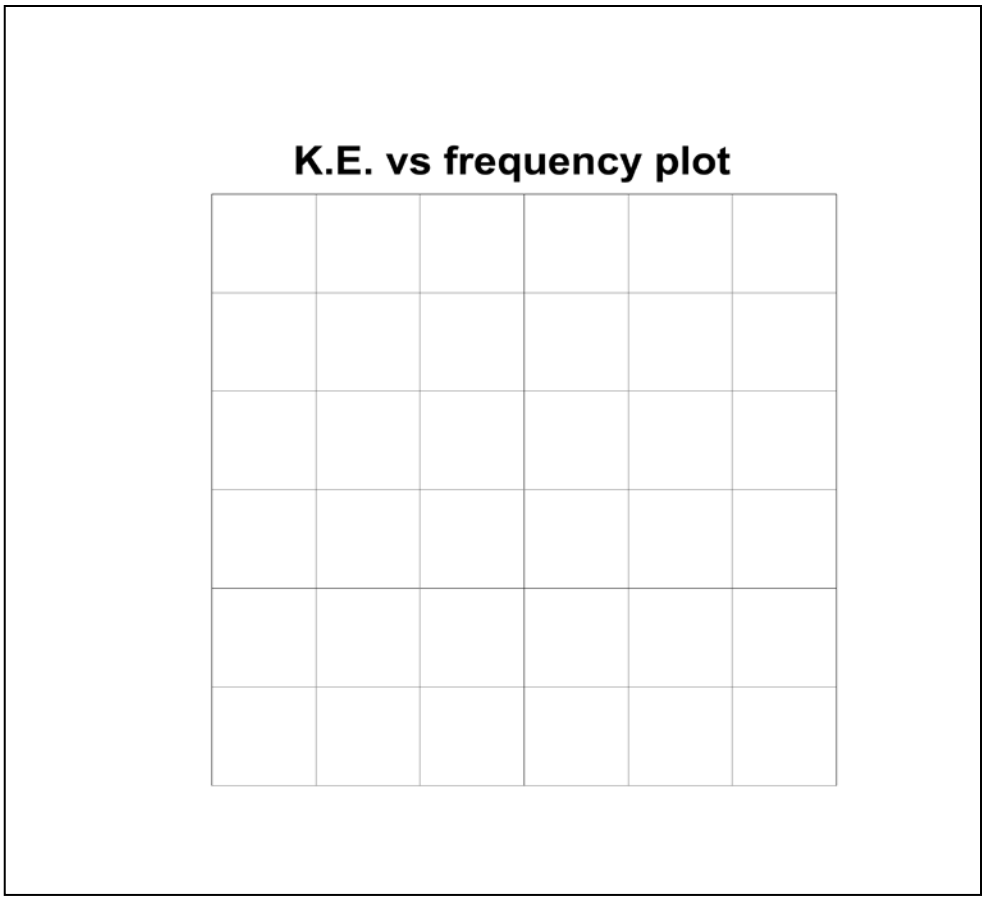
Part III: Experiment 2: Calculations

7. Use the wavelength slider to find the highest wavelength of light that will dislodge an electron. What is the energy ($in\ J$) of the electrons at this wavelength? Does this make sense? Why?

8. Based on the wavelength you found, and using Planck's constant as well as the speed of light, calculate the value of the workfunction.

9. Based on your calculation of the workfunction and other observations, explain why photons from a 254 nm UV lamp can dislodge electrons from an iron plate, while a red laser cannot.

10. In class, each group will be assigned to one of the following five metals: lithium, beryllium, sodium, magnesium or potassium. Your group will decide on a strategy, then each group member will use this strategy to measure and plot the K.E. of the electron vs. incident frequency (ν_{photon}). Use the grid below and make sure to label your axes and



indicate the metal! Upon completion of the activity, the groups will discuss their results with the class.