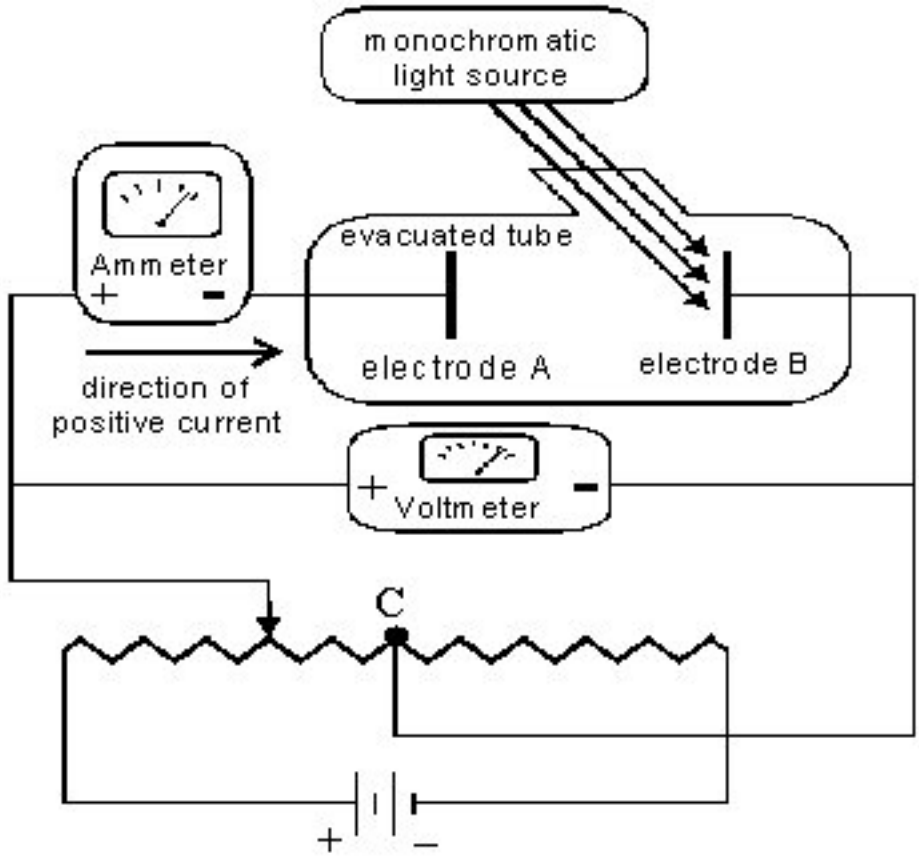
Photoelectric Effect

Consider two electrodes in an evacuated tube, as in the diagram below. The potential difference between the electrodes can be varied and electrode A can be set to be at either a higher or lower potential than electrode B. It is observed that when a monochromatic light is shone on electrode B, electrons are emitted. These are often called photoelectrons. Experimentally, the potential at electrode A can be adjusted so that it is higher than that at electrode B and the electrons attracted to the electrode register as a current through the ammeter. This is called the photocurrent.



Picture from "Development of a computer-based tutorial on the photoelectric effect," Richard N. Steinberg , Graham E. Oberem , and Lillian C. McDermott, Am. J. Phys. 64, 1370 (1996).

Prediction 1: Suppose the frequency and intensity of the incident light are fixed. As the potential difference is varied from positive (electrode A at a much higher potential than B) through zero (electrodes A and B at the same potential) to negative (electrode A at a lower potential), how do you predict the photocurrent would change?

Graph the photocurrent vs. potential difference in your lab notebook.
This is a prediction. (It is your "guess" at what will happen.)

Two interesting questions are whether the photocurrent depends on the frequency or intensity of the light.

Prediction 2: Does the photocurrent depend on the intensity of the light? Would there still be a photocurrent, if the intensity of the light was decreased to practically zero? Do you think that the kinetic energy of the liberated electrons would depend on the intensity of the light? Record your predictions in your notebook.

Prediction 3: Do you think that the photocurrent depends on the frequency of the light? Would there always be a photocurrent, even at very high or very low frequencies? Record your predictions in your notebook.

Read Sections 2-2 and 2-3 in the Quantum Physics text or the section on the photoelectric effect in some other modern physics text.

Before doing the experiment, you should be able to explain the following:

1. How do you experimentally determine the kinetic energy of the fastest electrons emitted?
2. What is the work function?
3. What is the stopping potential?
4. How is the maximum kinetic energy of the emitted electrons related to the work function and the frequency of the light mathematically?
5. How could you use the photoelectric effect to measure the ratio of two constants h/e?