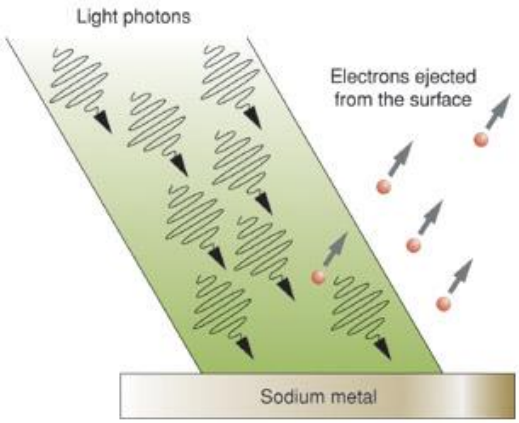
Photoelectric Effect

Planck's work on quantum theory was developed to fit experimental data. Planck's work led to the concept that energy is quantized. Einstein took this idea and the observations made of the photoelectric effect to come to the conclusion that **light itself is quantized**.

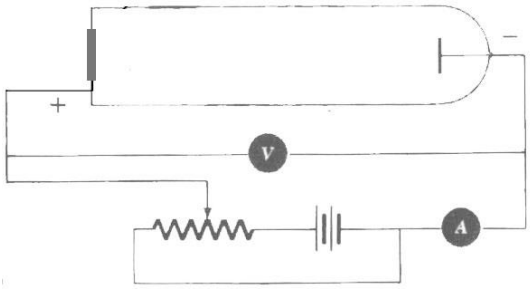
Light comes in discrete packages or wave-packets called **photons**.



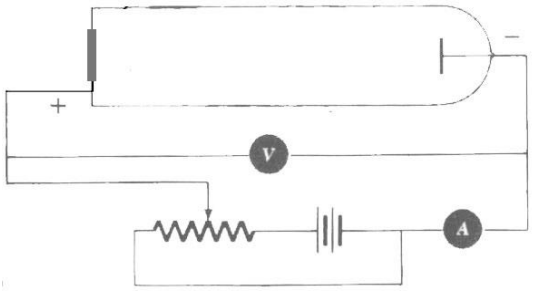
Photons of light incident on a metal surface will eject electrons if the energy of the photons is sufficient. Each metal has a different threshold, or work-function, that it will not release electrons unless the energy is sufficient. If photons of higher energy are incident on the metal the "left-over" or excess energy is given to the ejected electrons in the form of kinetic energy.

Investigating the Photoelectric Effect

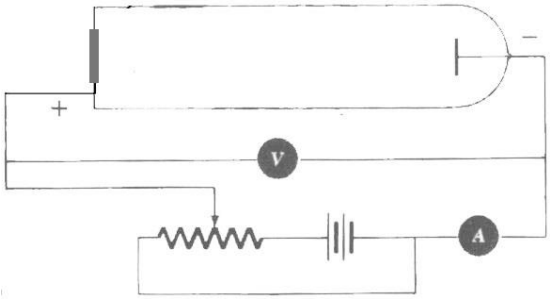
The setup for this experiment is quite simple, yet powerful.



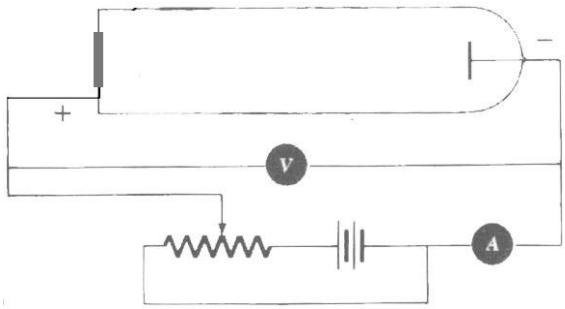
Retarding voltage is zero: ***V=0***



Retarding voltage is greater than zero: ***V>0***



Retarding voltage stops current flow: $V=V_{stop}$



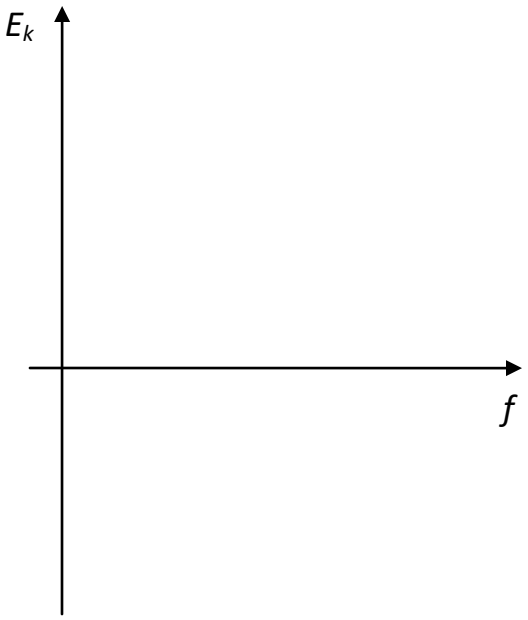
Summary – Light is Quantized!

Three observations were made from the photoelectric effect which led to Einstein's theory of the ***photon (quantized light)***.

1. For a given metal and frequency of incident radiation, the rate at which photoelectrons are ejected, and hence the photocurrent, is directly proportional to the intensity of the incident light.
2. For a given metal, there exists a certain minimum frequency of incident radiation below which no photoelectrons can be emitted. This frequency is called the **threshold frequency**.
3. For a given metal of particular work function, increase in intensity of incident beam increases the magnitude of the photoelectric current, though **stoppage voltage remains the same**.

Mathematical Analysis

Case 1)



Case 2)

Case 3)