التجربة الثانية

اسم التجربة:- الظاهرة الكهروضوئية

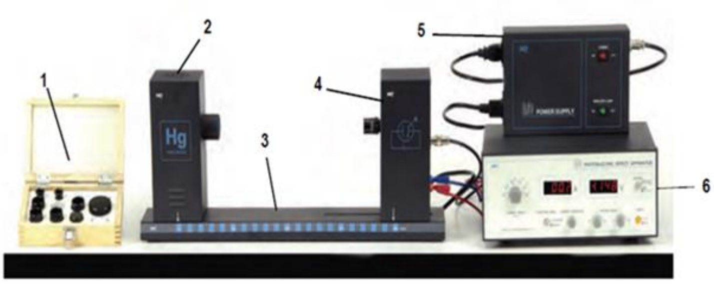
Photoelectric phenomenon

The purpose of the experiment:-

1- Find the Planck constant
2- Determining the value of the work function of the metal

Used equipment's :-

Power supply, Mercury vapor lamp, A set of color filters, Photocell, voltage divider, battery, Base, voltmeter, micrometer



Photoelectric cell device

Theory :-

Photoelectric phenomenon: It is the phenomenon of electrons leaving metals when exposed to light of greater energy than the energy of binding the negative electron to the nucleus of the positive atom.

It was found through this phenomenon that the kinetic energy of the liberated electrons (KE) is directly proportional to the frequency of the light (f) falling on them.

It is not affected by the intensity of light, which proves that the energy of light (E) is directly proportional to its frequency only ($E \alpha F$), so the equation for light energy becomes ($E = h F$)

Also, light is made up of quanta or units called photons whose energy is specific and indivisible.

Each metal has a binding energy (W_o) that keeps the electron from escaping out of the metal atom.

If the energy of the photon incident on the metal is greater than the binding energy of the electron, the electron is released and acquires kinetic energy equal to the difference between the photon energy and the binding energy.

$$KE = hf - W_o$$

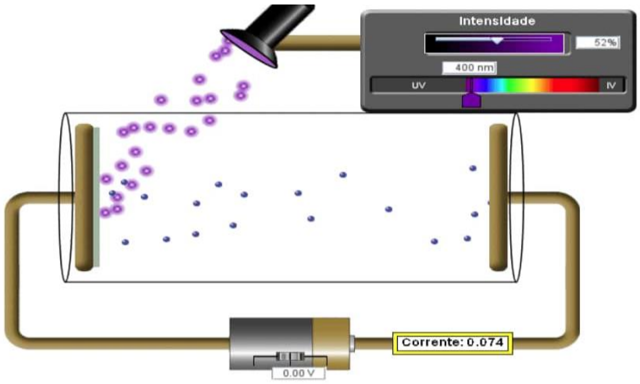
The work function W_0 is the work required to liberate an electron from an atom. It is exactly equal to the electron binding energy. To measure Planck's constant and prove that the energy of light is a function of frequency, a vacuum tube with two electrodes made of two metals, one positive and the other negatively charged, is used (as shown in Figure 1).

When light with a specific energy greater than the binding energy (work function) falls on the negative electrode, electrons with kinetic energy (KE) are emitted and directed to the positive electrode forming an electric current with a potential difference that can be measured.

To find out the kinetic energy of an electron, we apply an opposite voltage to its motion, and by adjusting this voltage to the amount that the electrons stop. This voltage is called the stopping voltage (V_s). Thus, the kinetic energy of the electron is directly proportional to the stopping voltage

$$KE = eV_s$$

Each color (for each frequency) has a different stopping voltage, the higher the frequency, the higher the energy of the light, the higher the stopping voltage.



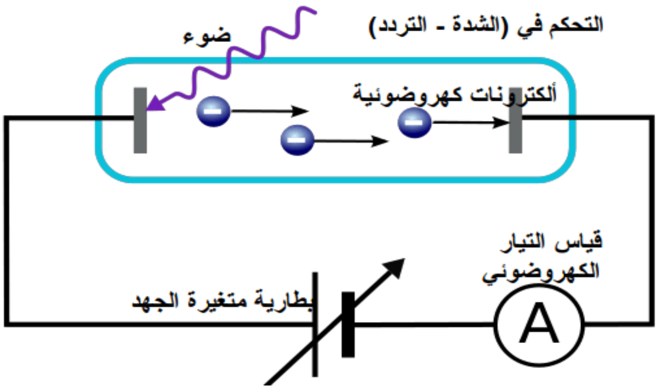
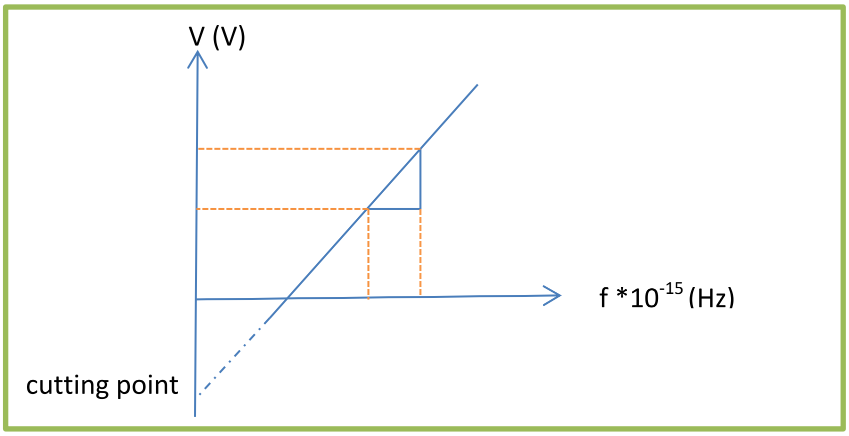


Figure 1 (The working principle of the photoelectric cell)

Work steps :-

1- Detect the photocell window and place a 4mm hole and a light filter inside the photocell window.
2- Turn on the mercury lamp and shine the light towards the photocell from a certain distance.
3- Adjust the voltage until you get the zero value of the ammeter.
4- Record the values of the stopping voltage for these wavelengths in the table.
5- Find the frequency of the light source for each wavelength of the relationship ($f = \frac{c}{\lambda}$) where (c) the speed of light.
6- Draw the graph between frequency (f) and voltage (V) and find the value of Planck's constant from the relationship $\underline{h = e * Slop}$ and find the value of the work function from the relationship $\underline{W_o = -e * (cutting\ point)}$ where ($e = 1.6 * 10^{-19}$) is the charge of the electron.



$\lambda\ nm$	$f = \frac{c}{\lambda}$	V (V)
365		
404		
435		
546		
577		