Physical Experiments 7

Pre-lab Assignment

The Photoelectric Effect

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Score

Answers to Questions (20 points)

(1) What is the photoelectric effect threshold frequency for a given element?

No electrons are emitted is the incident light frequency falls below some cut-off frequency f_c , also called the threshold frequency, which means that no electrons would emit if the frequency is not bigger than the threshold frequency, because the energy of the electron is not bigger than the work function.

(2) What is work function for a given element?

The work function represents the minimum energy with which an electron is bound in the metal and if the electron is given the energy more than the work function, it could become the free electrons. The work function is usually on the order of a few electron volts. There are some examples of work function for various metals which is list on the book which is in the table below.

metal	w/eV
Ag	4.73
Al	4.08
Cu	4.70
Fe	4.50
Na	2.36
Pb	4.14
Pt	6.35
Zn	4.31

(3) A sodium surface is illustrated with light of wavelength 0.300 μm. The work function for a sodium is 2.46 eV. Calculate:

A. The energy of each photon in electron volts;

According to the Einstein's theory, the energy of radiation come sin chunks of the frequency is v multiplied by a constant is h.

$$E = hv = h\frac{c}{\lambda}$$

$$= 6.626\times10^{-34}\times\frac{3\times10^{8}}{300\times10^{-6}}$$

$$= 6.626\times10^{-19}J = 4.14125eV$$

B. The maximum kinetic energy of the ejected photoelectrons;

According to Einstein, the maximum kinetic energy for these liberated photoelectrons is:

$$E_{kmax} = hv - w$$

$$= 6.626\times10^{-34}\times3\times10\times10^{-4}J - 2.46eV$$

$$= 1.68125eV = 2.69\times10^{-19}J$$

C. The cut-off wave length for sodium.

When the frequency is cut-off frequency

$$0 = E_{kmax} = hv - w$$

$$hv_c = w$$

$$w = h\frac{c}{\lambda_c}$$

$$\lambda = \frac{hc}{w} = \frac{6.626\times10^{-34}\times3\times10^{8}}{2.46\times1.6\times10^{-19}} \approx 5.05\times10^{-7}m = 0.505\mu m$$