Arab Academy for Science & Technology & Maritime Transport
(AASTMT – Cairo Branch)
College of Engineering & technology
Electronics & Communication Engineering Department

Course : Solid State Electronics
Course Code : EC210

Sheet #6

TextBook
'Principles of Electronic Materials and Devices', Third Edition, S.O. Kasap © McGraw-Hill, 2006

Constants:

$\varepsilon_o = 8.85\times10^{-12}\,\mathrm{Fm^{-1}}$

Charge of electron $(q) = 1.6\times10^{-19}\,\mathrm{C}$

Mass of electron $(m_e) = 9.1\times10^{-31}\,\mathrm{kg}$

Plank's Constant $(h) = 6.63\times10^{-34}\,\mathrm{Js}$

Put (T) for the true statement or (F) for the false statement:

1. The photoelectric effect proves that light waves behave as particles.
2. If the work function of a metal is Φ_1, electrons in this metal need an energy more than or equal to Φ_1 to be removed from the surface of the metal.
3. According to quantum theory, increasing the frequency of light used in a photoelectric experiment causes the kinetic energy of electrons ejected to decrease.
4. In a photoelectric experiment: according to quantum theory, if the intensity of light used is increased, the kinetic energy of photoelectrons is not affected.
5. If the intensity of light used in a photoelectric experiment is arbitrarily increased, photoelectric current can be produced regardless of the frequency of light used.
6. If the wavelength of light is increased, the energy of photons of this light will increase.

Choose the correct answer justifying your choice:

1. When photons with energy of 10eV are incident on a surface, the ejected electrons have energies up to 4 eV. If photon energy is 20 eV, the energy of ejected electrons will be up to:

a) 4eV
b) 10eV
c) 14eV
d) 20eV
e) 16eV

2. A material with a photoelectric threshold frequency of f_o, is illuminated with light of frequency $f=1.5\ f_o$. The maximum kinetic energy of the photoelectrons ejected is:

a) hf_o
b) $3.5hf_o$
c) $2.5\ hf_o$
d) $1.5\ hf_o$
e) $0.5\ hf_o$

3. Light of frequency *f* incident on a given metal produces photoelectrons with a maximum kinetic energy K. If light of frequency *f/2* is incident on the same metal, the maximum kinetic energy will be:

a) 0
b) less than K/2
c) K/2
d) more than K/2
e) ∞

Solve the following problems

[1] Example 3.1 p.198

[2] Example 3.2 p.199

[3] The photoelectric work function of potassium is 2 eV. If the light having a wavelength of 350 nm falls on potassium, find:

a. The kinetic energy of the most energetic electrons.
b. The stopping potential (V_s).
c. The velocities of the electrons.
d. If the wavelength is changed to 348nm, calculate the change in stopping potential.

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