Answer on Question#61366 – Physics – Electromagnetism

17) When a copper surface is illuminated by radiation of wavelength 2537 angstrome units the value of the stopping potential is found to be 0.24volts. Calculate the work function of copper.
a) 4.48eV
b) 7.46eV
c) 3.26eV
d) 2.67eV
Solution. Einstein described the photoelectric effect using a formula that relates the maximum kinetic energy (K_{max}) of the photoelectrons to the energy of the absorbed photons (E) and the work function (φ): $K_{max} = E - \varphi$. Increasing the voltage drives increasingly more energetic electrons back until finally none of them are able to leave the metal surface and the microammeter reads zero. The potential at which this occurs is called the stopping potential. This means than $K_{max} = eV$ (where $e = 1.6 \cdot 10^{-19}C$ – the charge of the electron; V – voltage). Hence $K_{max} = eV = 1.6 \cdot 10^{-19} \cdot 0.24 \approx 0.38eV$. The energy of the photon can be found using the formula $E = \frac{hc}{\lambda}$ (where $h = 6.63 \cdot 10^{-34} J \cdot c$ – Planck's constant; λ – wavelength; $c = 3 \cdot 10^8 \frac{m}{s}$ – velocity of light). Therefore $E = \frac{6.63 \cdot 10^{-34} \cdot 3 \cdot 10^8}{2537 \cdot 10^{-10}} = 7.84 \cdot 10^{-19} J = 4.9eV$.
Hence work function φ equal $\varphi = E - K_{max} = 4.9 - 0.38 = 4.52eV$.
Answer. a) 4.48eV.

18) A spectral line is emitted when an atom undergoes transition between two levels with a difference in energy of 2.4eV. What is the wavelength of the line?
a) 287nm
b) 507angstrome units
c) 377angstrome units
d) 518nm
Solution. The energy of emitted photon is equal to the energy between levels $E = 2.4eV = 3.84 \cdot 10^{-19} J$. The energy of the photon can be found using the formula $E = \frac{hc}{\lambda}$ (where $h = 6.63 \cdot 10^{-34} J \cdot c$ – Planck's constant; λ – wavelength; $c = 3 \cdot 10^8 \frac{m}{s}$ – velocity of light).
Therefore $\lambda = \frac{hc}{E} = \frac{6.63 \cdot 10^{-34} \cdot 3 \cdot 10^8}{3.84 \cdot 10^{-19}} = 5.18 \cdot 10^{-7} m = 518nm$.
Answer. $\lambda = 518nm$.