King Fahd University of Petroleum & Minerals

Physics Department

Phys212- Quiz#3

Name: Key ID#:

1. The work function of potassium is 2.24 eV. If potassium metal is illuminated with light of wavelength 350 nm, find

(a) The stopping potential in eV.

$$eV_s = hf - \phi \qquad V_s = \frac{hf}{e} - \frac{\phi}{e} = \frac{hc}{\lambda e} - \frac{\phi}{e}$$

$$V_s = \frac{1240\ eV\cdot nm}{350\ nm\ e} - \frac{2.24\ eV}{e} = 3.54 - 2.24 = \boxed{1.3\ V}$$

(b) The cutoff wavelength.

$$K_{max} = \frac{hc}{\lambda_c} - \phi = 0 \Rightarrow \lambda_c = \frac{hc}{\phi} = \frac{1240\ eV\cdot nm}{2.24\ nm}$$

$$\boxed{\lambda_c = 553.5\ nm}$$

2. X-rays with energy of 300 keV undergo Compton scattering from a carbon target. If the scattered X-rays are detected at an angle of 90° relative to the incident rays, find

(a) The shift in wavelength (called the Compton shift) at this angle.

$$\Delta\lambda = \frac{h}{m_e c}(1 - \cos\theta) = 0.00243\ nm\ (1 - \cos 90^\circ)$$

$$\boxed{\Delta\lambda = 0.00243\ nm}$$

(b) The energy of the scattered X-rays.

$$\lambda' = \lambda_0 + \Delta\lambda = \frac{hc}{E_0} + \Delta\lambda = \frac{1240\ eV\cdot nm}{300\,000\ eV} + 0.00243$$

$$= 0.00656\ nm$$

$$E' = \frac{hc}{\lambda'} = \frac{1240\ eV\cdot nm}{0.00656\ nm} = 1.9 \times 10^5\ eV$$

$$= \boxed{0.19\ MeV}$$