Photoelectric Effect

Tuesday, January 14, 2014 8:07 AM

Example 1

Yellow light with a frequency of 6.0 * 10^14 Hz is the main frequency in sunlight. What is the energy in a photon with this frequency?

$f = 6.0 \times 10^{14}\ Hz$

$E_{in\ photon} = ?$

$E = hf = 6.63 \times 10^{-34} \cdot 6.0 \times 10^{14}\ Hz$

$= 4.0 \times 10^{-19}\ J \cdot \left(\frac{1\ eV}{1.6 \times 10^{-19}\ J}\right)$

$= \boxed{2.5\ eV}$

Example 2

A sodium surface is illuminated with light of wavelength 0.300 micrometers. Find the maximum KE of the ejected photoelectrons and the cutoff wavelength for sodium.

$\lambda = 0.300\ \mu m$

$\Phi_{sodium} = 2.46\ eV$ (from table in book)

$E = hf = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \cdot 3 \times 10^{8}}{3.0 \times 10^{-7}} = 6.63 \times 10^{-19}\ J$

$6.63 \times 10^{-19}\ J \cdot \frac{1\ eV}{1.6 \times 10^{-19}\ J} = 4.14\ eV$

$KE_{max} = hf - \Phi = 4.14 - 2.46 = 1.68\ eV$

Cutoff wavelength

$\Phi = 2.46\ eV = 2.46\ eV \cdot \frac{1.6 \times 10^{-19}\ J}{1\ eV} = 3.94 \times 10^{-19}\ J$

$\lambda_c = \frac{hc}{\Phi} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{}$

$$\lambda_c = \frac{hc}{\phi} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{3.94 \times 10^{-19}}$$

$$= 5.05 \times 10^{-7}\ m$$

$$= \boxed{505nm}$$