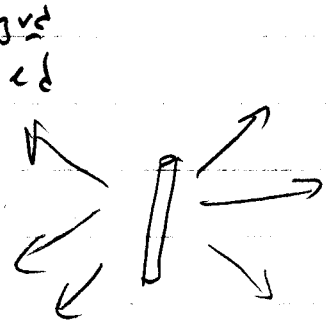
3-12



$P = 10W$

$\lambda = 589.3\,nm$

$\Delta t = 1\,sec$

$$n = \frac{P}{\frac{hc}{\lambda}} \Delta t = \frac{10\,W \; 589.3\times10^{-9}\,m}{6.626\times10^{-34}\,J\,sec \; 3\times10^{8}\,\frac{m}{sec}} \cdot 1\,sec$$

$n = 2.96 \times 10^{19}$ photons

3-13 3rd ed

~~2.12~~ In the photoelectric effect, the kinetic energy, K, of electrons expelled from a metal surface is

$$K = hf - \phi \quad \text{, where}$$

f = frequency of the incident photons and
ϕ = work function of the metal.

A retarding potential or stopping potential is applied which prevents the photoelectrons from escaping. Thus

$$eV_s = K \qquad (e = \text{electronic charge})$$

We're given $\lambda = \frac{c}{f} = 250\text{nm}$ and $V_s = 2.92\text{V}$.

Solve for ϕ

$$eV_s = hf - \phi$$

$$\phi = hf - eV_s$$

$$= \frac{hc}{\lambda} - eV_s \qquad [hc = 1240\text{eV nm}]$$

$$= \frac{1240\text{ eV nm}}{250\text{nm}} - 2.92\text{eV}$$

$$= 2.04\text{ eV}$$

The work function is 2.04eV

$[3.27 \times 10^{-19}\text{ J}]$

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~~2.15~~ Photo electric Effect

$$K = hf - \phi = \frac{hc}{\lambda} - \phi$$

Given $\lambda = 300\ nm$

$K = 2.23\ eV$

a) Solve for the work function

$$\phi = \frac{hc}{\lambda} - K$$

$$= \frac{1240\ eV\,nm}{300\ nm} - 2.23\ eV$$

$$= 1.90\ eV$$

For Cesium, the work function is 1.90 eV.

b) The stopping potential is given by

$$eV_s = K$$

$$eV_s = \frac{hc}{\lambda} - \phi \quad \text{with now } \lambda = 400\ nm.$$

$$eV_s = \frac{1240\ eV\,nm}{400\ nm} - 1.90\ eV$$

$$V_s = 1.2\ Volts$$

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	ϕ	eV_s (K_{max})
Li	2.3	1.84
Be	3.9	.24
Hg	4.5	−.76

$\lambda = 300\,nm$

$$eV_s = \frac{hc}{\lambda} - \phi = \frac{4.14\times10^{-15}\,eV\cdot s\,(3\times10^{8}\,m/s)}{300\times10^{-9}\,m} - \phi$$

$$eV_s = 4.14\,eV - \phi$$

a) Li + Be will exhibit the photoelectric effect while Hg will not.

b) $K_{max} = eV_s$

$$K_{max} = \frac{hc}{\lambda} - \phi = eV_s$$