

# Physics 217

## Homework 1

1.  $E_{chem} = 1eV = \frac{hc}{\lambda_{chem}} \rightarrow \lambda_{chem} = 1.24 \times 10^{-6}m = 12400\text{\AA}$

This wavelength is located in the infrared.

$$E_{nuc} = 1MeV = \frac{hc}{\lambda_{nuc}} \rightarrow \lambda_{nuc} = 1.24 \times 10^{-12}m = 1240Fermi$$

This is an gamma ray.

2.  $E_{photon} = \frac{hc}{\lambda_{photon}} = 3.978 \times 10^{-19}J = 2.49eV$

Sunlight could produce photoelectrons from metals with the smallest work functions.

3. (a)  $eV_{01} = h\nu_1 + w_0$       and       $eV_{02} = h\nu_2 + w_0$

Taking the difference of these two equations gives  $h = e \frac{V_{01} - V_{02}}{\nu_1 - \nu_2}$

using  $\nu = \frac{c}{\lambda}$  you arrive at  $h = \left(\frac{e}{c}\right) \left(\frac{V_{01} - V_{02}}{\frac{\lambda_2 - \lambda_1}{\lambda_1 \lambda_2}}\right) = 6.6 \times 10^{-34}$ .

(b)  $eV_{01} = \frac{hc}{\lambda_1} - w_0 \rightarrow w_0 = 3.67 \times 10^{-19}J = 2.29eV$

Also  $eV_{02} = \frac{hc}{\lambda_2} - w_0 \rightarrow w_0 = 3.67 \times 10^{-19}J = 2.29eV$  which is good news!

(c)  $w_0 = h\nu_0 = \frac{hc}{\lambda_0} \rightarrow \lambda_0 = 5.43 \times 10^{-7}m = 5430 \text{\AA}$

4.  $E_{ultra} = \frac{hc}{\lambda_{ultra}} = 4.97 \times 10^{-19}J$       and likewise       $E_{infra} = 2.84 \times 10^{-19}J$

(a) Since both bulbs eject the same amount of energy per second (40J) the infrared bulb ejects more photons because these photons are less energetic.

(b) Each bulb ejects 40J of energy in a one second interval. In 1 sec. the infrared bulb ejects  $1.41 \times 10^{20}$  photons while the ultraviolet bulb ejects  $8.05 \times 10^{19}$  photons.

Thus the infrared bulb ejects  $\approx 6 \times 10^{19}$  more photons in a one second interval.