Monday 30 April 2012
Name: ID#:

1. Electromagnetic radiation with a frequency of 5.3×10^{19} Hz is incident on stationary electrons. Radiation that has a wavelength of 6.57×10^{-12} m is detected at a scattering angle θ.
   (a) What is the value of the angle θ?
   (b) What is the kinetic energy of the recoiling electron?

a) $\lambda = \dfrac{c}{f} = \dfrac{3 \times 10^{8}}{5.3 \times 10^{19}} = 5.66 \times 10^{-12}$ m.

$\Delta\lambda = \lambda_c (1 - \cos\theta) \Rightarrow \dfrac{\Delta\lambda}{\lambda_c} = 1 - \cos\theta$

$\theta = \cos^{-1}\left(1 - \dfrac{\Delta\lambda}{\lambda_c}\right) = \cos^{-1}\left(1 - \dfrac{9.1 \times 10^{-13}}{2.43 \times 10^{-12}}\right)$

$= \underline{51.3^\circ}$

b) $K = E_p - E_{p'} = hc\left(\dfrac{1}{\lambda} - \dfrac{1}{\lambda'}\right) = 1240 \text{ eV.nm}\,\dfrac{10^{9}}{\downarrow}\left(\dfrac{10^{+12}}{5.66} - \dfrac{10^{+12}}{6.57}\right)$

$\underline{\underline{K = 30.3 \text{ keV}}}$

2. The diagram shows the graphs of the stopping potential as a function of the frequency of the incident light for photoelectric experiments performed on three different materials. Rank the materials according to the values of their work functions, from greatest to least. **EXPLAIN your choice.**
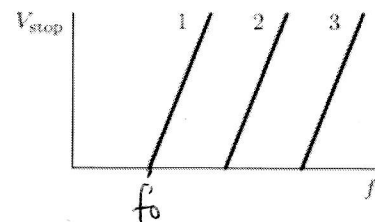
A. 1, 2, 3
B. 3, 2, 1 (circled)
C. 2, 3, 1
D. 2, 1, 3
E. 1, 3, 2

$e V_s = hf - \phi$

when $V_s = 0$

$\phi = h f_0$

large $f_0 \Rightarrow$ large ϕ !

f_0 is called the cut off frequency !