1. $E = h f = \frac{h c}{\lambda}$

wavelength $\lambda = \frac{h c}{E}$

For chemical processes,

the corresponding wavelength of electromagnetic radiation is

$\lambda_{chemical}$ =

$$\frac{h c}{E} = \frac{6.63 \times 10^{-34}\ J\ s}{1.6 \times 10^{-19}\ J / eV} \frac{3 \times 10^{8}\ m / s}{1\ eV} = 1.24 \times 10^{-6}\ m$$ which falls into infrared

For nuclear processes, the corresponding

wavelength of electromagnetic radiation is

$$\lambda_{chemical} = \frac{h c}{E} = \frac{6.63 \times 10^{-34}\ J\ s}{1.6 \times 10^{-19}\ J / eV} \frac{3 \times 10^{8}\ m / s}{1 \times 10^{6}\ eV} = 1.24 \times 10^{-12}\ m$$ which falls into γ ray

2. The energy of a typical photon in sunlight is

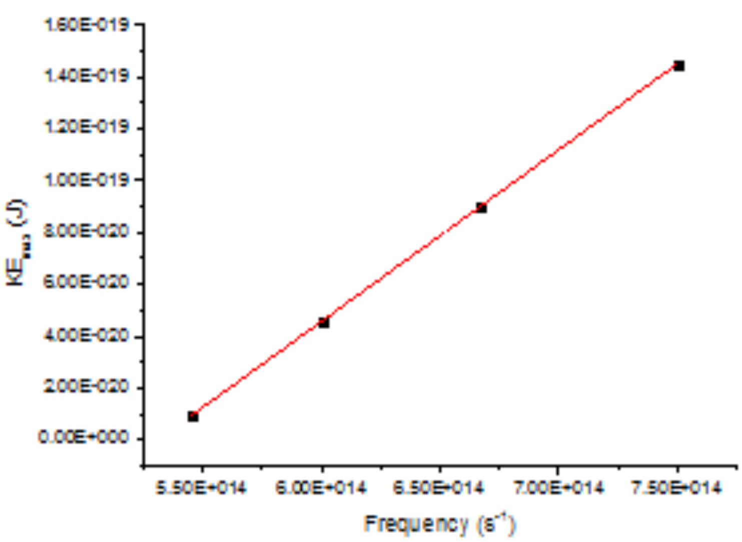
$$E = h f = \frac{h c}{\lambda} = \frac{6.63 \times 10^{-34}\ J\ s}{1.6 \times 10^{-19}\ J / eV} \frac{3 \times 10^{8}\ m / s}{500 \times 10^{-9}\ m} = 2.49\ eV$$

The spectrum of sunlight typically spreads over 2 - 5 eV.

Hence generally sunlight can produce photoelectrons from metals.

3. $KE_{max} = q\,U_{stop} = h\,f - \phi = \frac{h\,c}{\lambda} - \phi$

Convert the U_{stop} into the maximum kinetic energy KE_{max} of the photoelectrons $KE_{max} = q\,U_{stop}$, and the wavelength λ into frequency $f = \frac{c}{\lambda}$. Then do a linear fitting of $KE_{max} - f$,
the slope of the fitting curve gives the Plank ' s constant and the intercept gives the work function of the metal : $KE_{max} = h\,f - \phi$.



the fitting function is

$$KE_{max} = 6.634 \times 10^{-34}\ (J\,s)\ f - 3.523 \times 10^{-19}\ (J)$$

Therefore we get the Plank ' s constant $h = 6.634 \times 10^{-34}$ J s,
and the work funtion of the metal $\phi = 3.523 \times 10^{-19}$ J.

4. $P_1 \sin\theta = P \sin\phi \qquad (1)$

$P_0 - P_1 \cos\theta = P \cos\phi \qquad (2)$

divide (1) by (2) :

$$\rightarrow \frac{P_1 \sin\theta}{P_0 - P_1 \cos\theta} = \tan\phi$$

eliminate P_1 :

$$\frac{1}{P_1} = \frac{1}{P_0} + \frac{1}{m_0\,c}(1 - \cos\theta)$$

$$\frac{\sin\theta}{\frac{P_0}{P_1} - \cos\theta} = \frac{\sin\theta}{P_0\left(\frac{1}{P_0} + \frac{1}{m_0\,c}(1 - \cos\theta)\right) - \cos\theta}$$

$$= \frac{\sin\theta}{(1 - \cos\theta)\left(1 + \frac{P_0\,c}{m_0\,c^2}\right)} = \tan\phi$$

Therefore

$$\left(1 + \frac{h}{m\,c\,\lambda}\right)\tan\phi = \frac{\sin\theta}{1 - \cos\theta} = \cot\frac{\theta}{2}$$