1. \( E = hf = \frac{hc}{\lambda} \)

wavelength \( \lambda = \frac{hc}{E} \)

For chemical processes, the corresponding wavelength of electromagnetic radiation is

\[
\lambda_{\text{chemical}} = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \text{ J s}}{1.6 \times 10^{-19} \text{ J / eV}} = 1.24 \times 10^{-6} \text{ m} \quad \text{which falls into infrared}
\]

For nuclear processes, the corresponding wavelength of electromagnetic radiation is

\[
\lambda_{\text{chemical}} = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \text{ J s}}{1.6 \times 10^{-19} \text{ J / eV}} = 1.24 \times 10^{-12} \text{ m} \quad \text{which falls into } \gamma \text{ ray}
\]

2. The energy of a typical photon in sunlight is

\[
E = hf = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \text{ J s}}{500 \times 10^{-9} \text{ m}} = 2.49 \text{ eV}
\]

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

Hence generally sunlight can produce photoelectrons from metals.
3. Convert the $U_{\text{stop}}$ into the maximum kinetic energy $KE_{\text{max}}$ of the photoelectrons $KE_{\text{max}} = q U_{\text{stop}}$, and the wavelength $\lambda$ into frequency $f = c/\lambda$. Then do a linear fitting of $KE_{\text{max}} - f$, the slope of the fitting curve gives the Planck's constant and the intercept gives the work function of the metal: $KE_{\text{max}} = h f - \phi$. 

The fitting function is

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

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

4. $P_1 \sin \theta = P \sin \phi \quad (1)$
$P_0 - P_1 \cos \theta = P \cos \phi \quad (2)$

Divide (1) by (2):

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

Eliminate $P_1$:

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

$$= \frac{\sin \theta}{\frac{1}{P_0} (1 + \frac{P_1 c}{m_0 c^2} (1 - \cos \theta)) - \cos \theta}$$

Therefore

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