Quantum Physics

(1) $hf_0 = \phi$

$$f_0 = \frac{\phi}{h} = \frac{3.00\ eV\ (1.6\times10^{-19}\ J\,eV^{-1})}{6.63\times10^{-34}\ Js} = \underline{7.24\times10^{14}\ Hz}$$

(2) $hf = hf_0 + eV$

$$eV = hf - hf_0$$
$$= h(f - f_0)$$
$$= 6.63\times10^{-34}\ Js\left(3.87\times10^{14}\ Hz - 2.25\times10^{14}\ Hz\right)$$
$$\frac{eV}{e} = \frac{1.07\times10^{-19}\ J}{e}$$

$$V = \frac{1.07\times10^{-19}\ J}{1.6\times10^{-19}\ C} = \underline{0.67\ V}$$

(3) (a) $I = \frac{q}{t} = \frac{10^{15}\left(1.6\times10^{-19}\ C\right)}{1} = \underline{1.6\times10^{-4}\ A}$

(b) $hf = \phi + E_{max}$

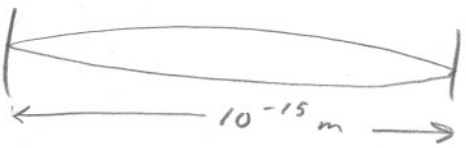
$$\phi = hf - E_{max} = \frac{hc}{\lambda} - E_{max}$$
$$= \frac{(6.63\times10^{-34}\ Js)(3.0\times10^{8}\ ms^{-1})}{(5.4\times10^{-7}\ m)} - (2.1\ eV)(1.6\times10^{-19}\ J\,eV^{-1})$$

$$= \underline{3.2\times10^{-20}\ J} \quad \text{or} \quad \underline{0.20\ eV}$$

(4) (a) $\lambda = \frac{h}{p} = \frac{h}{mv} = \frac{6.63\times10^{-34}\ Js}{(0.250\ kg)(10\ ms^{-1})} = \underline{2.7\times10^{-34}\ m}$

(b) No, the wavelength is too small to be significant.

(5) (a)



$\lambda = \underline{2 \times 10^{-15}\ m}$

(b) $E_k = \dfrac{n^2 h^2}{8 m_e L^2} = \dfrac{(1)^2 (6.63 \times 10^{-34}\ J_s)^2}{8(9.11 \times 10^{-31}\ kg)(10^{-15}\ m)^2}$

$= \dfrac{6.03 \times 10^{-8}\ J}{1.6 \times 10^{-19}\ J eV^{-1}}$

$E_k = 4 \times 10^{11}\ eV = \underline{4 \times 10^{5}\ meV}$