Problem #1: see lecture notes

Problem #2: values in textbook front cover

HW#2 Solutions

#24 $E = \frac{hc}{\lambda} = hf$ a) $\frac{1240\,eV\cdot nm}{380\,nm} = \boxed{3.26\,eV}$ $\frac{1240\,eV\cdot nm}{750\,nm} = \boxed{1.65\,eV}$

b) $\frac{1240\,eV\cdot nm}{0.30\,m/ns} \cdot 100\,MHz = \cancel{3.26\,eV}$ $\boxed{4.13\times10^{-7}\,eV}$

note: $\lambda = \frac{c}{f} = \frac{0.30\,m/ns}{100\,MHz} = 3.0\,m$

#26 $eV_0 = hf - \phi$ a) threshold frequency f_0 when $V_0 = 0$

$$f = \phi/h = \frac{1.9\,eV \cdot 0.3\,m/ns}{1240\,eV\cdot nm} = \boxed{4.59\times10^{14}\,Hz}$$

$$\lambda = \frac{hc}{\phi} = \frac{1240\,eV\cdot nm}{1.9\,eV} = \boxed{653\,nm}$$

b) stopping potential when $\lambda = 300, 400\,nm$.

$$V_0 = (hf-\phi)/e = \left(\frac{hc}{\lambda} - \phi\right)/e = \left(\frac{1240\,eV\cdot nm}{300\,nm} - 1.9\,eV\right)/e = \boxed{2.23\,V}$$

$400\,nm \rightarrow \boxed{1.20\,V}$

#31 $E = n\cdot hf = 60 \cdot \frac{1240\,eV\cdot nm}{550\,nm} = 135\,eV$

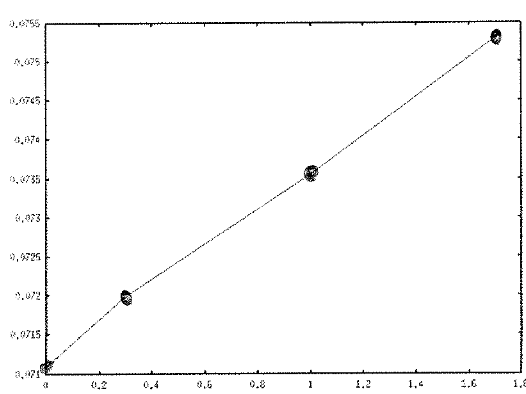
$= n\frac{hc}{\lambda}$ $= 135\times1.6\times10^{-19}\,\underbrace{C\cdot V}_{J} = \boxed{2.17\times10^{-17}\,J}$

#40 calibration of Bragg spectrometer: $\theta_B = 6°42' = 6.7°$

$$2d\sin\theta = m\lambda$$

$$\frac{2d}{m} = \frac{\lambda}{\sin\theta} = \frac{0.0711\,nm}{\sin(6.7°)} = 0.6094\,nm$$

θ_c	$1-\cos\theta_c$	θ_B	$\lambda_2 = \left(\frac{2d}{m}\right)\sin\theta_B$
0	0	6°42'	0.0711 nm
45°	0.293	6°47'	0.0720
90°	1	6°56'	0.0736
135°	1.707	7°06'	0.0753



y-intercept = 0.07117 nm

slope $= \boxed{0.002432\,nm}$

$= \lambda_c$

$\chi^2 = 1.59\times10^{-8}\,nm \rightarrow \delta y = \sqrt{\frac{\chi^2}{2}} \approx 0.0009\,nm$

#41. a) $\lambda_c = \frac{hc}{m_p c^2} = \frac{1240 \text{ MeV}\cdot\text{fm}}{938.2 \text{ MeV}} = \boxed{1.321 \text{ fm}}$ $\quad (1 \text{ fm} = 10^{-15} \text{ m})$

b) $E = \frac{hc}{\lambda_c} = mc^2$ $\quad$ electron: $m_e c^2 = \boxed{0.511 \text{ MeV}}$ $\quad$ proton: $m_p c^2 = \boxed{938.2 \text{ MeV}}$

both are gamma rays.

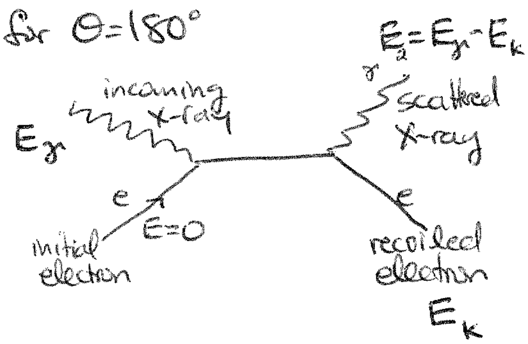
(not assigned)

#47. $eV_0 = hf = \frac{hc}{\lambda}$ $\Rightarrow$ $V_0 = \frac{hc}{e} \cdot \frac{m}{2d\sin\theta} = \frac{1240 \text{ eV}\cdot\text{nm}}{e} \cdot \frac{1}{2 \times 0.28\text{nm} \sin(20°)} = \boxed{6.47 \text{ kV}}$

$2d\sin\theta = m\lambda$

#49 Compton: $\lambda_2 - \lambda_1 = \frac{h}{mc}(1-\cos\theta) = \frac{h\cdot 2}{mc}$ for $\theta = 180°$

using $E = \frac{hc}{\lambda}$, $\quad \frac{hc}{E_2} - \frac{hc}{E_1} = \frac{2hc}{mc^2}$



using conservation of energy

$$\frac{1}{E_\gamma - E_k} - \frac{1}{E_\gamma} = \frac{2}{mc^2}$$

Solving for E_k:

$$\boxed{E_k = \frac{2E_\gamma^2}{2E_\gamma + mc^2}} = \frac{(hf)^2}{(hf) + \frac{1}{2}mc^2} = \boxed{\frac{hf}{1 + \frac{mc^2}{2hf}}}$$