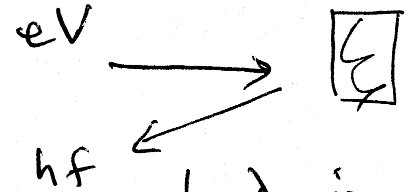
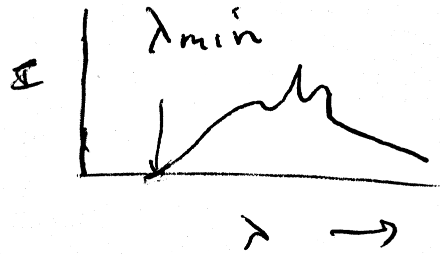
Physics 1C
Spring 2010
Quiz 3 form A



1) X ray spectrum -
shortest wavelength λ_{min}
all of the electron's energy
goes to the photon -



$$E = eV = hf = h\frac{c}{\lambda}$$

$$\lambda = \frac{hc}{eV} = \frac{6.6\times10^{-34}\,J\cdot s\,(3\times10^{8}\,m/s)}{1.6\times10^{-19}\,J/V\,(3000\,V)} = 4.1\times10^{-10}\,m$$

$$\lambda = \boxed{0.41\,nm}$$

2)

$\lambda = 450\,nm$

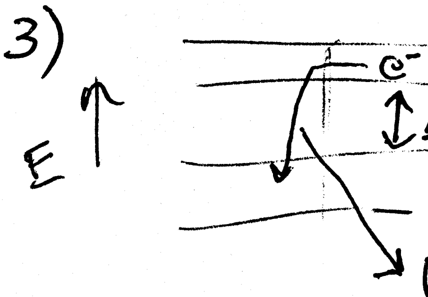
$nhf = E = 0.20\,J$

$$E = nhf = n\frac{hc}{\lambda} = 0.20\,J$$

$$n = \frac{E\lambda}{hc} = \frac{0.20\,J\,(450\times10^{-9}\,m)}{6.6\times10^{-34}\,J\cdot s\,(3\times10^{8}\,m/s)}$$

$$n = 4.5\times10^{17} \sim \boxed{5\times10^{17}}$$

3)



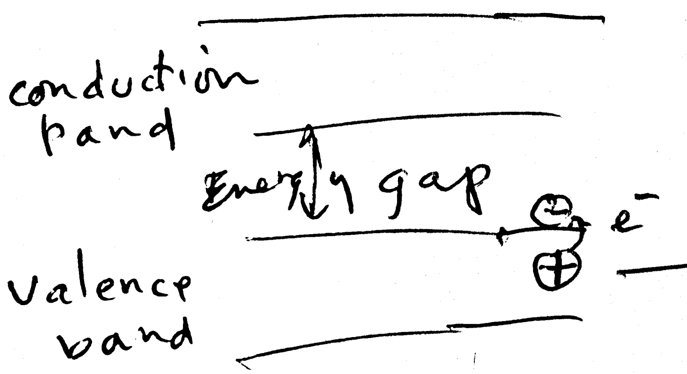
$$\Delta E_g \sim \frac{hc}{\lambda}$$

The photon energy ~~increases~~ with ΔE_g - larger (band gap) - gives a shorter wavelength -

4) For an electron in the n=3 state.

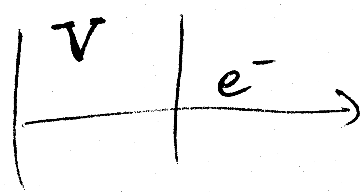
				no of states
$n=3$	$l=0$	$m_l = 0$	$m_s = \pm\frac{1}{2}$	2
	$l=1$	$m_l = -1, 0, 1$	$m_s = \pm\frac{1}{2}$	6
	$l=2$	$m_l = -2, -1, 0, 1, 2$	$m_s = \pm\frac{1}{2}$	10
			total	**18**

5) p-type semiconductor



→ mobile positive charges in the valence band

6)



$\lambda_{dB} = 0.03\,nm$

$$\lambda = \frac{h}{p} \quad \text{de Broglie wavelength}$$

$$E = eV = \frac{1}{2}mv^2 = \frac{1}{2}\frac{m^2v^2}{m} = \frac{1}{2}\frac{p^2}{m}$$

$$p = \sqrt{2meV}$$

$$\lambda = \frac{h}{\sqrt{2meV}}$$

6)

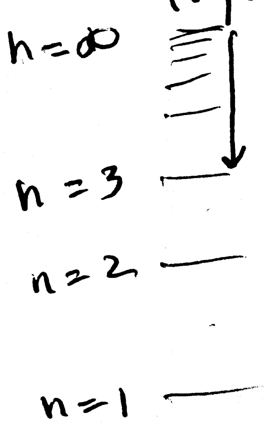
$$\lambda^2 = \frac{h^2}{2meV}$$

$$V = \frac{h^2}{\lambda^2 (2me)}$$

$$V = \frac{(6.6 \times 10^{-34} \, J \cdot s)^2}{(0.03 \times 10^{-9} \, m)^2 (2)(9.1 \times 10^{-31} \, kg)(1.6 \times 10^{-19} \, \frac{J}{V})}$$

$$V = \boxed{1.66 \times 10^{3} \, V.}$$

7) Hydrogen Emmission spectrum — Rydberg equation



transition from $n = \infty$ to $n = 3$

$$\frac{1}{\lambda} = R\left(\frac{1}{n^2_{final}} - \frac{1}{n^2_{initial}}\right)$$

$$= R\left(\frac{1}{3^2} - \frac{1}{\infty^2}\right) = \frac{R}{9}$$

$$\lambda = \frac{9}{R} = \frac{9}{1.097 \times 10^{7} \, m^{-1}} = 8.2 \times 10^{-7} \, m$$

$$\lambda = \boxed{820 \, nm}$$

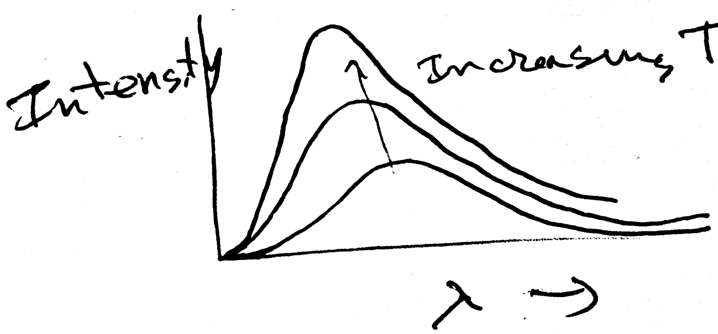
8) Visible light is in the region from 400–700 nm

~ 500 nm is typical.

$$E = h\frac{c}{\lambda} = \frac{6.6\times10^{-34}\,J\cdot s \;\; 3\times10^{8}\,m/s}{500\times10^{-9}\,m\,(1.6\times10^{-19}\,J/eV)}$$

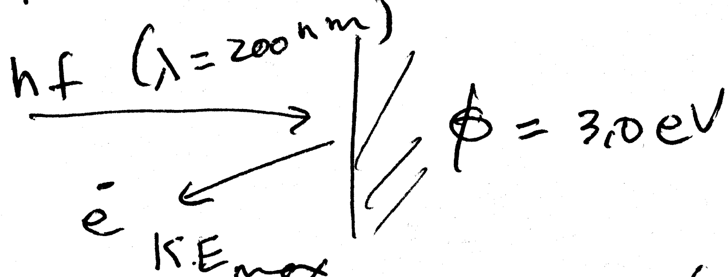
$\cong 2.5\,eV$ (closest to $\boxed{1eV}$)

9) Black Body Radiation



as temperature increases λ_{max} decreases and total intensity increases

10) Photoelectric Effect.



$KE_{max} = hf - \phi$

$= \frac{hc}{\lambda e} - \phi$

(convert J to eV) divide by e – $1.6\times10^{-19}\,\frac{J}{eV}$

$$KE_{max} = \frac{6.6\times10^{-34}\,J\cdot s\,(3\times10^{8}\,m/s)}{200\times10^{-9}\,m\,(1.6\times10^{-19}\,J/eV)} - 3.0\,eV = \boxed{3.2\,eV}$$