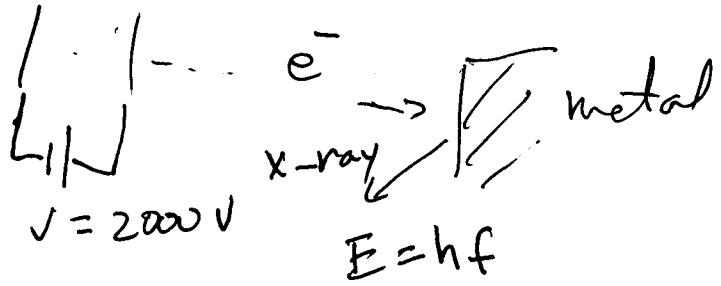
Physics 1C

Quiz 3 form A

1) x-ray source



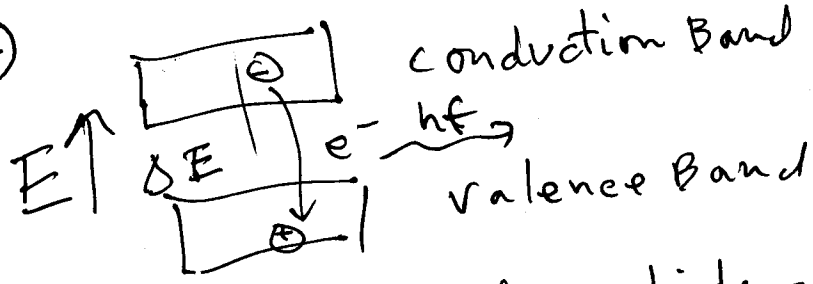
The shortest wavelength x-ray is produced when all the energy of the electron is transfered to the photon

$$eV = hf = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{eV} = \frac{(6.6\times10^{-34}\ J\cdot s)(3\times10^{8}\ \frac{m}{s})}{(1.6\times10^{-19}\ C)(2000\ J/C)} = 6.2\times10^{-10}\ m$$

$$\boxed{\lambda = 0.62\ nm}$$

2)

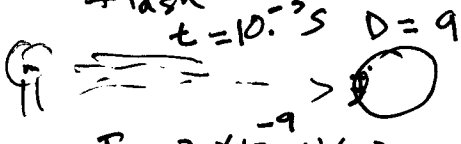


A semiconductor laser diode - the electron jumps from the conduction band to the valence band. <u>the larger the band gap ΔE</u> the shorter the wavelength of the photon produced.

3) $n = 4$ Can have $L = 0, 1, 2, 3$.

L	m_ℓ	m_s	no of states
0	0	$\pm 1/2$	2
1	$-1, 0, 1$	$\pm 1/2$	6
2	$-2, -1, 0, 1, 2$	$\pm 1/2$	10
3	$-3, -2, -1, 0, +1, 2, 3$	$\pm 1/2$	14
		total	32

4)



$$\text{Energy} = IAt = N\frac{hc}{\lambda} \quad (N = \text{no of photons})$$

$$A = \frac{D^2}{4}\pi$$

$$N = \frac{IAt\lambda}{hc} = \frac{ID^2\pi t\lambda}{4hc}$$

$$N = \frac{2\times10^{-9}\,\frac{W}{m^2}\,(9\times10^{-3}\,m)^2\,\pi\,(10^{-3}\,s)(500\times10^{-9}\,m)}{4\,(6.6\times10^{-34}\,J/s)(3\times10^{8}\,m/s)}$$

$N =$ **320** photons

5) de Broglie wavelength of an electron

$v = 10^5$ m/s

$e^- \longrightarrow$

$$\lambda = \frac{h}{mv} = \frac{6.6\times10^{-34}\,J\cdot s}{(9.1\times10^{-31}\,kg)(10^5\,m/s)} = 7.2\times10^{-9}\,m$$

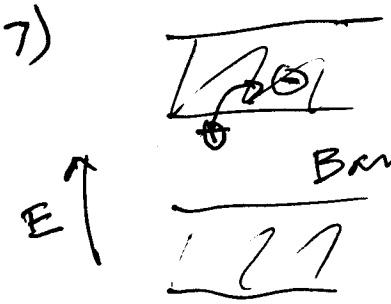
7.2 nm

6) In the Bohr model the angular momentum is quantized.

$$mvr = \frac{n\,h}{2\pi}$$

for the ground state $n = 1$ and the angular momentum is $\boxed{\frac{h}{2\pi}}$

7)

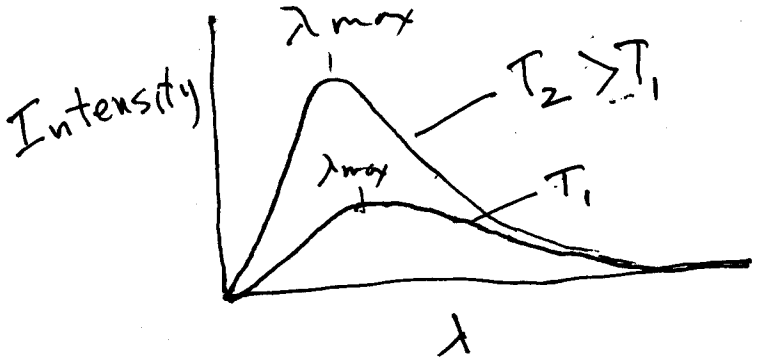


For an n-type semiconductor negative charge carriers are produced in the conduction band.

8) A typical visible photon has an energy closest to 1 eV. eg- $\lambda = 500\,nm$

$E \sim 2\,eV$

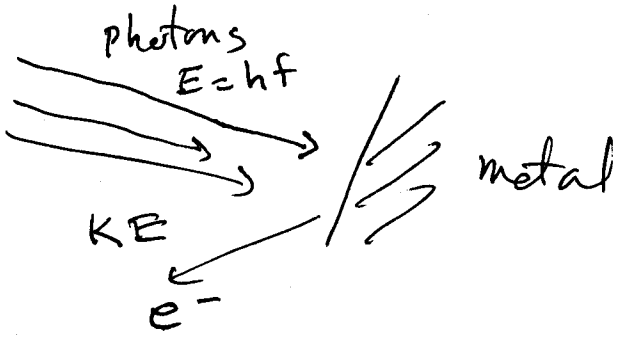
9) Spectrum of blackbody radiation



The intensity increases at higher T

The peak wavelength decreases at higher T

10) Photoelectric effect.



The stopping potential is a measure of the maximum kinetic energy of the photoelectrons produced by the light. The stopping potential is dependent on the frequency since this changes the photon energy. It is independent of the intensity since this does not change the photon energy. It only changes the no. of photons/sec.