Tan Zhi Yong Quantum Physics Ass

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18ai)

$$E = h(f_B - f_0)$$

$$h = \frac{E}{f_B - f_0}$$

$$= \frac{2.0 \times 10^{-19}}{3.0 \times 10^{14}}$$

$$= 6.67 \times 10^{-34}\ Js\ (3s.f)$$

18aii)

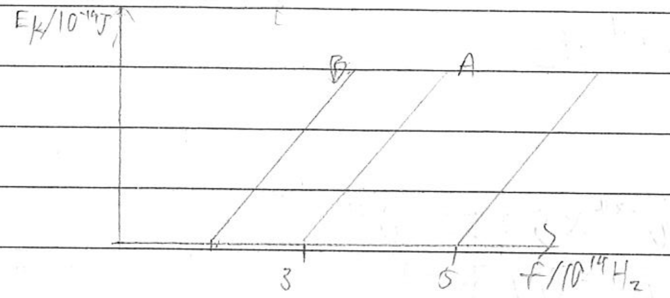
$$\frac{1}{2}mv^2 = E - \phi$$

$$\phi = E - \frac{1}{2}mv^2$$

$$= (6.667 \times 10^{-34})(6.0 \times 10^{14}) - 2.0 \times 10^{-19}$$

$$= 2.0 \times 10^{-19}\ J$$

18b)



The work function ϕ_B is lower than ϕ_A

$$E_0 = \phi_0$$

$$\therefore E_B < E_A$$

$$hf_B < hf_A$$

~~Since~~ $\cancel{eV_s = hf - hf_0}$ $\therefore f_B < f_A$

$\cancel{V_s = \frac{h}{e}f - \frac{h}{e}f_0}$ Since light ~~to~~ used for B has a higher intensity, it supplies more photons per unit time, but only 1 photon is absorbed by 1 electron, hence K.E of electron is the same.

18di) The ability of electrons to exhibit both particle and wave properties.

18dii)

$$\lambda = \frac{h}{mv}$$

$$\lambda \propto \frac{1}{m},\ \lambda \propto \frac{1}{v},\ m \propto \frac{1}{v},$$

They are all inversely proportionate to each other.

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18e)

$$d \sin\theta = n\lambda$$
$$= \frac{nh}{mv}$$

v

19ai)

$$E_0 = hf_0$$
$$\frac{hc}{\lambda} = hf_0$$
$$f_0 = \frac{c}{\lambda}$$
$$= \frac{3.0\times10^{8}}{550\times10^{-9}}$$
$$= 5.45\times10^{14}\ Hz$$

19aii)

$$\phi = hf_0$$
$$= 6.63\times10^{-34}\times5.45\times10^{14}$$
$$= 3.62\times10^{-19}\ J\ (3s.f)$$

19bi)

$$\text{Energy of photon} = \frac{hc}{\lambda}$$
$$= \frac{6.63\times10^{-34}\times3.0\times10^{8}}{400\times10^{-9}}$$
$$= 4.973\times10^{-19}\ J$$
$$KE_{max} = 4.973\times10^{-19} - 3.62\times10^{-19}$$
$$= 1.35\times10^{-19}\ J$$

19bii)

$$eV_s = 1.35\times10^{-19}$$
$$V_s = \frac{1.35\times10^{-19}}{1.6\times10^{-19}}$$
$$= 0.845\ V\ (3s.f)$$

If electron has been emitted from deeper within the metal surface it ~~ha~~ may have a lower kinetic energy as it has to overcome repulsive forces of positively-charged nuclei, hence it has a lower speed.

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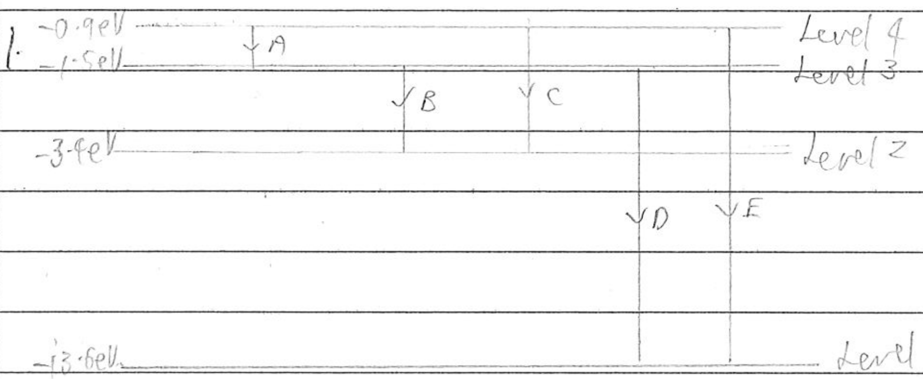
19b iii) The kinetic energy of the ejected electrons is not affected as ~~one~~ each electron only absorbs the energy of one photon. The no. of electrons emitted per second will double as the no. of photons received per unit time doubles.

19c i) The absorbtion spectra is the inverse of the emission spectra for the same element. ~~Absorbtion spectra shows the photons with absorbed with~~

19c ii) 1.



2.

$$\cancel{hf = eV \quad \lambda = \frac{h}{p}}$$

$$hf = eV$$

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

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

~~When 3eV~~ In transition ~~from~~ A, $\lambda = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{[-0.9-(-1.5)]1.6\times10^{-19}}$

$= 2.07\times10^{-6}$ m $\therefore$ not visible

In transition B, $\lambda_B = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{[-1.5-(-3.4)]1.6\times10^{-19}}$

$= 6.54\times10^{-7}$ m $\therefore$ ~~not~~ visible

In transition C, $\lambda_C = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{[-0.9-(-3.4)]1.6\times10^{-19}}$

$= 4.97\times10^{-7}$ m $\therefore$ ~~not~~ visible

In transition E, $\lambda_E = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{[-0.9-(-13.6)]1.6\times10^{-19}}$

$= 9.79\times10^{-8}$ m $\therefore$ not visible

In transition D, $\lambda_D = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{[-1.5-(-13.6)]1.6\times10^{-19}}$

$= 1.03\times10^{-7}$ m $\therefore$ not visible

$\therefore$ lines B & C are observed.

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