Part IB — Quantum Mechanics Example Sheet 1

Supervised by ?

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Michaelmas 2017

QUESTION 1

The first electron has wavelength $\lambda_1 = 3 \times 10^{-7}$ m, and moves at the speed of light, so frequency ν_1 is given by

$$\nu_1 = \frac{c}{\lambda_1} = \frac{3.00 \times 10^8}{3 \times 10^{-7}} = 1 \times 10^{15} \text{ s}^{-1}$$

Similarly $\nu_2 = 0.6 \times 10^{15}$. If W is the minimum energy needed to liberate an electron from Potassium then

$$K_1 = h\nu_1 - W$$
$$K_2 = h\nu_2 - W$$

where K_1, K_2 are the maximum kinetic energy of the liberated electrons. Thus the value of h is given by

$$h = \frac{K_1 - K_2}{\nu_1 - \nu_2} = \frac{1.6 \times (1.60 \times 10^{-19})}{0.4 \times 10^{15}} = 6.4 \times 10^{-34}$$

Thus

$$\begin{aligned} W &= h\nu_1 - K_1 \\ &= 6.4 \times 10^{-19} - 2.1 \times (1.60 \times 10^{-19}) \\ &= 3.04 \times 10^{-19} \text{ J} \\ &= 1.9 \text{ eV} \end{aligned}$$

QUESTION 3

QUESTION 4

QUESTION 5