



Quiz 1

Time: 30 min. Total points: 8

1. Light of wavelength 600 nm is incident on Potassium metal surface. The workfunction of Potassium is 2.3 eV. Calculate the kinetic energy of emitted electrons. (2 points)

Einstein's photoelectric equation

$$hv = \phi + KE$$

$$\phi = hv_0 = \frac{hc}{\lambda_0}$$

$$\lambda_0 = \frac{hc}{\phi} = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{2.3 \times 1.602 \times 10^{-19}} = 5.395 \times 10^{-7} m = 539.5 \times 10^{-9} m = 539.5 \text{ nm}$$

The threshold wavelength for Potassium metal to emit electrons is 539.5 nm and the incoming light has wavelength of 600 nm. Hence, electrons will not be emitted from Potassium metal surface when light of wavelength 600 nm is incident on it.

2. Calculate the de Broglie wavelength of an electron accelerated by 10 kV potential. (2 points)

An electron accelerated by 10 kV potential will have KE:

$$\frac{1}{2}mv^2 = eV$$
$$v^2 = \frac{2eV}{m} = \frac{2 \times 1.602 \times 10^{-19} \times 10^4}{9.1 \times 10^{-31}} = 0.3521 \times 10^{16}$$

$$v = 0.5934 \times 10^8 \text{ ms}^{-1}$$

$$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{9.1 \times 10^{-31} \times 0.5934 \times 10^8} = 1.227 \times 10^{-11} = 12.27 \times 10^{-12} m = 12.27 \text{ pm}$$



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3. Is the following statement true or false? Justify your answer. (2 points)

For all quantum mechanical states, $|\Psi(x, t)|^2 = |\psi(x)|^2$.

The statement is not true. Only for stationary states i.e. V is independent of time, the above statement is true.

4. Classify the following as linear or non-linear operators. (2 points)

(a) $4x \frac{d}{dx}$ (b) $()^3$ (c) $e^{()}$ (d) $\int dx$

(a) linear (b) non-linear (c) non-linear (d) linear

Useful data

Speed of light, $c = 3.0 \times 10^8 \text{ ms}^{-1}$

Planck's constant, $h = 6.626 \times 10^{-34} \text{ Js}$

Mass of electron, $m_e = 9.109 \times 10^{-31} \text{ kg}$

1 eV = $1.602 \times 10^{-19} \text{ J}$

Charge on electron, $e = 1.602 \times 10^{-19} \text{ C}$