

Atomic physics 1

1. Find the boundary frequency for the nickel plate necessary for the photoelectric effect. The work of the electrons emitted from nickel is 5 eV. What colour corresponds to the found frequency value?
2. The energy needed to excite a hydrogen atom from its ground state to its fourth excited state is (?)
3. Two electrons are moving with the same speed $0.8c$, in opposite directions. What is their relative speed?

HW: Find the energy needed to excite a hydrogen atom from its ground state to its third excited state.

Support (hints):

1)

$$\Phi_E = \oint_S \vec{E} \cdot d\vec{s} = \frac{Q}{\epsilon_0} ,$$

$$F = \frac{s^4 \cdot A^2}{m^2 \cdot kg} = \frac{s^2 \cdot C^2}{m^2 \cdot kg} = \frac{C}{V} = \frac{A \cdot s}{V} = \frac{W \cdot s}{V^2} = \frac{J}{V^2} = \frac{N \cdot m}{V^2} = \frac{C^2}{J} = \frac{C^2}{N \cdot m}$$

2)

$$\Phi_B = \oiint_S \vec{B} \cdot d\vec{s}$$

$$\cos(0^\circ) = 1, \cos(180^\circ) = -1, \cos(90^\circ) = 0$$

$$\text{Wb} = \text{T}\cdot\text{m}^2$$

3)

$$|\vec{B}| = \frac{\mu_0}{2\pi} \frac{I}{r},$$

$$H = \frac{\text{kg}\cdot\text{m}^2}{\text{s}^2\cdot\text{A}^2} = \frac{\text{N}\cdot\text{m}}{\text{A}^2} = \frac{\text{kg}\cdot\text{m}^2}{\text{C}^2} = \frac{\text{J}}{\text{A}^2} = \frac{\text{T}\cdot\text{m}^2}{\text{A}}$$

4)

$$I_d = \varepsilon_0 \frac{d\Phi_B}{dt} \Rightarrow I_d \approx \varepsilon_0 \frac{EA}{t} \quad \text{and} \quad E = \frac{U}{d}$$