Waves and Particles

Due on November 14th 2023

J= LV =1.60LX10¹⁸45

Please indicate your name on the solution sheets and send it to your seminar — Lordon loader!

leader!

to the

Multiple-choice test: Please tick all box(es) with correct answer(s)!

(correctly ticked box: +1/2 point; wrongly ticked box: -1/2 point)

Visible spectral range

γ-ray spectral range

X-ray spectral range

Infinitely large

Larger than zero

Smaller than 1

Equal to one

Negative

In the X-ray spectral region, the refractive index of a non-magnetic material is usually

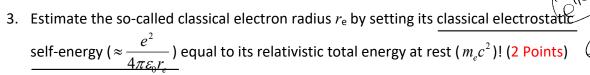
A photon with a photon energy of 0.5eV corresponds

. . . .

2. True or wrong? Make your decision!

(2 points): 1 point per correct decision, 0 points per wrong or no decision

	1, L We / 1, 1 -> k= -	= 14W V2	er - Kersen (1 million)
Assertion	K- 25(m) 27	true	wrong
The concentration of absorbing species in	a medium may be		(K
estimated from the imaginary part of the dielectric function			
integrated over the (angular) frequency.	Sluz Rescut i Imslus		6- WROTEN til
The phase velocity may exceed c.		\/	
		-	(1/1/4)



- 4. A photon releases a photoelectron with a kinetic energy <u>2eV</u> from a metal which has a work function of 2eV. What is the smallest possible energy of that photon? Indicate the wavelength of such a photon! (3 points)
- 5. If the kinetic energy of a <u>relativistic</u> electron is equal to its rest mass, what is its velocity? (4 points)
- 6. A resting atom with mass m absorbs a photon with angular frequency ω . As a result of momentum conservation, after absorption the atom will no more be at rest.
 - a) When assuming a non-relativistic case (v_{atom} <<c), find an expression for the velocity and the kinetic energy of the atom after absorption. Estimate the ratio of the kinetic energy and the photon energy for ω =10¹⁵s⁻¹ and m = 10⁻²⁶kg. (3 Points)
 - b) Find the expression for the atoms velocity assuming a relativistic case! (8 points)



(9) Ex=hf- ϕ ϕ is the work funktion of the muterial, Ex is the kinetic energy of the emitted electron light

Thus => $f = \frac{E_K + \phi}{h}$ $f = \frac{1}{\sqrt{1 + \frac{C}{\lambda}}} \Rightarrow \lambda = \frac{Ch}{E_K + \phi} = \frac{3 \times 10^8 \text{ m/s} \cdot 66 \text{ bit} \times 10^{-34} \text{ ws}^2}{4 \times 160 \times 10^{-18} \text{ CV}} \approx 3.1 \times 10^{-7} \text{ m} = 3.10 \text{ nm}$

(a) Phonon Energy Eph = $hv = hw = \frac{b \cdot b \cdot 2 \cdot x(o^{-3/p}w \cdot s^2 \cdot 10^{15} s')}{2\pi} \times [0s \times 10^{-18}]$ According to momentum conservation $P_{\mu} = P_{\alpha}$ $E = pc = hw \Rightarrow p = \frac{h^2 v}{c}$ $T_{\mu}h = \frac{P_{\alpha}^2}{2m} = \frac{P_{\alpha}h^2}{2mc^2} = \frac{h^2w^2}{2mc^2}$ $V = \frac{h^2w^2}{2mc^2} = v = \frac{hw}{mc}$

cb) Pp C+m C2= \(\int_{a}^{2} \cdot^{2} + m_{i}^{2} \cdot^{4} \) the mass of the atom increase after absorption

Q m