Optics class One 9-3-2020

Homeworks due at 5:00 P.m

What is light? Particle & Wave

Mostly treat as wave in Optics

Energies

E_1 → E_0 Light

History of light

	Particle	Wave
	→ Newton	
1700s		→ Huygen
		→ Young - Double slit
		→ Maxwell - Em eqs
1800s		→ Michelson & Morley - Speed of light
		→ Fresnel - No medium Ether not real!
1900s	Planck → E Chunk	Einstein → Special theory of Relativity

$E = h\nu$ ↑ Frequency (nu)

$h = 6.63 \times 10^{-34}$ Js ↑ planck's Constant

Einstein → Photoelectric effect
Bohr → Emission absorp.
Compton → Compton Scattering
Lewis → Names it the photon

Light energies

De Broglie wavelength → $\lambda = \frac{h}{p}$, $p = mv$ momentum

"Review" of special Relativity (6 on eq sheet)

$\beta = \frac{v}{c}$, $\gamma = \frac{1}{\sqrt{1-\beta^2}}$

$v \geq 0.1c$ For special relativity $v = c$ (obviously)

$E_0 = mc^2$

$E_K = mc^2(\gamma - 1)$ Kinetic

Total energy E_{Tot} or Just E → $E = E_0 + E_K$

1. $\lambda = ?$ $E_0 = E$, $E_\gamma = E_{0,p} = m_p c^2$
$\nu = ?$ $E_\gamma = (1.67 \times 10^{-27}\ kg)(3 \times 10^8)^2$
$p = ?$

$\lambda = \frac{h}{p} \xrightarrow{6.10} \lambda = \frac{h}{\left(\frac{E_\gamma}{c}\right)}$

$\lambda = (6.63 \times 10^{-34}\ Js)$

$$\left[\frac{(1.67 \times 10^{-27}\ kg)\, c^2}{c}\right]$$

$\lambda = (6.63 \times 10^{-34}\ Js)\ \frac{1}{(1.67 \times 10^{-27}\ kg)(3 \times 10^8 \frac{m}{s})}$

$\lambda = 1.32 \times 10^{-15}\ m$ Gamma Ray

$\nu = \frac{c}{\lambda} = \frac{3 \times 10^8 \frac{m}{s}}{1.32 \times 10^{-15}\ m} = 2.27 \times 10^{23}\ Hz$

$p = \frac{E_\gamma}{c} = \frac{mc^2}{c} = \frac{mc}{c} = (1.67 \times 10^{-27}\ kg)(3 \times 10^8\ m/s)$

$p = 5.01 \times 10^{-19}\ kg\frac{m}{s}$

2. $E^2 = (pc)^2 + (mc^2)^2$ Photons have zero rest mass. Can a photon come to rest?

$E^2 = (pc)^2 + (0c^2)^2$

$E^2 = (pc)^2$

$p^2 = \frac{E^2}{c^2}$

$p = \frac{E}{c}$

$v = \frac{pc^2}{E}$ (6.9)

$v = \frac{\left(\frac{E}{c}\right) c^2}{E}$, $v = c$

No a photon cannot come to rest. $v = c$ ALWAYS