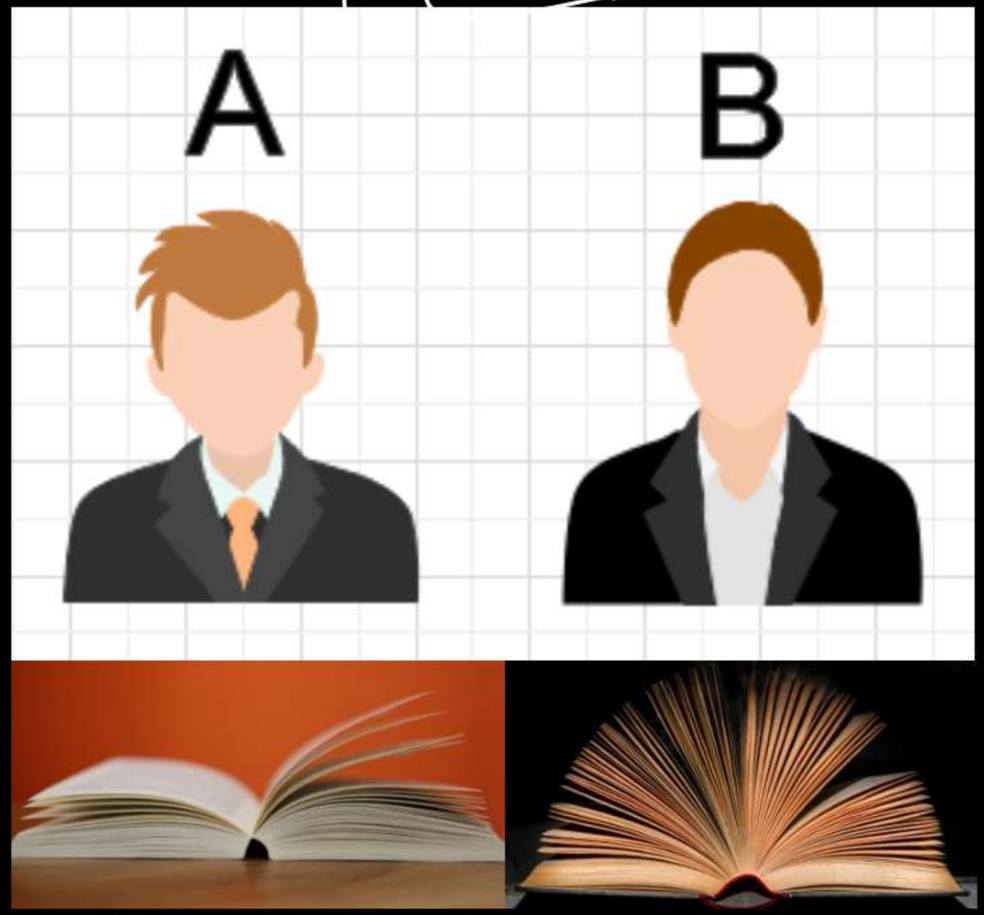
Session 4: Modern Physics

- Recap
- Photon v/s wave
- Photon v/s material particles
- Photoelectric effect

5th Sept 2022,
Monday, 6.00 PM

Who is topper?

Revision



Recalling ability

↳ like Visualization

↓

Observation

Notes

- Macro notes → PDFs
- Micro notes → 1 page note
  - Smaller the better.
  - Personalized micro notes.

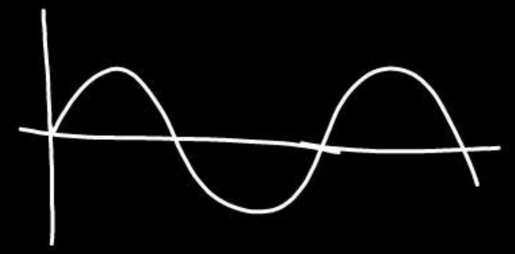
Father of Quantum Mech – Max Planck

How is wave and particle nature related?

e_b

X rays v/s radio waves

Light particle is called as photon. Its energy is related through the frequency of light wave
Each photon is an energy packet



Mass, speed, momentum, energy, collision, Newton's laws, quantization

Energy of photon ~ ν (frequency)

Einstein (in 1905) → light is made up of quanta

photon ≡ quanta

$E = ne$ e/2

$e = 0.5\,J$

$n \in I$

Max Planck Explained Black body radiations using quantization of energy.

Infrared radiation → due to hotness of various objects.

The total radiation emitted by an object is quantized & each quanta is proportional to the frequency @ which each atom is emitting that radiation.

$$E_{light} = ne$$

Energy of the photon $\rightarrow e$

$$e \propto \nu$$

$$e = h\nu$$

$\nu = \frac{c}{\lambda}$

$h \rightarrow$ Planck's constant

6.626×10^{-34} J-s

$e_1 = 0.5 \quad (\nu_1)$

$e_2 = 0.7 \quad (\nu_2)$

$e_3 = 1.98 \quad (\nu_3)$

How to explain Photoelectric emission using photon theory of light →

$$E = IAt$$
wave

$$= \frac{1}{2}\epsilon_0 E_0^2 c A t$$

$$E_{photon} = n(h\nu)$$

freq. of UV light > freq. of visible light.

UV light

E

quanta (photons)

$E = ne_1$

$e_1 = h\nu_1$

$e_1 > e_2$

Visible light

E

(photons)

$E = ne_2$

$e_2 = h\nu_2$

Photon v/s Material particle.

1). Rest mass → 0 (photon)

2). Velocity of photon → $C \rightarrow (3 \times 10^8 \text{ m/s})$

3). Energy, momentum → definite values.

$$E = h\upsilon = \frac{hc}{\lambda}$$

$$p = h/\lambda$$

4). Collision with a material particle. E & p will be Conserved.

$N_p \rightarrow$ No. of photons won't be conserved.

5). $I \uparrow \Rightarrow N_p \uparrow$ (Intensity)