

QUANTUM THEORY

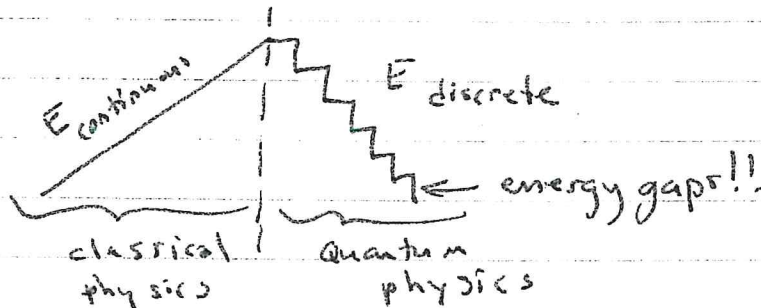
- ① STUDY OF SMALL OBJECTS (ATOMS)
- ② QUANTA → SMALL "PACKET"
- ③ 1^o PRINCIPAE →

ENERGY IS
QUANTIZED

MAX PLANCK
(1901)

solved the
black body problem
by quantizing
energy.

energy is not continuous; it
is actually delivered in small packets
or quanta.



PLANCK'S
THEORY

$$E = n h f$$

energy
(J)
or
(eV)

1, 2, 3, 4

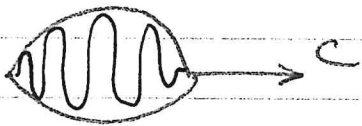
planck's
constant
(6.63×10^{-34} J.s)

frequency (Hz)

This led Einstein to propose that light itself is not a continuous wave but rather a "wave-packet" called a PHOTON.

Light is both a wave and a particle!!!

PHOTONS carry ENERGY!



WAVE EQUATION } $C = f \lambda$ ← wavelength (m)

 ↑ ↑

$3 \times 10^8 \frac{m}{s}$ frequency (Hz)

 (constant)

$$C = f \lambda$$

high frequency
⇒ small/short wavelength



$$C = f \lambda$$

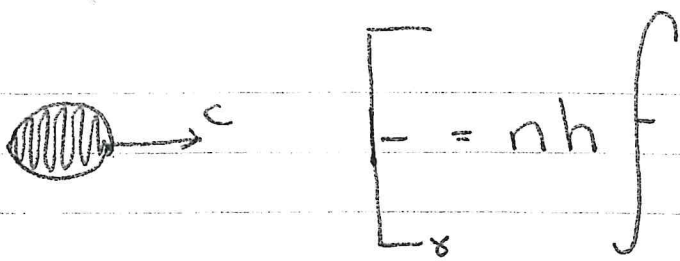
low frequency
⇒ large/long wavelength



PHOTON ENERGY }

$$E = n h f$$

n → represent the # of photons



high frequency
 \Rightarrow high energy



$$E_\gamma = nhf$$

low frequency
 \Rightarrow low energy

$$E_\gamma = nhf$$

wave equation

$$c = f\lambda$$

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

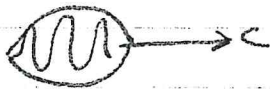
$$E_\gamma = \frac{nhc}{\lambda}$$

1 photon $\Rightarrow n=1$

$$\left\{ \begin{array}{l} 1 \text{ nm} = 1 \times 10^{-9} \text{ m} \\ \text{(nanometre)} \end{array} \right\}$$

$$\left\{ \begin{array}{l} 1 \text{ eV} = 1.60 \times 10^{-19} \text{ J} \\ \text{(electron-volt)} \end{array} \right\}$$

ex. YELLOW PHOTON



$$\lambda = 550 \text{ nm} = 550 \times 10^{-9} \text{ m}$$

calculate the energy of one photon: $E_\gamma = hf = \frac{hc}{\lambda}$

$$E_\gamma = 2.3 \text{ eV}$$

$$E_\gamma = \frac{(6.63 \times 10^{-34})(3 \times 10^8)}{(550 \times 10^{-9})}$$

$$E_\gamma = 3.62 \times 10^{-19} \text{ J}$$