Teacher's Sign / Remarks

Physics

Fundamental physical constants:-

1) Speed of light :- $3 \times 10^8 m/s$ // Unit :- m/s
2) Gravitational Constant (G) :- $6.674 \times 10^{-11} N\text{-}m^2/Kg^2$

   Unit :- ~~m/s~~ Newton m^2/Kg^2
3) Planck's constant (h) :- 6.626×10^{-34} J.S

   Unit :- Joules seconds
4) Elementary charge (e) :- 1.602×10^{-19} C

   Unit :- Coulombs (C)
5) Boltzmann Constant (K) :- 1.38×10^{-23} J/K

   Unit :- Joules/Kelvin
6) Avagadro's Number :- 6.022×10^{23}
7) Gas Constant (R) :- 8.314 J/(mol·K)
8) Electron Volt (eV) :- Conversion $1eV = 1.602 \times 10^{-19} J$

   Units :- Joules

Important Units

1) Force = Newton [$1N = 1 Kg.m/s^2$]
2) Energy/Work = Joule [$1J = 1N \cdot m$]
3) Power = Watt (W) [$1W = 1 J/s$]
4) Electric charge = Coulomb [1C = charge of 6.242×10^{18} el.
5) Current = Ampere (A) [$1A = 1C/s$]
6) Resistance = ohm (Ω) [$1\Omega = 1V/A$]

$\Rightarrow 10^3 \rightarrow$ Kilo	$\Rightarrow 10^9 =$ Giga	$\Rightarrow 10^{-2} =$ Centi	$\Rightarrow 10^{-6} =$ micro
$\Rightarrow 10^6 \rightarrow$ Mega	$\Rightarrow 10^{12} =$ Tera	$\Rightarrow \frac{1}{100} = 0.01$	$\Rightarrow 10^{-9} =$ Nano
		$\Rightarrow 10^{-3} =$ mili	$\Rightarrow 10^{-12} =$ Pico

① Kirchof's

② stefan law :- $E \propto T^4$ the stefan law states that the energy is directly propotional to T^4

$$E = \sigma T^4$$

③ Wien's law :- The wavelength λm of radiation corresponding to maximum intensity is inversly propotional to the temperature T of the emitting body

$$\lambda_m \propto \frac{1}{T} \Rightarrow \lambda_m T = \text{Constant} \quad (1)$$

⇒ Wein also explained maximum energy E_m of peak emission is directly propostional to 5^{th} power of the absolute temperature

$$E_m \propto T^5 \Rightarrow E_m T^{-5} = \text{Constant} \quad (2)$$

$$E_\lambda d\lambda = C_1 \lambda^{-5} e^{-C_2/\lambda T} d\lambda \quad \text{——} (3)$$

Draw backs :-

It holds good for smaller values of wavelength but doesn't let the experimental curves for higher value of λ.

The main

1. Energy is a discreate quanta
2. Each qu the freq

Where h
$= 6.625$

3. An osc absorbs
~~Where~~
Where the a absorpti

$\Rightarrow \lambda = \frac{h}{P}$

Let a

$P = mV$,

Assume

$E =$

$(E$

The main postulates of plank's law :-

1. Energy is absorbed or emitted by a blackbody in a discreate manner, in the form of small packets called quanta

2. Each quantum has energy that depends only on the frequency of the radiation and is given by

$$E = h\nu \text{ --- (5)}$$

where h is a constant known as plank's constant $= 6.625 \times 10^{-34}$ J-sec.

3. An oscillater may gain or lose energy when it absorbs or emits radiation of frequency ν given by ~~where~~

$$\nu = \Delta E/h \text{ --- (6)}$$

where ΔE is the difference in energies of the oscillater before & after emission or absorption

De-Broglie Wavelength (λ) :-

$$\Rightarrow \lambda = \frac{h}{P} = \frac{h}{mV}$$

Let a particle has mass 'm'. moving with velocity 'V'. $P = mV$, wavelength can be calculated

Assume particle & wave nature:

$E = mc^2 \rightarrow$ ① [Einstein]

$E = h\nu \rightarrow$ ② [Plank's Law]

Compare ① & ②

$$E = mc^2 = h\nu$$

$$m(\nu\lambda)^2 = h\nu$$

$$m\nu^2\lambda^2 = h\nu$$

$$m\nu\lambda^2 = h$$

$$c = \nu$$

$$m\nu\left(\frac{c^2}{\nu^2}\right) = h$$

$$\frac{m\nu v^2}{\nu \times \nu} = h$$

$$\frac{mv^2}{\nu} = h$$

$$P\frac{v}{\nu} = h$$

$$P\lambda = h$$

$$\lambda = \frac{h}{p}$$

Date

1. Green light has a wavelength of 525nm Determine the energy for the green light in joules

$\lambda_{Green} = 525\ nm = 525 \times 10^{-9}\ m$

$E = ?$ in Joule $\quad h = 6.625 \times 10^{-34}\ J\text{-}sec$

$E = nh\nu \qquad c = 3 \times 10^{8}\ m/s$

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

$\nu = \frac{c}{\lambda} \quad \frac{3}{5.5} = 0.005714$

0.03785

$E = \frac{(6.625 \times 10^{-34} \times 3 \times 10^{8})}{525 \times 10^{-9}}$ 0.03785 ×10

$= 0.0378 \times 10^{-17}\ J$

$= 3.78 \times 10^{-19}\ J$ //

3. Calculate the ene

$E = nh\nu$

$= 6.625$

$E = 16.5$

$E = \frac{(6 \ldots}{525 \ldots}$

$= 0.0378 \times 10^{-17} J$

$= 3.78 \times 10^{-19} J$ //

2. Let as assume there is a shining Blue light of wavelength 620 nm ($620 \times 10^{-9} m$) How much enrgy does the blue light give

$\lambda_{Blue} = 620 nm$

$= 620 \times 10^{-9} m$

$E = ?$ $\quad E = nh\nu$

$\therefore E = \frac{(6.625 \times 10^{-34} \times 3 \times 10^{8})}{620 \times 10^{-9}}$

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

$\nu = \frac{c}{\lambda}$ $[c = 3 \times 10^{8} m/s]$

$= 0.03205 \times 10^{-17}$

$= 3.205 \times 10^{-19}$ J

3. Calculate the enegy of photon with frequency 2.5×10^{15} Hz

$E = nh\nu$ $h = 6.625 \times 10^{-34}$ J/sec

or $\nu = 2.5 \times 10^{15}$ Hz

$E = ?$

$= 6.625 \times 10^{-34} \times 2.5 \times 10^{15}$

$E = 16.56 \times 10^{-19}$ //

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3.

Q. Calculate the energy of photon with frequency 2.5×10^{15} Hz

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&/ $\nu = 2.5 \times 10^{15}$ Hz

$E = ?$

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Schrodinger time Independent Wave Equation

e^{-}, m, v, λ as per De-brogile

$\lambda = \frac{h}{p}$ —①

Fundamental wave equation

$\Psi = Ae^{i(kx - \omega t)}$ —②

Ψ = wave function

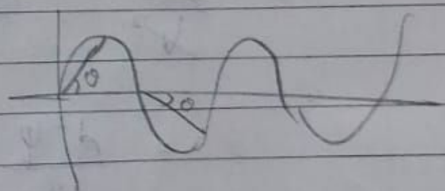
A = Amplitude

k = wave number

x - position

ω - angular frequency

t - time



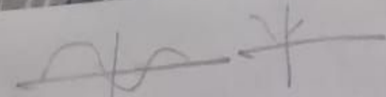
eq ② diffrentiate 'time t' twice

$\Psi = Ae^{i(kx - \omega t)}$

$\frac{dy}{dx} = i(kx - \omega t) \cdot Ae^{i(kx - \omega t)}$

Sinsoidal order
cos

e^{2x}



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$$\Rightarrow \frac{d\psi}{dt} = i(kx-\omega t).\,Ae^{i(kx-\omega t)}$$

$$\frac{d\psi}{dt} = Ae^{i(kx-\omega t)}(-i\omega) \qquad e^{i\theta} = \cos\theta + i\sin\theta$$

differentiate eq ② w.r.t 't'

$$\frac{d^2\psi}{d^2t} = Ae^{i(kx-\omega t)}(-i\omega)(-i\omega) \qquad i^2 = -1, \quad i^2 = (\sqrt{-1})$$

$$\frac{d^2\psi}{dt^2} = -Ae^{i(kx-\omega t)}\,\omega^2$$

$$\frac{d^2\psi}{dt^2} = -\psi\,\omega^2 \quad - ③$$

$$V = \left(\frac{dx}{dt}\right)^2 \qquad \text{from travelling wave eq}$$

$$= \frac{\cancel{V}}{\cancel{V^2}} = \frac{d^2\psi}{d^2x} = \frac{1}{V^2}$$

$$= \frac{d^2\psi}{d^2x} = \frac{1}{V^2} = \frac{d\psi}{dt^2}$$

$$= \underbrace{\frac{V^2 d^2\psi}{d^2x} = \frac{d^2\psi}{dt^2}}$$

Travelling ~~equ~~ wave equation

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using travelling wave substitue eq ① in eq ③

$$\frac{d^2\psi}{dt^2} = \frac{v^2 d^2\psi}{d^2x^2}$$

Substitute eq ⑤ in eq ③

$$\frac{v^2 d^2\psi}{dx^2} = -\omega^2$$

$\omega = 2\pi\nu$

$$= \frac{d^2\psi}{dx^2} = \frac{-\omega^2}{v^2}\psi$$

$V = \nu\lambda$

$V = \frac{c}{\lambda} \times \lambda$

$V = c$

$$\Rightarrow \frac{d^2\psi}{dx^2} = \frac{-\omega^2}{v^2}\psi$$

$$\frac{d^2\psi}{dx^2} = \frac{(-2\pi\nu^2)^2}{c^2}$$

$$\frac{d^2\psi}{dx^2} = -\frac{4\pi\nu^4}{c^4}$$