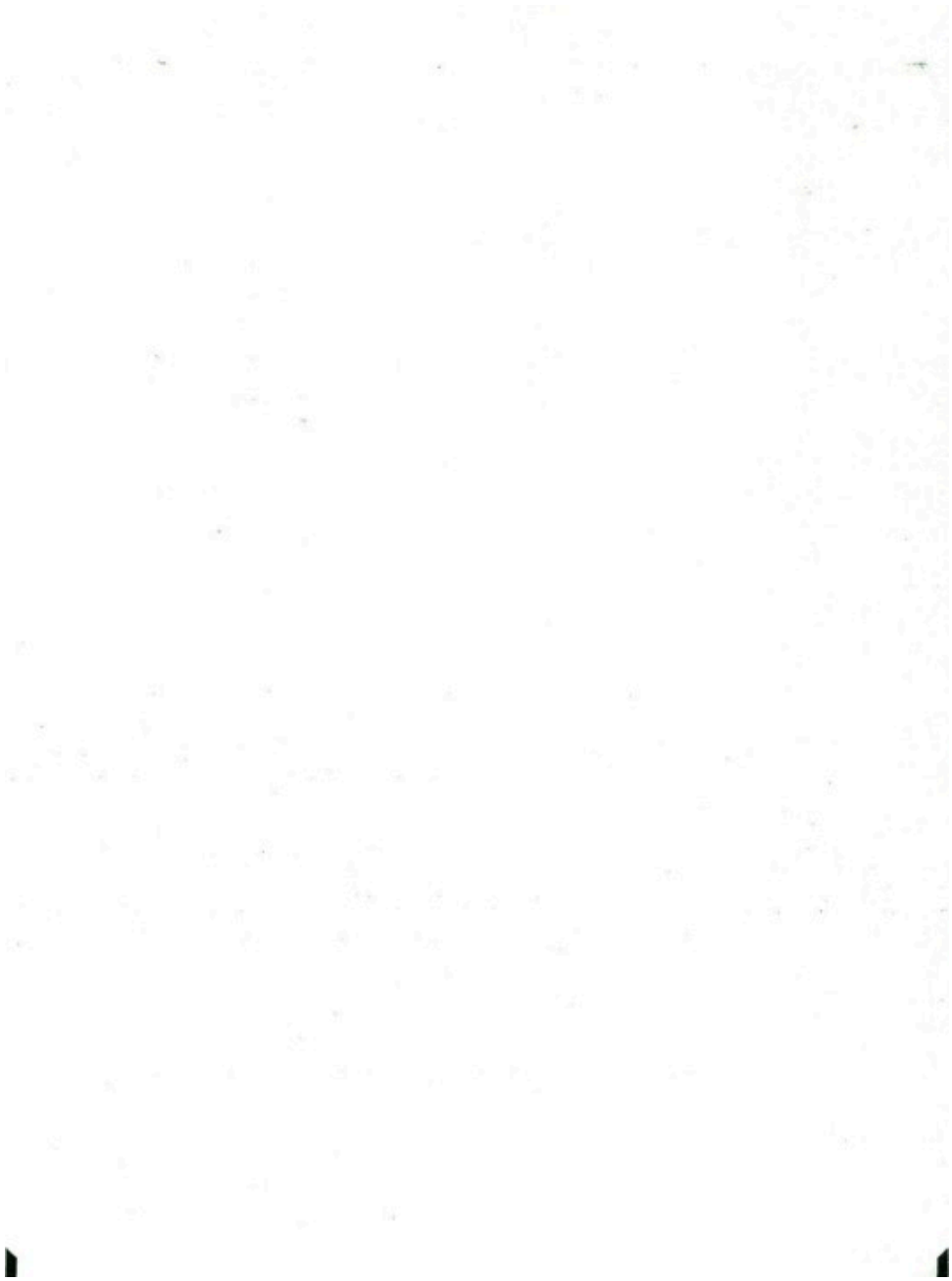




$F_c = 2 \times w$

$g = \sqrt{\frac{GM_E}{r}}$

$F = GM/r^2$

$= \frac{1}{r^2} \times$

(Section B)

Q. No. 2 Part (i)

As

$$v_o = \sqrt{\frac{GM_E}{R}}$$

so

orbital velocity $v_o \propto \frac{1}{\sqrt{R}}$

so if satellite is put into lower orbit so, R reduces hence orbital velocity increases as v_o (orbital velocity) is inversely proportional to $\sqrt{R}$.

Q. No. 2 Part (ii) **conditions for observing interference fringes.**

i) coherent sources :- Two sources emitting waves must be coherent means they should have constant phase relationship and same frequency and wavelength.

ii) Narrow slits:- slits should be narrow and length of slits must be comparable to wavelength of waves.

iii) Monochromatic sources :- Two sources emmitting waves must be monochromatic which means they should have same wavelength.

iv) Free from disturbances :- system should be free from disturbances like air currents or vibrations that disturb interference Pattern.

(Section B)

Q. No. 2 Part (iii) **Uses of Capacitors**
(Household)

i) Capacitors are used in tuning frequencies of radios and TV sets.

ii) Capacitors are used to increase speed of fans.

iii) Refrigerator: Capacitors are used to make compressor running.

Q. No. 2 Part (iv)

Mutual inductance:- The phenomenon in which changing current in one coil induces emf in another coil is called Mutual inductance.

As $\varepsilon = -M \Delta I/\Delta t$

so $M = \varepsilon \frac{\Delta t}{\Delta I}$

SI Unit:- henry (H) $\therefore H = VAS^{-1}$

Factors :-

As $M = \varepsilon \Delta I/\Delta t$

so, Mutual inductance depends upon

i) emf induced in coil.

ii) Time rate change of current.

(Section B)

Q. No. 2 Part (v)

Braking Radiations :- When high energy emitted electron moves away from positive nucleus it decelerates and release radiations known as Braking radiation.

As $eV = hf_{max}$

$$eV = \frac{hc}{\lambda_{min}}$$

$$\lambda_{min} = \frac{hc}{eV}$$

Q. No. 2 Part (vi) **Role of atmosphere in climate balance**

i) Atmosphere envelopes the earth from harmful UV radiations and maintain climate balance.

ii) Atmosphere provide insulation to earth and make earth warm and hence maintain climate balance.

iii) convection and wind movements in atmosphere also regulate climate balance.

iv) some trace gases like methane and CO_2 are greenhouse gases that trap heat inside the earth contributing to Global warming.

(Section B)

Q. No. 2 Part (vii) **Pair Annihilation:-**

"When electron and positron combine their energy is converted into two Gama rays photon. This phenomenon is known as pair Annihilation.

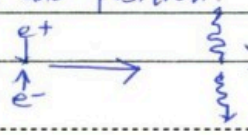
★ **Conservation of Energy:-**

Energy before collision = Energy after collision.

$2\,m_0c^2 + K.E_{(electron)} + K.E_{(positron)} =$ Energy of γ ray photons

This process emit 2 photons each with minimum energy = 0.511 MeV.

★ **Conservation of Momentum:-** Two γ ray photons are emmited in opposite direction to conserve momentum of electron and positron.



Q. No. 2 Part (viii) **Applications of Ultrasound**

i) Ultrasound is used in medical imaging techniques like sonography to diagnose tissues. Ultrasounds are less harmful than other radiations that are used in medical imaging.

ii) Ultrasounds are used in ultrasonic flow meter. this involve use of doppler's effect to determine flow rate through doppler's shift in frequency. it is used to find flow rate of blood.

iii) Intense Ultrasonic waves can be emitted on small area of tissues without affecting surrounding tissues. This property enables use of ultrasounds in neurosurgery.

v) They are also used to treat arthritis, and rheumatism.

(Section B)

Q. No. 2 Part (ix)

$V_{rms} = 220\ V.$

$R = 20\ \Omega$

As $V = IR$

$I_{rms} = V_{rms}/R = 220/20 = 11\ A.$

As $V_{rms} = V_o/\sqrt{2}$

so, $V_o = V_{rms}\sqrt{2}$

$V_o = 220\sqrt{2}$

$V_o = 311.12\ V$

As $I_{rms} = I_o/\sqrt{2}$

so, $I_o = I_{rms}\sqrt{2}$

$I_o = 11\sqrt{2}$

$I_o = 15.55\ A$

Q. No. 2 Part (x)

According to weins displacement law → $T \propto \frac{1}{\lambda}$ > it is used to find Temperature of star

so If wavelength of light/radiation emitted by star is larger so, it's temperature would be lower.

Formula:-

~~Equation~~: $T \propto \frac{1}{\lambda}$

$T = \text{constant} \frac{1}{\lambda}$

here, constant $= 2.9 \times 10^{-3}\ mK$

(Section B)

Q. No. 2 Part (xi)

Control rods :- They are safety rods and they prevent use of excessive fuel at single time and also absorb the neutron inorder to allow only one neutron to produce fission chain reaction and also maintain constant output. They are made of boron and cadmium.

Moderators :- They slowers the speed of fast moving neutrons and are made of water and graphite. Energy of neutrons that is required for fisson chain reaction is 0.025 eV but actual energy of neutrons is in MeV so they reduce of energy of neutrons to sustain fission chain reaction.

Q. No. 2 Part (xii) **Free oscillations :-**

A body is set to be executing free oscillations when it oscillates under the influence of restoring force only.

Examples :-

i) Simple pendulum that once released move back and forth about mean position under action of restoring force only.

ii) Mass attach to spring that once released oscillates about mean position under action of restoring force only.

(Section B)

Q. No. 2 Part (xiii)

Peak Value	rms Value
★ It is maximum value of Alternating quantity	It is that amount of steady quantity which when flowing through the resistance produce same heat as Alternating quantity.
★ It is represented as X_0	★ It is represented as X_{rms}.
★ X_0 occur twice in each cycle once in negative half cycle. once in positive half cycle.	$X_{rms} = X_0/\sqrt{2}$.

Q. No. 2 Part (xiv) As C_2 & C_3 are parallel combination.

$$C_{11} = C_2 + C_3$$
$$= 4\mu F + 4\mu F = 8\mu F$$

As C_{11}, C_1 and C_4 are in series than.

$$\frac{1}{C_{eq}} = \frac{1}{C_{11}} + \frac{1}{C_1} + \frac{1}{C_4}$$

$$\frac{1}{C_{eq}} = \frac{1}{8} + \frac{1}{2} + \frac{1}{2}$$

$$\frac{1}{C_{eq}} = \frac{1+4+4}{8}$$

$$\frac{1}{C_{eq}} = \frac{9}{8}\ \mu F$$

Taking reciprocal.

$C_{eq} = 8/9\ \mu F = \boxed{0.89 \times 10^{-6} F}$

(Section C)

Q. No. 3 (Page 1)

Energy Conservation in SHM.

Energy of SHM is always conserved

As

$W_{net} = F_{av} \Delta r$ — i)

A/c to Hooke's law

$F = kx$

so, $F_{av} = \frac{0 + kx}{2} = \frac{1}{2} kx$ — ii)

so, putting ii) in i)

$W_{net} = \frac{1}{2} kx(x)$

$W = \frac{1}{2} kx^2$

This work is converted into elastic potential energy. so, P.E at instaht $t =$

$W = P.E = \frac{1}{2} kx^2$.

At extreme position.

$x = x_0$

so, $T.E = P.E = \frac{1}{2} kx_0^2$ — (A)

when body is set free from extreme position it moves back and forth about mean position. and attain velocity :-

$v = \omega \sqrt{x_0^2 - x^2}$

$v = \sqrt{\frac{k}{m}(x_0^2 - x^2)}$ $\because \omega = \sqrt{\frac{k}{m}}$

(Section C)

Q. No. 3 (Page 2) At instant t :

$$K.E = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\sqrt{\frac{k}{m}(x_0^2 - x^2)}\right)^2$$

$$= \frac{1}{2}k(x_0^2 - x^2)$$

At mean :- $x = 0$

So,

$$T.E = K.E = \frac{1}{2}kx_0^2 \quad -(B)$$

Total energy at instant t is

$$T.E = K.E + P.E$$

$$T.E = \frac{1}{2}k(x_0^2 - x^2) + \frac{1}{2}kx^2$$

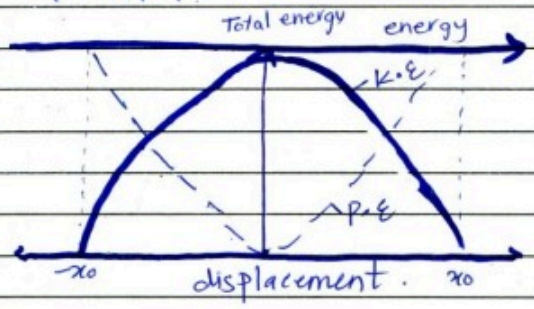
$$T.E = \frac{1}{2}kx_0^2$$

So, $\because$ As $\omega = \sqrt{\frac{k}{m}}$

$$T.E = \frac{1}{2}\omega^2 m x_0^2 \quad -(C) \qquad \omega^2 m = k$$

eq (A) (B) and (C) shows that Total Energy remains constant in SHM.

Sketch :-



(Section C)

Q. No. 3 (Page 3)

(Section C)

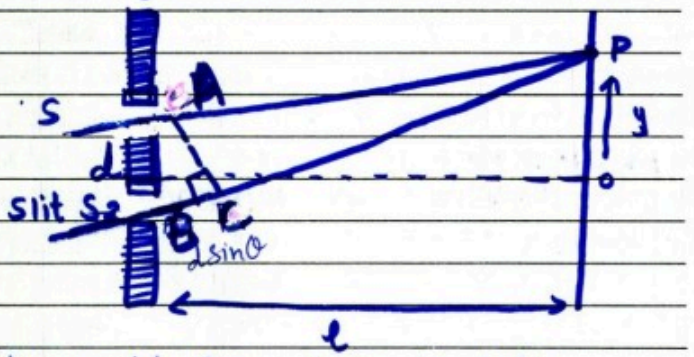
Q. No. 4 (Page 1)

Young's Double Slit Experiment.

Thomas Young presented Double Slit Experiment of light. He allowed sunlight (mixture of wavelengths) to pass through double slit. He made ..., partially coherent (constant phase difference) sunlight to pass through double slit. light rays diffracted in form semicircle and interfere to form fringes of dark and light color.

Young's use of sunlight made it easier to observe interference pattern because sunlight is mixture of different wavelengths (colors).

Working



Consider light from slits S1 & S2 meet at point p on screen. Such that light from S2 has to travel larger distance. which is proportional to phase difference

(Section C)

Q. No. 4 (Page 2)

In ΔABC.

$$\sin\theta = \frac{BC}{AB}$$

so,

$$d \sin\theta = BC$$

it is path difference.

Path difference =

In case of constructive interference (Maxima)

$$d\sin\theta = m\lambda.$$

(Path difference is integral multiple of wavelength.)

$$m = (\pm 1, \pm 2, \pm 3, \ldots \pm n)$$

In case of Destructive interference. (Minima)

$$d\sin\theta = (m + \tfrac{1}{2})\lambda$$

(Path difference is odd multiple of half of wavelength.

$$m = \pm 1, \pm 2, \pm 3 \ldots \pm n)$$

Positions of Maxima & Minimas

* Maxima.

As $d \sin\theta = m\lambda$

As θ is small so,

$\sin\theta = \tan\theta$.

$$d \tan\theta = m\lambda$$

$$d \frac{y}{L} = m\lambda$$

$$y = m\lambda L / d$$

In $\triangle BOP$

$$\therefore \tan\theta = \frac{y}{L}$$

(Section C)

Q. No. 4 (Page 3)

Minima :-

similarly

$$\frac{dy}{l} = (m + 1/2)\lambda$$

$$y = m + 1/2 \frac{\lambda L}{d}.$$

Fringe Spacing :-

It is ~~conse~~ distance between consecutive maximas & minimas.

Maxima :-

Δy = Fringe Spacing = $\frac{(m+1)\lambda L}{d} - \frac{m\lambda L}{d}$

$$= \frac{\lambda L}{d}.$$

Minima :-

Δy = Fringe Spacing = $\frac{m+1/2\ \lambda L}{d} - \frac{m+1/2\ \lambda L}{2d}$

$$= \frac{\lambda L}{d}$$

(Section C)

Q. No. 5 (Page 1)

Photoelectric effect

"The process of emmiting electron from metal surface when metal surface is exposed to electromagnetic radiation of sufficiently high frequency. is called photo electric effect.

Work function Φ

The minimum amount of energy required to escape electron from metal surface is called work function.

Einstein photoelectric equation.

Einstein reinterpreted photoelectric effect and proposed that photon transfer energy to electrons in metal and this energy is distributed into work function and kinetic energy of electron.

$E = \Phi + K \cdot \mathcal{E}$ $E = hf$

$hf = \Phi + K \cdot \mathcal{E}$.

(Section C)

Q. No. 5 (Page 2)

If $E = \Phi$
photoelectric effect will be observed but electrons will not have k.E.

If $E < \Phi$
No photo electric effect will be observed.

If $E > \Phi$
photoelectric effect will be observed and electrons will have k.E.

effect frequency on k.E

If frequency is increased, maximum k.E of photoelectrons will also increase.
If ~~bright~~ dim light of high frequency hit the metal plate. Photoelectrons ~~emit~~ will ~~emit~~ ~~will have~~ with high k.E. this dependence is not explained by classical Physics.

There is minimum frequency called threshold frequency (f_0) below which no photoelectric effect is observed..

(Section C)

Q. No. 5 (Page 3)

(Section C)

Q. No. 6 (Page 1)

Exponential decay

A/c to rate law

$$\frac{\Delta N}{\Delta t} = -\lambda N$$

for small ~~decay~~ change.

$$\frac{dN}{dt} = -\lambda N$$

$$\frac{1}{N} dN = -\lambda t$$

Taking integration

$$\int \frac{1}{N} dN = -\int \lambda t$$

$$\ln N = -\lambda t + \text{constant} \quad - i)$$

if $N = N_0 = t = 0$

then

$$\ln N_0 = \text{constant} \quad - ii)$$

putting ii) in i)

$$\ln N = -\lambda t + \ln N_0$$

$$\ln N - \ln N_0 = -\lambda t$$

~~Taking~~ $\ln \frac{N}{N_0} = -\lambda t$

Taking antilog :- $N/N_0 = e^{-\lambda t}$

(Section C)

Q. No. 6 (Page 2)

$N = N_0 e^{-\lambda t}$ ... iii)

This equation show exponential nature of nuclear decay with time.

b) $T_{1/2}$ of Sr = 9.7 hours.

convert into seconds

$T_{1/2} = 9.7 \times 3600 = 34920$ sec

As $T_{1/2} = \frac{0.693}{\lambda}$

$\lambda = \frac{0.693}{T_{1/2}} = \frac{0.693}{34920 \text{ sec}}$

$\lambda = 1.98 \times 10^{-5} s^{-1}$

(Section C)

Q. No. 6 (Page 3)