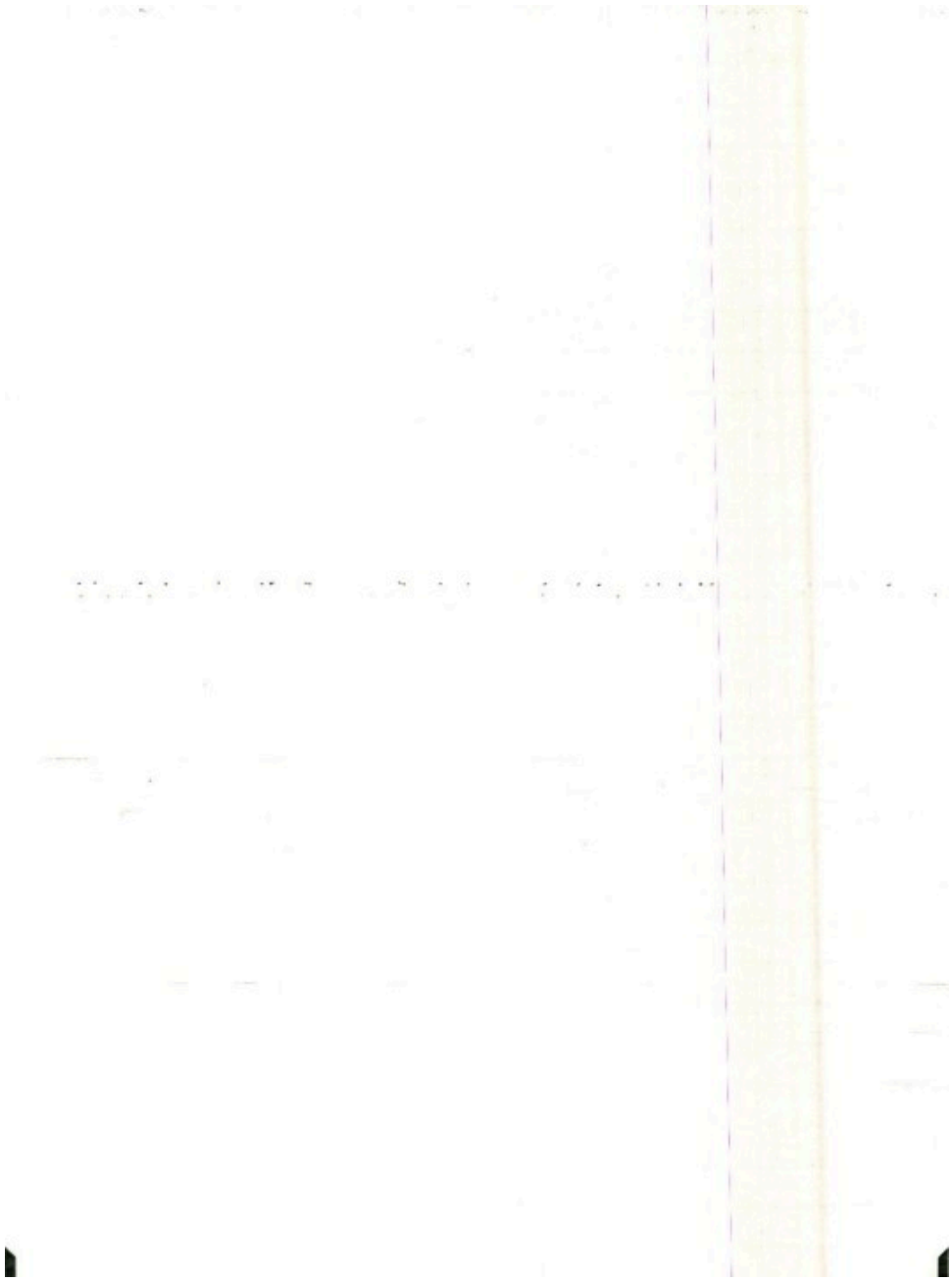
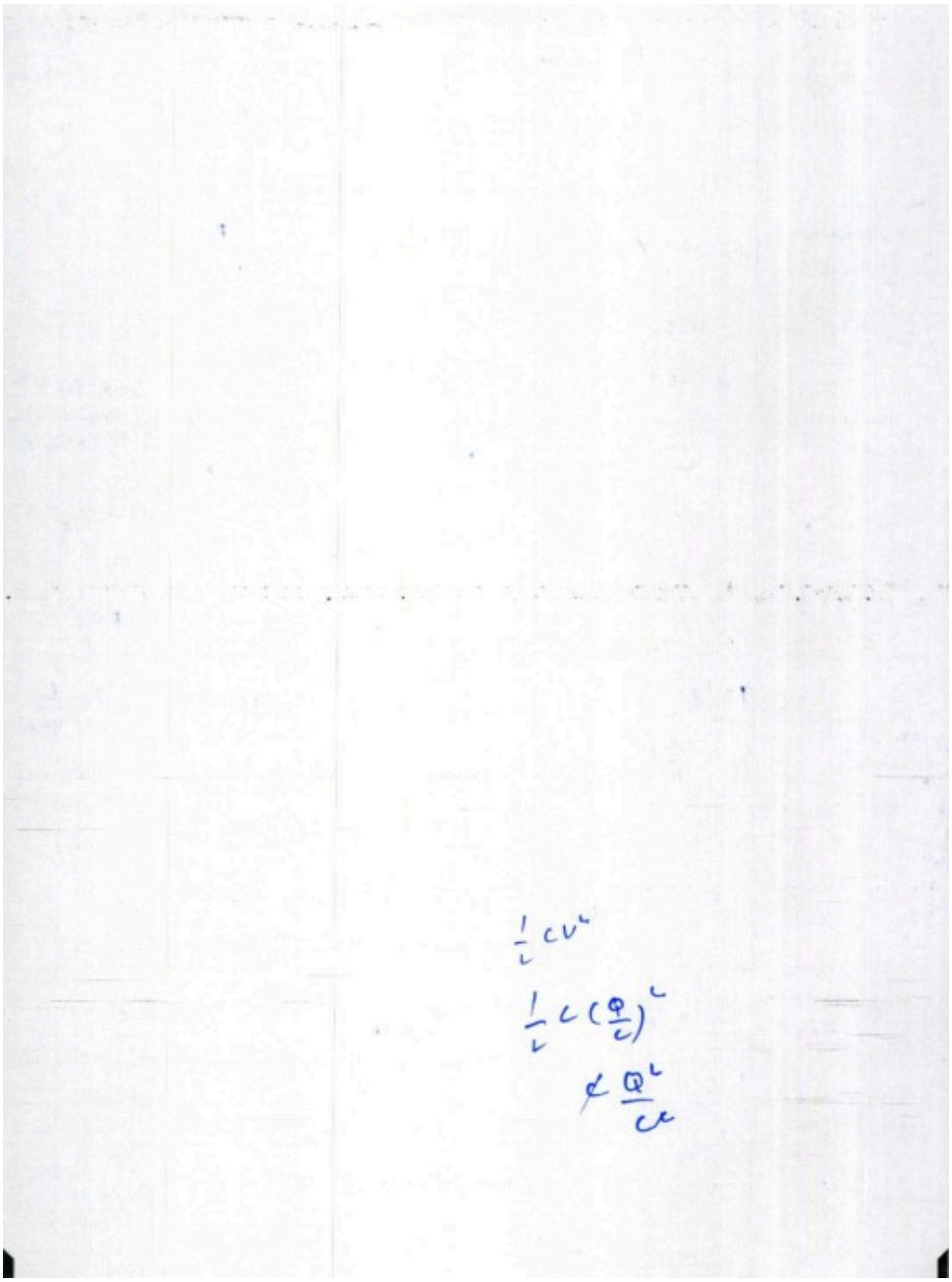
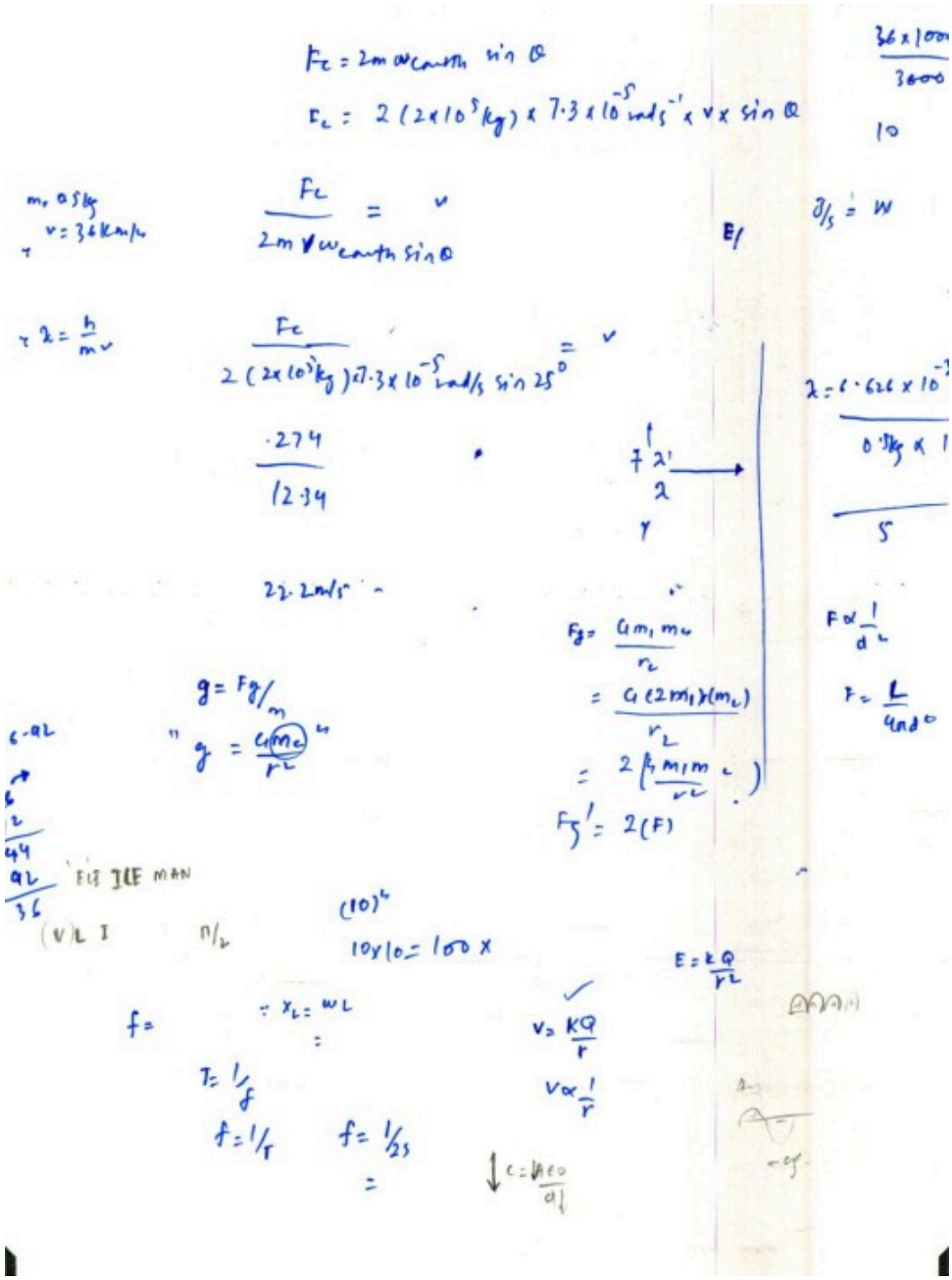



$\frac{1}{2}CV^2$
$\frac{1}{2}C\left(\frac{Q}{C}\right)^2$
$\propto \frac{Q^2}{C}$



$F_c = 2mv\omega_{earth}\sin\theta$

$F_c = 2(2\times10^{5}\,kg)\times 7.3\times10^{-5}\,rad\,s^{-1}\times v\times\sin\theta$

$\frac{F_c}{2mv\omega_{earth}\sin\theta} = v$

$\frac{F_c}{2(2\times10^{5}kg)7.3\times10^{-5}rad/s\sin25^{0}} = v$

$\frac{\cdot274}{12.34}$

22.2 m/s

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

$g = F_g/m$

$g = \frac{GM_e}{r^2}$

$F_g = \frac{Gm_1m_w}{r^2}$

$= \frac{G(2m_1)(m_2)}{r^2}$

$= 2\left(\frac{Gm_1m_2}{r^2}\right)$

$F_g' = 2(F)$

$F \propto \frac{1}{d^2}$

$E = \frac{kQ}{r^2}$

$V = \frac{KQ}{r}$

$V \propto \frac{1}{r}$

$f = 1/T$

$T = 1/f$

$f = 1/25$

$\omega = 2\pi f$

$v = \omega r$

$\frac{36\times1000}{3600}$

10

$\frac{6.626\times10^{-34}}{0.5kg\times1}$

$\frac{5}{4\pi^2}$

(Section B)

Q. No. 2 Part (i) Ans:

Given : $m = 800g = 0.8kg$ ∵ $F = kx$

$F = 60N$, $x = 0.3$ $\frac{F}{x} = k$

$k = 200N/m$

(a). $\omega = ?$

∵ $\omega = \sqrt{k/m}$

$= \sqrt{\frac{200N/m}{0.8kg}}$

$= \sqrt{250}$

$\Rightarrow \omega = 15.811 rad/s$

(b). ∵ $a = -\omega^2 x$ ∵ $x = \frac{12cm}{100} = 0.12m$

$a = -(15.811)^2(0.12)$

$= -(249.9)(0.12)$

$\Rightarrow a = -29.99 \approx -30 m/s^2$ (towards mean position).

Q. No. 2 Part (ii) Ans:

⇒ Pressure related to ρ.

→ Pressure of gas $(P) \propto \frac{1}{\rho}$ (density of gas)

Here if Pressure of gas increases its means if density is Low or vice versa. Mathematical form:

∵ $P = \frac{1}{3}\frac{mN}{V}\langle v \rangle$ ∵ $\frac{mN}{V} = \rho$

$\Rightarrow P = \frac{1}{3}\rho\langle v^2 \rangle$

So, $P \propto \frac{1}{\rho}$ (As $\frac{1}{3}$ and $\langle v^2 \rangle$ is constant)

→ Increase v_{rms} ($\because P = \frac{1}{3}\rho\langle v_{rms}^2 \rangle$)

(Section B)

Q. No. 2 Part (iii) Ans:

⇒ Use of capacitors:

(1). Capacitors are used in motors of fan to speed up fan as, capacitor stored electric potential energy.

(2): In refrigerator, capacitor are used for the running of freezer compressor.

(3): Capacitors are used in common household camera flashes as it quickly store and release electrical energy than batteries.

(4). Capacitors are used to reduce ripple factor in pulsating DC.

Q. No. 2 Part (iv) Ans:

Given: $h = 35700\ km$ $\quad M_E = 6 \times 10^{24}\ kg$

$\because R_E = 6.4 \times 10^6\ m$ $\quad G = 6.673 \times 10^{-11}\ Nm^2/kg$

Sol: $\because g = \frac{GM_E}{(R)^2}$ $\quad \because R = R_E + h = 8.4 \times 10^6\ m + 35700 \times 10^3\ m$

$= 6.4 \times 10^6\ m + 3.5700 \times 10^7\ m$

$$= \frac{6.673 \times 10^{-11}\ Nm^2/kg \times 6 \times 10^{24}\ kg}{(42100000)^2}$$

$$g = \frac{4.0038 \times 10^{14}}{1.77241 \times 10^{15}}$$

$$g = 0.225\ m/s^2$$

(Section B)

Q. No. 2 Part (v) Ans:

(i) Def: "Braking radiation also known as "Bremsstrahlung radiation" in which photon of maximmum energy and λ_{min} is produced by stopping or decelerating electron moving closer to target atom." and, thus lose its K.E into Energy of photon.

(ii) Relation : $K.E_e = E_{max}$

$eV = hf_{max}$ ∴ $c = f_{max}\lambda_{min}$

So. $\frac{c}{\lambda_{min}} = f_{max}$.

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

So.

$\Rightarrow \lambda_{min} = \frac{hc}{eV}$ → $h = 6.626 \times 10^{-34} Js$, $c = 3 \times 10^8 m/s$

Here $\lambda_{min} \propto \frac{1}{V}$

Q. No. 2 Part (vi) Ans:

⇒ Role of Atmosphere:

(i). This Layer protects us from harmful radiations by traping uv rays and allow some rays to enter stratosphere as incoming radiation thus "warming the earth" (Global Temperature controlled by atmosphere).

(ii). Weather and precipitation occurs in troposphere Layer of atmosphere thus regulating climate by keeping constant precipitation patterns.

(iii). By analyzing wind speed, humidity and precipitation in troposphere we can predicate climate in particular Large region Thus, atmosphere by keeping constant water vapour Level maintaining weather and climatic conditions.

(Section B)

Q. No. 2 Part (vii) Ans:

⇒ **Main role of ocean:** Ocean plays major role in climate inertia and thus respond slowly to changes in external factor like "change in solar output."

→ **(1) In short term:** ocean shows delayed response by slowly warming although ocean absorbs more of heat than earth surface. But due to climate inertia ocean slowly absorbs heat and slowly release heat.

→ **(2) In long term:** In Deep ocean warming, delayed response is also observed due to climate inertia and also warm air or heat circulate in deeper layer of ocean takes centuries or long time to cause deep ocean warming thus here again ocean show climate inertia.

Q. No. 2 Part (viii) Ans:

⇒ **Application of ultrasound in Medical:**

(i) **Treating kidney stones:** In ESWL (Extra corporeal sound wave lithotripsy) ultrasonic waves of high frequency are used to remove stones from "kidney or nephron"

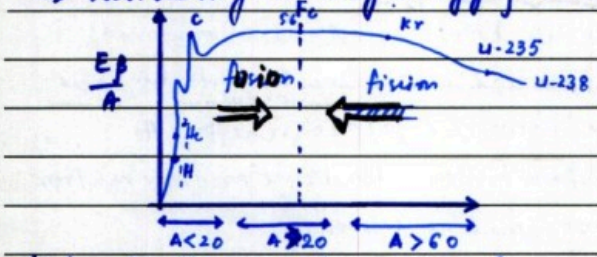
(ii) **Neurosurgery:** Ultra sonic waves are used in surgery of neuron or nervous system. to minimize injury risks

(iii) **Blood flow:** Ultra sonic flow meter are used to measure blood flow rate in blood vessels by measuring time difference and doppler shift in reflected of waves. Thus give analysis of fluids velocity in vessels. (blood)

(Section B)

Q. No. 2 Part (ix) Ans:

⇒ variation of binding energy per nucleon:



(i). **Low Binding energy per nucleon:** if A < 20 then due to presence of less no of nucleon binding energy per nucleon is observed and their stability of nucleus decreases so they undergo fusion reaction "E.g $_1H^2$ and $_1H^3$"

(ii). **High binding energy per nucleon:** "$_{26}Fe_{56}$" has max peak of E_B/A as its A > 20 upto 56 thus intermediate no of nucleons and intermediate repulsive and nuclear force but in "U-235". Binding energy per nucleon is low so they undergo fission reaction to achieve stability.

Q. No. 2 Part (x) Ans:

⇒ **Wien's displacement Law:** λ_{max} in black body radiation curve is inversely proptional to Temperature of black body.

⇒ **Relation:** $\lambda_{max} \propto \frac{1}{T}$, $\lambda_{max} \cdot T$ = constant

∴ constant = 2.9×10^{-3} mk.

⇒ **Defining temperature of star:**

→ if star emitts blue wavelength (λ_{max} is small) then it is hot body as "T is Large"

→ if star emits Red (λ_{max} is Large) so it is cold body as T is small so proves $\lambda_{max} \propto \frac{1}{T}$.

(Section B)

Q. No. 2 Part (xi) Ans:

➡ **Function of control rods and Moderators:**

(1) **control rods:** In nuclear reactors, control rods or boron rods are in core to absorb neutron and thus move inwards or outwards to speed up or slow down nuclear fission reaction in reactor. As it allow one neutron to sustain fission chain reaction other neutrons are absorbed by control rods, mad up of boron.

(2). **Moderators:** especially "graphite or d_2O" used to slow down the speed of neutron and energy from E (higher in Mev to 0.025 Mev. So to control fission chain reaction. and thus controlled chain (fission reaction is observed in nuclear reactors).

$${}^{1}_{0}n + U\text{-}235 \longrightarrow {}^{x}_{}U\text{-}238 \rightarrow {}^{142}_{56}Ba + {}^{92}_{36}Kr + {}^{1}_{0}n + {}^{1}_{0}n$$

control rod.

$${}^{1}_{0}n + U235 \longrightarrow U\text{-}35 + {}^{142}_{56}Ba + {}^{9}_{36}Kr + {}^{3}_{0}n$$

Q. No. 2 Part (xii)

Ans: (i) **Def:** "Oscillation of a vibrating body due to its natural frequency under the influence of restoring force only in the absence of other external force." (Ex).

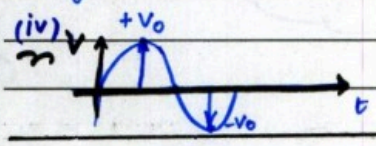
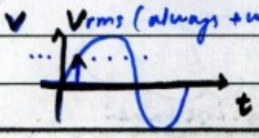
(ii) **E.g:** (1) Ideal pendulum undergoes SHM (free oscillation) in vacuum (no air friction).

(2). Swing or Mass spring system when frictional force = 0 as ideally. (damping = 0).

⇒ Here frequency (natural) is observed in free oscillation no damping as resisting force = 0.

(Section B)

Q. No. 2 Part (xiii)

Peak value of (V) :	rms value of V :
(i). Def: V_o is the max peak in AC voltage wave form give maximum output voltage."	(i) Def: Effective value of Ac voltage equivalent to Dc voltage output. (V_{rms})
(ii) formula: $V = V_o \sin\omega t$, ($V_o = \frac{V}{\sin\omega t}$) also $V_o = I_o X_c$ or $V_o = I_o X_L$	(ii) " : $V_{rms} = \frac{V_o}{\sqrt{2}} = 0.707 V_o$
(iii) Magnitude: Magnitude is greater than V_{rms}.	(iii) Magnitude is smaller than V_o (as it is $0.707 V_o$).
(iv) 	

Q. No. 2 Part (xiv) Ans:

⇒ fringe spacing factors:

• fringe spacing / fringe width = $\frac{\lambda L}{d}$ (for both consecutive fringes (or))

⇒ So, $\Delta y = \frac{\lambda L}{d}$. Here $\Delta y \propto \lambda$ (L and d, constant) and $\Delta y \propto \frac{1}{d}$ (L = constant.

So. If distance b/w adjacent slits (slit separation) decrease than fringe spacing increases. Also If λ of coherent wave increases than fringe spacing increases. and bands of light more farther a part. Thus become more focused and clear.

(Section C)

Q. No. 3 (Page 1) Ans:

⇒ Expressions for K.E and P.E of Mass Spring System:

(1) At mean position:

$F_{ext} = 0$, $x = 0$

So, ∵ $v = 0$ and object is at rest. But after some time object displace with F_{ext} from mean position

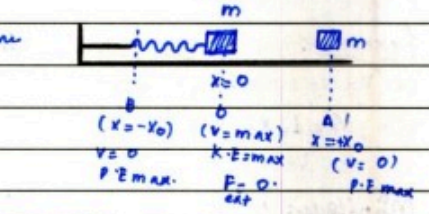
So, ∵ $W = F_{av} x$

$W = \frac{0+F}{2} x$

$= \frac{1}{2} F x$

Here $W = U_{elastic\ (potential\ energy)} = \frac{1}{2} k x^2$.

⇒ $W = \frac{1}{2} k x^2$



⇒ (2) At any instant:

$P.E = \frac{1}{2} k x^2$, $K.E = \frac{1}{2} k (x_0^2 - x^2)$.

⇒ (3). At extreme 'A' and 'B' point. $v = 0$

∵ $a \rightarrow max$ and $v = 0$. So. $K.E_{min} = 0$ (as $x = \pm x_0$)

→ and $P.E_{max} = \frac{1}{2} k x_0^2$ Here $x = \pm x_0$

(4).

⇒ Total energy at mean position:

∵ $T.E = E = P.E + K.E$. (as at mean position) $x = 0$ and $K.E$ is max and $P.E = 0$

So.

→ $T.E = \frac{1}{2} k x_0^2 + 0$

⇒ $T.E_{at\ mean} = \frac{1}{2} k x_0^2$ → (a) ✓

⇒ At any instant:

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

$= \frac{1}{2} k [x^2 + x_0^2 - x^2]$

⇒ $T.E = \frac{1}{2} k (x_0)^2$ → (b) ✓

(Section C)

Q. No. 3 (Page 2)

⇒ At extreme: ($P.E_{max} = \frac{1}{2} kx_0^2$ and $k.E_{min} = 0$)

Here $T.E = P.E + k.E$

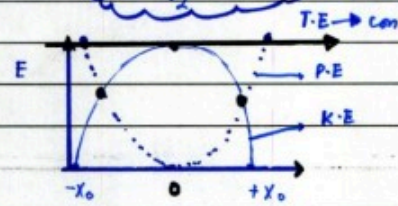
$= \frac{1}{2} kx_0^2 + 0$

⇒ $T.E = \frac{1}{2} kx_0^2$ → (c)

At a = b = c

So. $T.E = \frac{1}{2} kx_0^2$ which remains same at any point and following law of conservation of energy but it is independent of mass of vibrating body.

⇒ As : $T.E = \frac{1}{2} m\omega^2 x_0^2$ as : ω → constant



because k and m are constant.

⇒ Incomplete vibration

P.E = K.E (4 times)

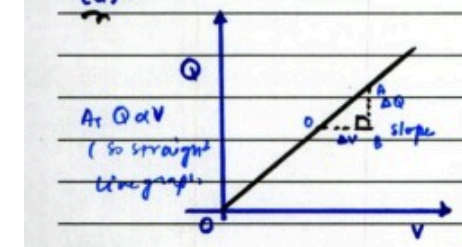
(Section C)

Q. No. 3 (Page 3)

(Section C)

Q. No. 4 (Page 1) Ans:

(a):



At Q∝V (So straight line graph)

⇒ The slope of QV graph = $\frac{\Delta Q}{\Delta V}$ also in this ΔOAB.

Area = ½ base × height

So. ½ V × Q

So. ∵ Area = energy store in form of Electric field in capacitor

$U = \frac{1}{2} QV$

⇒ $U = \frac{1}{2} QV$ ∵ $C = \frac{Q}{V}$ ∴ $Q = CV$ ∴ $E = \frac{V}{d}$

Also. $U = \frac{1}{2} CV^2$

and $U = \frac{Q^2}{2C}$

⇒ in terms of electric field $U = \frac{1}{2} A\varepsilon_0 (E)^2 (d)^2$, In terms of energy density. $U = \frac{1}{2} \varepsilon_0 E^2$

So $U = \frac{1}{2} A\varepsilon_0 E^2 d$

(b): $Q = 5C$ and $V = 15V$ ∵ $C = \frac{Q}{V} = 0.33$ Farad

∵ $U = \frac{1}{2} \frac{Q^2}{C}$

So by putting values

$U = \frac{(5C)^2}{2} = \frac{25}{2(0.33)} = \frac{25}{0.66} \Rightarrow 37.87$ Joules. $\simeq 37.5$ J

⇒ Other formula ∵ Possible.

∵ $U = \frac{1}{2} QV$

$= \frac{1}{2} (5C)(15)$

$= \frac{75}{2}$

⇒ $U = 37.5$ J

(Section C)

Q. No. 4 (Page 2)

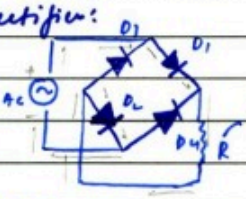
(Section C)

Q. No. 4 (Page 3)

(Section C)

Q. No. 5 (Page 1) Ans:

⇒ **Bridge rectifier:**



⇒ Here 4 diodes are used connected with Ac source.

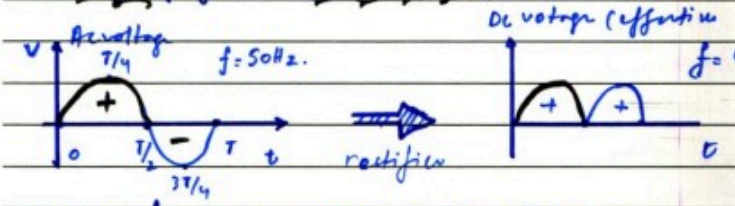
D1 and D2 → forward biased } In +ve cycle.
D3 and D4 → reverse biased

(i) **Working:** In full wave rectifications

⇒ **When (0 ⟶ T/2)**. In +ve cycle. D_1 and D_2 acts as forward biased diodes and allow 'I' with low resistance. So current from +ve terminal to -ve direction without passing through D_3 and D_4 diodes as they are reverse biased So reach -ve terminal and give one +ve ripple DC voltage.

⇒ **When (T/2 ⟶ T)**. In -ve cycle, D_3 and D_4 are forward biased and thus allow current while D_1 and D_2 are reverse biased So current from +ve terminal reaches -ve terminal without facing any resistance. and again give +ve ripple of DC voltage.

(ii). **Frequency of Ac (input) and Dc voltage:**



(iii). **Ripple factor:** In full wave rectification Ripple factor (γ) concentration of Ac voltage is lower than Half wave rectification Thus eliminating by filtering Dc voltage with capacitor attached

(Section C)

Q. No. 5 (Page 2) with resistor in parallel combination and smoothing DC (pulsating)

(Section C)

Q. No. 5 (Page 3)

(Section C)

Q. No. 6 (Page 1) Ans:

(a): (i) Def: "Power and put of radiation of star or energy per unit time emitted by star is called luminosity of a star."

(ii) Relation: According to Stefan boltzmann law, "Luminosity is directly proportional to Area and 4th power of Temperature of a star."

Thus. "$L = A\sigma T^4$" Its unit is Watt (J/s).

So $L \propto A$ (T → constant) $L \propto T^4$ (A → constant)

Here σ = constant = $5.67 \times 10^{-8} W/m^2K^4$

If Area doubles than "Luminosity doubles". (But if $r' = 2r$

⇒ then area' becomes 4 time A thus L' become 4L.

(b): Ans:

$T_A = 100K$, $T_B = 200K$, $R_A = 10m$ and $R_B = 5m$

→ $\because L_A = 4\pi R_A^2 \sigma T_A^4$ (Here "4π" and "σ" are constant)

and $L_B = 4\pi R_B^2 \sigma T_B^4$

By dividing,

$$\frac{L_A}{L_B} = \frac{4\pi R_A^2 \sigma T_A^4}{4\pi R_B^2 \sigma T_B^4}$$

$$\frac{L_A}{L_B} = \frac{R_A^2 T_A^4}{R_B^2 T_B^4}$$

$$= \frac{(10m)^2 \times (100k)^4}{(5m)^2 \times (200k)^4}$$

$$= \frac{100m^2 \times 100000000K^4}{25m^2 \times 1600000000K^4}$$

$$= \frac{100 \times 1 \times 10^8}{25 \times 16 \times 10^8}$$

$$\frac{L_A}{L_B} = \frac{1 \times 10^6}{4 \times 10^6}$$

(Section C)

Q. No. 6 (Page 2)

So relation = $\frac{L_A}{L_B} = \frac{1}{4}$

luminosity

Also. $L_A = \frac{L_B}{4}$

$4 L_A = L_B.$

(Section C)

Q. No. 6 (Page 3)