CBSE

Model Answer Sheet 2014

केन्द्रीय माध्यमिक शिक्षा बोर्ड, दिल्ली
सीनियर स्कूल सर्टिफिकेट परीक्षा (कक्षा बारहवीं)
परीक्षार्थी प्रवेश–पत्र के अनुसार भरे

विषय Subject : Physics (042)

परीक्षा का दिन एवं तिथि
Day & Date of the Examination : Wednesday 05/03/2014

उत्तर देने का माध्यम
Medium of answering the paper : English

प्रश्न पत्र के ऊपर लिखे कोड को दर्शाए
Write Code No. as written on the top of the Question paper : 55/2

अतिरिक्त उत्तर–पुस्तिका (ओं) की संख्या
No. of supplementary answer-book(s) used : 1

किसी शारीरिक अक्षमता से प्रभावित हो तो संबंधित वर्ग में ✓ का निशान लगाएँ।
If physically challenged, tick the category

B	D	H	S	C

B = दृष्टिहीन, D = मूक एवं बधिर, H = शारीरिक रूप से विकलांग, S = स्पास्टिक, C = डिस्लेक्सिक
B= Blind, D=Deaf & Dumb, H=Physically Handicapped, S=Spastic, C=Dyslexic

क्या लेखन – लिपिक उपलब्ध करवाया गया : हां / नहीं
Whether writer provided : Yes / No — No

*एक खाने में एक अक्षर लिखें। नाम के प्रत्येक भाग के बीच एक खाना रिक्त छोड़ दें। यदि परीक्षार्थी का नाम 24 अक्षरों से अधिक है, तो केवल नाम के प्रथम 24 अक्षर ही लिखें।
Each letter be written in one box and one box be left blank between each part of the name. In case Candidate's Name exceeds 24 letters, write first 24 letters.

कार्यालय उपयोग के लिए
Space for office use

सीनियर स्कूल सर्टिफिकेट परीक्षा (कक्षा बारहवीं)
SENIOR SCHOOL CERTIFICATE EXAMINATION (CLASS XII)

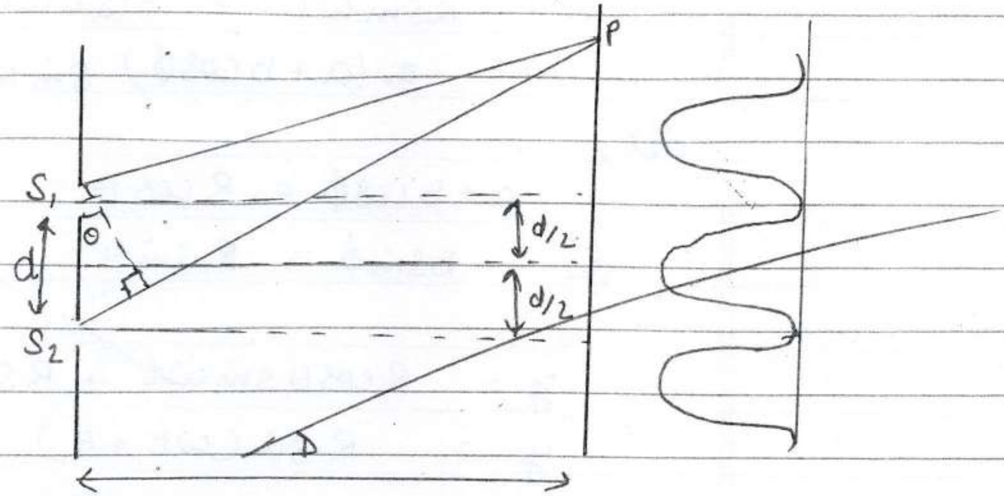
केन्द्रीय माध्यमिक शिक्षा बोर्ड, दिल्ली
CENTRAL BOARD OF SECONDARY EDUCATION, DELHI

प्रमाणित किया जाता है कि मैंने / हमने इस उत्तर–पुस्तिका का मूल्यांकन प्रश्न पत्र के समुचित सेट के अनुसार और पूर्ण रूप से मूल्यांकन पद्धति के अनुसार किया है।

Certified that I/we have evaluated this answer book according to the correct set of questio paper and strictly as per the marking scheme.

	संख्या	

30.



Consider a Young's double slit experiment with slits at a distance 'd' and separation between slits and screen 'D'.
Let light waves from coherant source meet with phase difference ϕ at P.
Let the waves be

$$y_1 = a \sin \omega t$$

and, $$y_2 = b \sin(\omega t + \phi)$$

Resultant displacement,

$$y = y_1 + y_2$$
$$= a \sin \omega t + b \sin(\omega t + \phi)$$

$$= a\sin\omega t + b(\sin\omega t\cos\phi + \cos\omega t\sin\phi)$$

$$= (a + b\cos\phi)\sin\omega t + b\sin\phi\cos\omega t$$

Let,

$$a + b\cos\phi = R\cos\theta \quad \text{--- (1)}$$

& $$b\sin\phi = R\sin\theta \quad \text{--- (2)}$$

$\therefore$ $$y = R\cos\theta\sin\omega t + R\sin\theta\cos\omega t$$

$$y = R\sin(\omega t + \theta)$$

Thus resultant wave will also be of same type with amplitude R.

Squaring and adding (1) & (2)

$$R^2 = (a + b\cos\phi)^2 + (b\sin\phi)^2$$

$$R = \sqrt{a^2 + b^2 + 2ab\cos\phi}$$

For R to be maximum,

$$\cos\phi = 1$$

$$\phi = 0, 2\pi, 4\pi, \ldots$$

$$\phi = 2n\pi$$

$\Rightarrow$ Phase difference, $\Delta x = n\lambda$

For minima,

$$\cos\phi = -1$$

$$\phi = \pi, 3\pi, \ldots$$

$$\phi = (2n-1)\pi, \text{ where } n = 1, 2, 3, \ldots$$

$\Rightarrow$ Phase difference, $\Delta x = \frac{(2n-1)\lambda}{2}$

~~Fringe width is the dist~~

For bright fringe, the two waves should meet with zero phase difference and for dark fringe waves should meet in opposite phase.

~~Phase~~ Path difference $= S_2P - S_1P$

$$(S_1P)^2 = D^2 + \left(y - \frac{d}{2}\right)^2$$

$$S_1P = D\left[1 + \frac{\left(y-\frac{d}{2}\right)^2}{D^2}\right]^{1/2} = D + \frac{\left(y - \frac{d}{2}\right)}{2D}$$

Similarly, $S_2P = D + \frac{(y+\frac{d}{2})^2}{2D}$

~~Phase~~ Path difference $= S_2P - S_1P$

$$= \frac{(y+\frac{d}{2})^2 - (y-\frac{d}{2})^2}{2D}$$

$$\Delta p = \frac{yd}{D}$$

$\sin\theta = \frac{\Delta p}{d}$ $\quad \therefore \quad y = \frac{\lambda D}{d}$

$\theta = \frac{\Delta p}{d} = \frac{y}{D}$

Fringe width is the separation between two consecutive crests or two consecutive troughs.

$$B = y_{n+1} - y_n$$

$$= (n+1)\frac{\lambda D}{d} - \frac{n\lambda D}{d} = \frac{\lambda D}{d}$$

$\therefore$ Fringe width, $\boxed{\beta = \frac{\lambda D}{d}}$

b) Given:

$$\frac{I_{max}}{I_{min}} = \frac{25}{9}$$

$\therefore$

$$\left(\frac{\sqrt{I_1} + \sqrt{I_2}}{\sqrt{I_1} - \sqrt{I_2}}\right)^2 = \frac{25}{9}$$

$$\frac{\sqrt{\frac{I_1}{I_2}} + 1}{\sqrt{\frac{I_1}{I_2}} - 1} = \frac{5}{3}$$

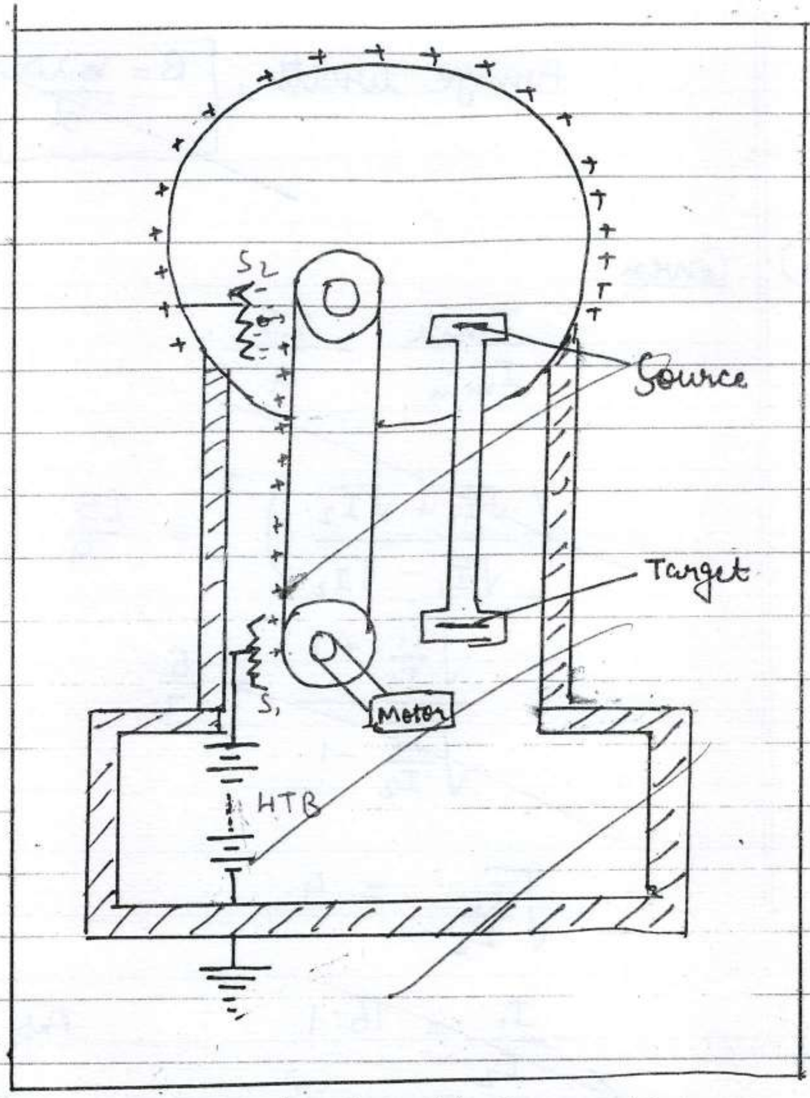
$$\sqrt{\frac{I_1}{I_2}} = 4$$

$$\frac{I_1}{I_2} = 16:1$$

As $\frac{I_1}{I_2} = \frac{W_1}{W_2}$

As $\Rightarrow$ $\boxed{\frac{W_1}{W_2} = 16:1}$

29.



Principle

Van de Graaff generator

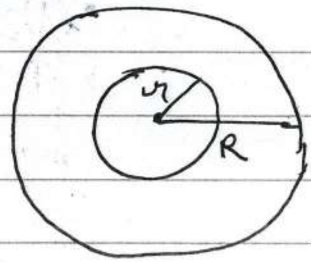
Working

There are two combs S_1 and S_2. When S_1 is connected to a high tension battery then due to its pointed ends, it will induce the air in the neighbourhood of it. Thus, positive charge is sprinkled on the belt which moves up and reaches near comb S_2. ~~Positive~~ Negative charge will be induced on one side of S_2 and on other side positive charge which will appear on the outer shell. The pointed ends of S_2 will ionise the air and neutralise the belt. The process is repeated and hence the outer sphere can ~~acq~~ acquire a lot of charge without its potential being raised so much.

The ion source present inside the shell get accelerated and hit the target.

Consider two spheres ~~S₁ and~~ with radii R and r such that $R > r$ and they are connected to each other.

Let charge on smaller sphere be q and on larger sphere be Q.



$$V_R = \frac{q}{4\pi\epsilon_0 R} + \frac{Q}{4\pi\epsilon_0 R} \quad \text{--- (1)}$$

& $$V_r = \frac{q}{4\pi\epsilon_0 r} + \frac{Q}{4\pi\epsilon_0 R} \quad \text{--- (2)}$$

From (1) & (2)

$$V_r - V_R = \frac{q}{4\pi\epsilon_0}\left[\frac{1}{r} - \frac{1}{R}\right]$$

$$V_r - V_R > 0$$

$$\therefore V_r > V_R$$

Hence, inner sphere will always be in higher potential ~~a~~ irrespective of the charge on the outer sphere.

Thus, charge will always ~~move~~ move from inner to outer sphere. This phenomenon is used in Van de Graaff generator.

- Uses

* It is used to study crystal structure of the target molecule.

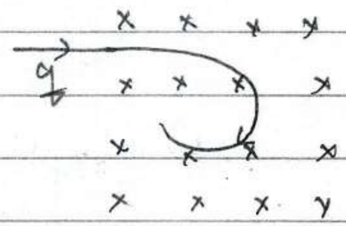
- Limitations

1. The outer shell cannot be charged to ~~a~~ high value because it will ionise the ~~g~~ air near it.

2. It cannot accelerate neutral particles like neutrons.

---

28. a) Consider a charged particle with charge q moving with a speed v in a uniform magnetic field B ~~at~~ perpendicular to the direction of magnetic field. Let its mass be m.



When the charge is in circular motion,

Centripetal force = Force on the particle

$$\frac{mv^2}{r} = qvB \sin 90$$

$$r = \frac{mv}{qB} \qquad v = \frac{qBr}{m}$$

Time period, $T = \frac{2\pi r}{v}$

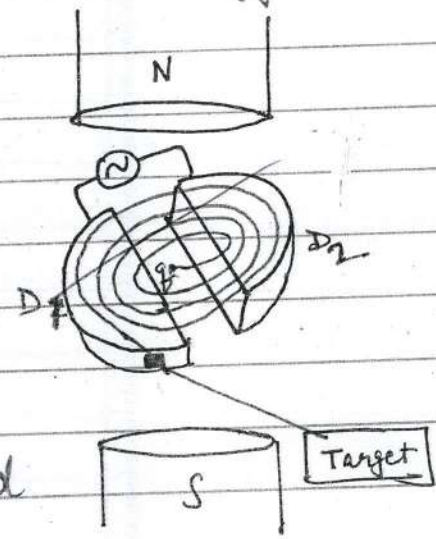
$= \frac{2\pi r\, m}{qBr}$

$T = \frac{2\pi m}{qB}$

$\therefore$ Frequency, $\boxed{f_c = \frac{qB}{2\pi m}}$

As the expression for f_c doesn't contains v and E
$\therefore$ frequency is independent of velocity and energy

b) <u>Construction of Cyclotron</u>
It consists of two dee shaped hollow conductors D_1 and D_2. A high oscillating electric field is applied across the dees and magnetic field with the help of strong bar magnet is applied. Through deflecting window the accelerated charged



particle comes out and hits the target. There is charge source between the dees.

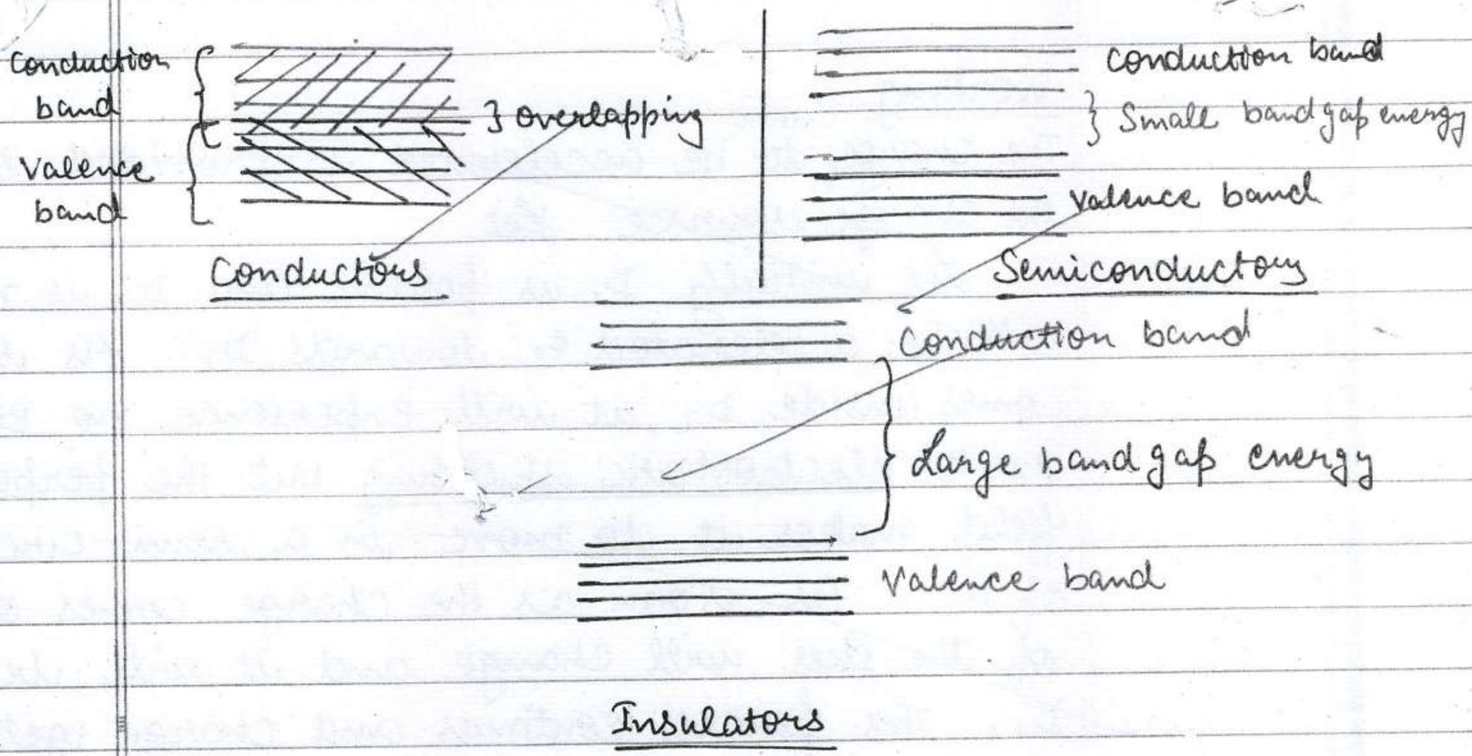
<u>Working</u>

The charge (proton) to be accelerated is provided between the dees by the charge source. ~~Let~~

Let initially D_1 is positive and D_2 is negative. So, charge will be accelerated ~~to~~ towards D_2. As soon as, the charge comes inside D_2, it will experience no electrostatic force due to <u>electrostatic shielding</u> but the perpendicular magnetic field makes it to move in a semi-circle and move out of D_2. As soon as the charge comes out, the polarities of the dees will change and it will be accelerated towards D_1. This process continues and charge gets accelerated between the dees. This time matching between charge moving in semi-circle and change of polarities is called ~~cy~~ ~~resonancy~~ ~~resonancy~~ <u>cyclotron's resonance condition</u>.

Thus, the highly accelerated charge ~~patt~~ particle moves out of deflecting window and hits the target.

27.



i) As shown above, in conductors the valence band and conduction band are overlapping. In semi-conductors, the band gap energy is small and in insulators band gap energy is large.

ii) There are no free electrons in insulators. In semi-conductors some charge carriers at temperature greater than 0 K and in conductors there are large number of charge carriers.

26. Given :- $V = 5 \times 10^4\ V$

de-Broglie wavelength, $\lambda = \frac{h}{p}$

$$\lambda = \frac{h}{\sqrt{2mE}} = \frac{h}{\sqrt{2meV}}$$

$$= \frac{12.27}{\sqrt{V}}\ \mathring{A}$$

$$= \frac{12.27}{\sqrt{5 \times 10^4}}\ \mathring{A}$$

$$= \frac{12.27}{2.17 \times 10^2}\ \mathring{A}$$

$$= 5.6 \times 10^{-12}\ m$$

R.P. of a

For a microscope,

$$R.P. = \frac{2\mu \sin\theta}{\lambda}$$

As Numerical Aperature i.e. $\mu \sin\theta$ is same

$$\therefore \quad R.P. \propto \frac{1}{\lambda}$$

$$\frac{(R.P)_e}{(R.P.)_{yel}} = \frac{\lambda_{yel}}{\lambda_{e}}$$

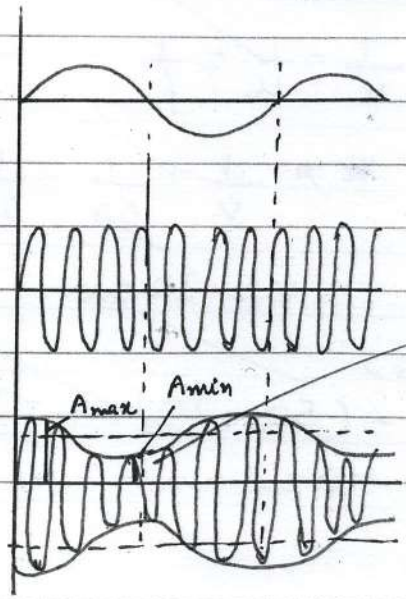
As $\lambda_{yell} > \lambda_e$

$\therefore (R.P.)_e > (R.P)_{yel}$

Hence, resolving power of electron microscope is more.

25. The two basic modes of communication are
i) Ground communication
ii) Space communication

The process in which amplitude of high frequency carrier wave is varied in accordance with low frequency baseband signal is called amplitude modulation.
It is done for the following purposes:-
i) to decrease the length of antenna
ii) to increase power gain
iii) to avoid confusion due to reception of more than one signal

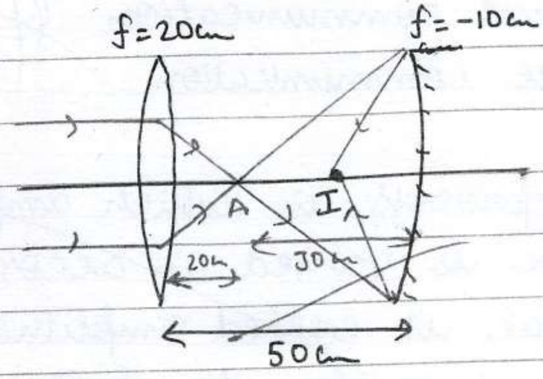


Low frequency baseband signal

High frequency carrier wave

Amplitude modulated wave

24.



<u>For convex lens</u>,

$u = -\infty \qquad f = +20\text{ cm}$

Applying lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} + \frac{1}{\infty} = \frac{1}{20}$$

$$v = 20\text{ cm}$$

<u>For concave lens</u>,

$$u = -(50-20) = -30\text{ cm}$$

$$f = -10\text{ cm}$$

Applying mirror formula,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$v = \frac{uf}{u-f} = \frac{30 \times 10}{-20}$$

$$= -15 \text{ cm}$$

Therefore, final image will be formed at a distance 15 cm in front of the concave mirror.

23\.

The qualities in Aarti are:-

i) Concern for her sister
ii) Day to day use of her knowledge
iii) Presence of mind

b) Radioisotopes when used to diagonose the brain, they emit different kinds of radioactive waves which are also called

Becqurel rays and they work on the defected part of the brain.

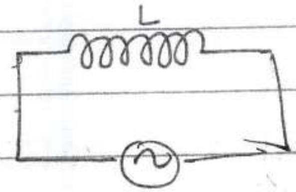
---

22. Self-inductance of a solenoid is defined as the ~~mag~~ flux associated with the solenoid when unit amount of ~~a~~ current passes through it.

Consider a solenoid of self inductance L, length l, area of cross section A. Let alternating voltage ~~E~~

$$\mathcal{E} = \mathcal{E}_0 \sin \omega t$$

is applied accross it.



Back EMF induced

$$e\ ~~\mathcal{E}~~ = -L\frac{dI}{dt}$$

$$dI = \frac{e\,dt}{L}$$

~~Flux~~ Small amount of ~~flux~~ work done,

$$dW = e\,I\ ~~dt~~\ dt$$

Total work done,

$$W = \int e I \, dt$$

$$= \int_0^I L I \, dI$$

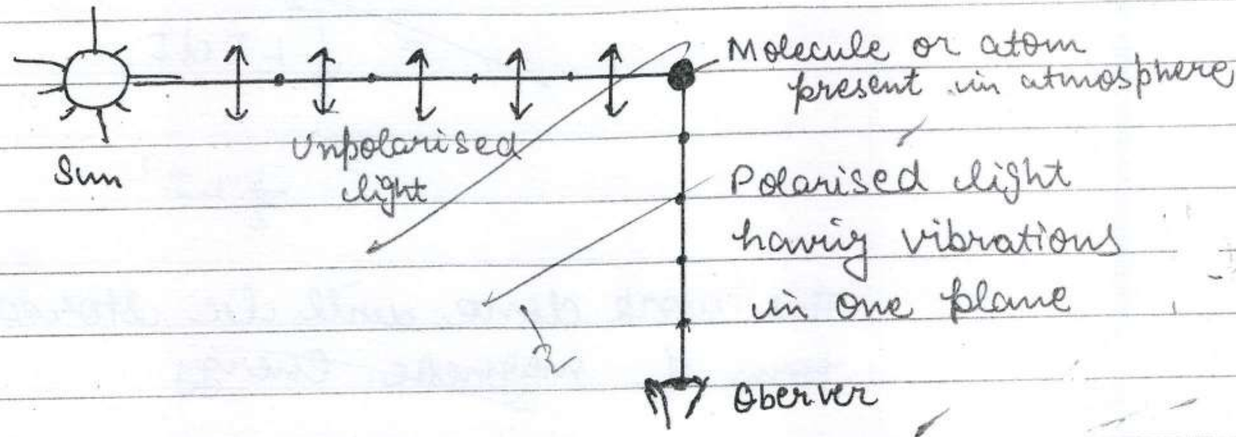
$$= \frac{1}{2} L I^2$$

This work done will be stored in the inductor in the form of magnetic energy.

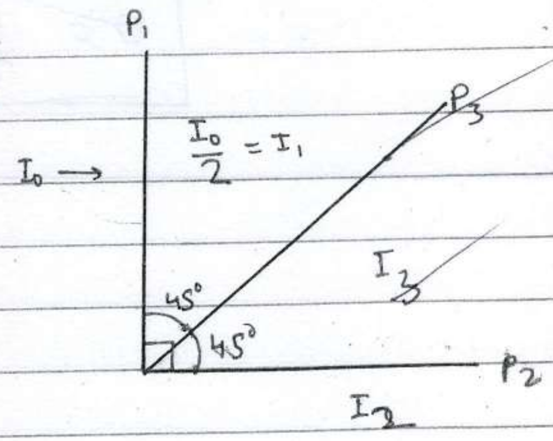
$$\therefore \boxed{U = \frac{1}{2} L I^2}$$

21.

a) Consider unpolarised light coming from Sun.



b)



When unpolarised light with intensity I_0 falls on P_1, then it gets polarised, so

$$I_1 = \frac{I_0}{2}$$

This light will be incident on P_3.
Applying Malus law,

$$I_3 = I_1 \cos^2 45$$
$$= \frac{I_0}{2} \times \frac{1}{2}$$

$$I_3 = \frac{I_0}{4}$$

This light will be incident on P_2,

$$\therefore \quad I_2 = I_3 \cos^2 45$$
$$= \frac{I_0}{4} \times \frac{1}{2}$$

$$I_2 = \frac{I_0}{8}$$

$\therefore$ intensity through P_1, P_2 and P_3 are $\frac{I_0}{2}$, $\frac{I_0}{8}$ and $\frac{I_0}{4}$.

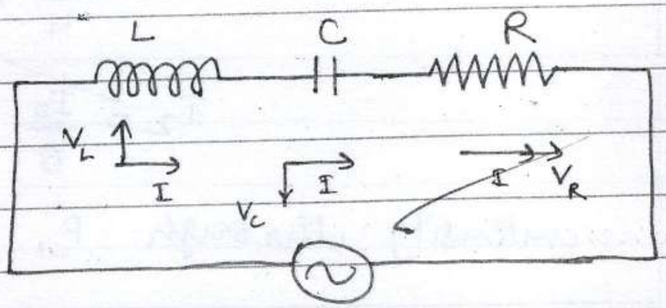
20.

a) The connections between the resistors are made of thick copper strips so that they may have negligible resistance which will not affect the ~~ito~~ true reading.

b) It is preferred to obtain balance point in the middle of the meter bridge wire ~~so~~ because meter bridge is most sensitive in this condition.

c) For metre bridge wire ~~na~~ Constantan or maganin wires are used as they have high resistivity and low value of temperature coefficient of resistance.

19.



Applied voltage is

$$V = V_0 \sin \omega t$$

Let the ~~sin alternating~~ instantaneous value of current flowing be

$$I = I_0 \sin(\omega t \pm \phi)$$

Instantaneous power ~~loss~~,

$$P = VI$$

$$= V_0 I_0 \sin\omega t \sin(\omega t \pm \phi)$$

$$= V_0 I_0 \sin\omega t (\sin\omega t \cos\phi \pm \cos\omega t \sin\phi)$$

$$= V_0 I_0 (\sin^2\omega t \cos\phi \pm \frac{1}{2} \sin 2\omega t \sin\phi)$$

Average power dissipated, $P_{av} = \frac{\int_0^T P\,dt}{T}$

$$= \frac{1}{T}\int_0^T \{ V_0 I_0 (\sin^2\omega t \cos\phi \pm \frac{1}{2} \sin 2\omega t \sin\phi) \} dt$$

$$= \frac{V_0 I_0}{T} \left\{ \int_0^T \cos\phi \frac{(1-\cos 2\omega t)}{2} dt \pm \frac{1}{2} \int_0^T \sin\phi \sin 2\omega t \, dt \right\}$$

$$= \frac{V_0 I_0}{2T} \left\{ \cos\phi [t - 0]_0^T \pm \frac{1}{2} \sin\phi [0]_0^T \right\}$$

$$P_{av} = \frac{V_0 I_0}{2T} \times T\cos\phi$$

$$= \frac{V_0 I_0}{2}\cos\phi$$

$$\boxed{P_{av} = V_{rms} I_{rms} \cos\phi}$$

i) If no power is dissipated,

$$P_{av} = 0$$

$$\therefore \cos\phi = 0$$

$$\phi = 90^\circ$$

⇒ Circuit is pure inductive or pure capacitive.

ii) Maximum power is dissipated when

$$\cos\phi = 1$$

$$\phi = 0^\circ$$

⇒ Circuit is pure resistive.

18. Consider a capacitor of capacitance C and it is charged to a potential V.

$\therefore$ Energy of capacitor, $U_i = \frac{1}{2}CV^2$

Now another capacitor is connected with it. Let the common potential be V'.

As net charge remains constant,

$$CV = CV' + CV'$$

$$V' = \frac{CV}{2C} = \frac{V}{2}$$

Final energy,

$$U_f = \frac{1}{2}C\left(\frac{V}{2}\right)^2 + \frac{1}{2}C\left(\frac{V}{2}\right)^2$$

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

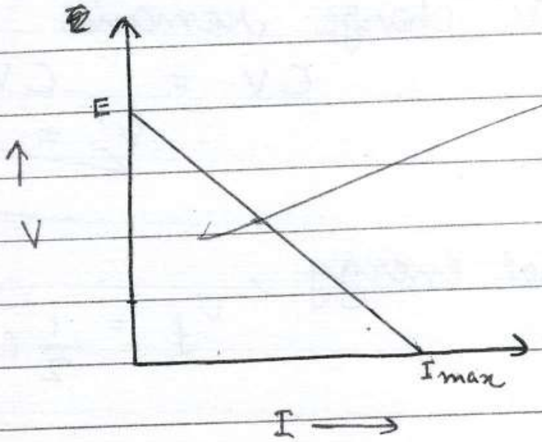
$\therefore$ Ratio of final energy and initial energy $= \frac{U_f}{U_i} = \frac{1}{2} = \underline{\underline{1:2}}$

17. If current I is flowing then,

$$V = E - Ir$$

With increase in current V reduces.

When $I \to 0$, $V \to E$



According to the eq^n $V = E - Ir$

when $I = 0$, then $V = E$

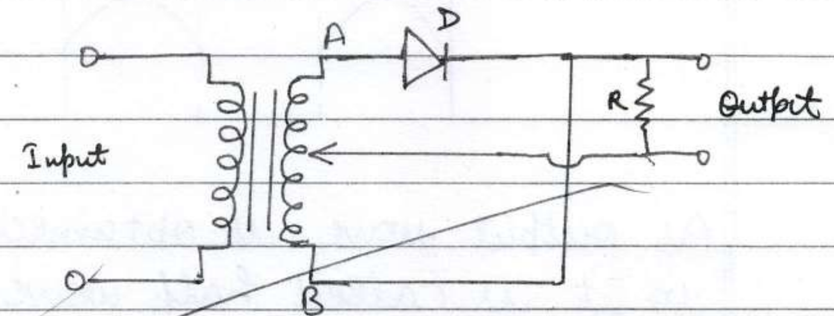
$\therefore$ y-intercept will depict the EMF of the cell.

Also, $I_{max} = \frac{E}{r}$

$\therefore$ Internal resistance, $r = \frac{E}{I_{max}}$

Knowing E (y-intercept) and I_{max} (x-intercept), internal resistance can be calculated.

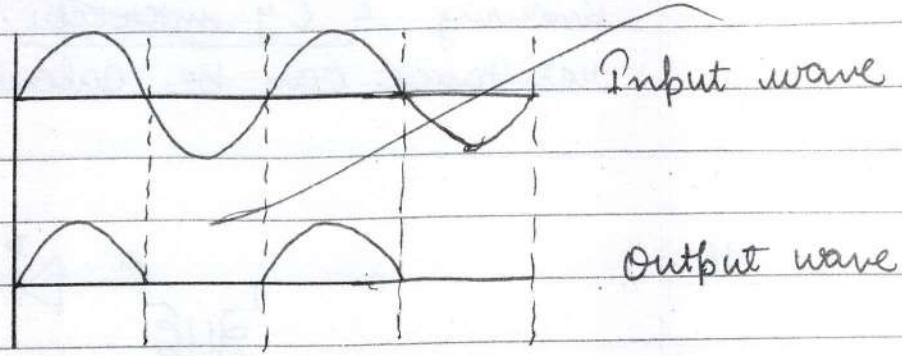
16.



The alternating signal is passed through p-n junction diode as shown above.

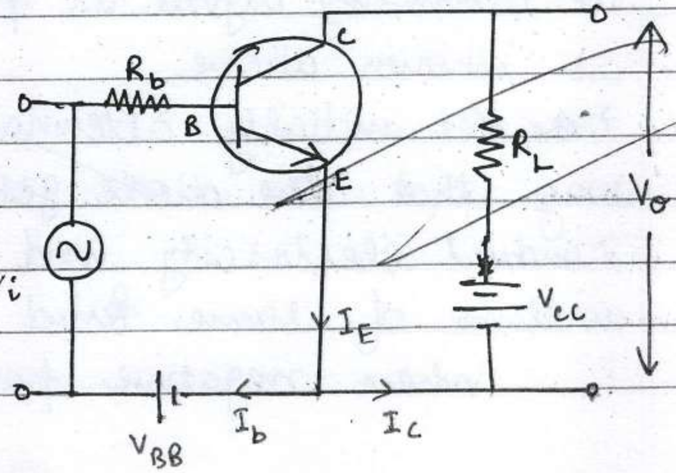
~~The~~ Let initially alternating signal be passed ~~in~~ such a way that the diode gets forward biased. So, it will conduct electricity and the output ~~wavefo~~ waveform will be of same kind.

When negative portion of wave passes through diode, then it will get reverse biased and will not conduct. So, no output waveform is obtained.



As output wave is obtained during half of the time, so it is called half wave rectification.

15.



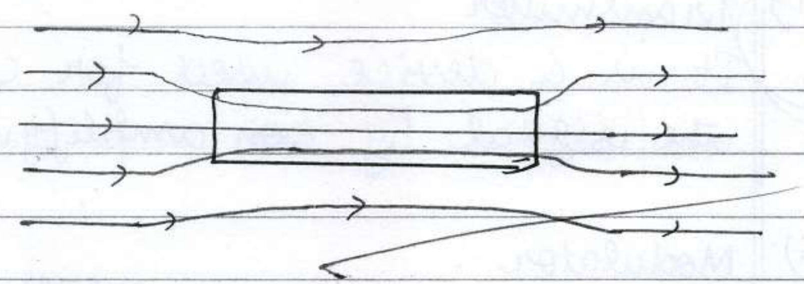
The transistor will work as an amplifier when

$$V_o > V_i$$

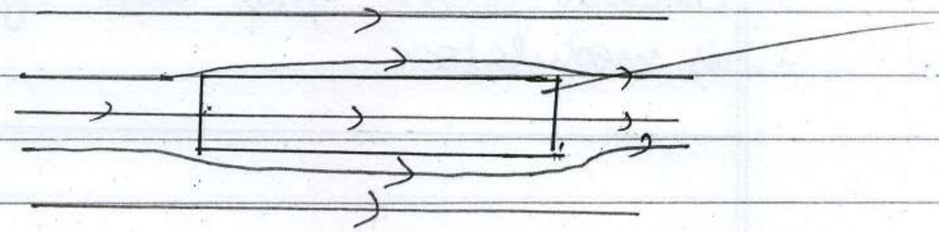
i.e. in active region when emitter-base junction is forward biased and ~~collector~~ output is reverse biased.

14.

i) Paramagnetic Substance



ii) Diamagnetic Substance



As the value of susceptibility χ_m for paramagnetic substance is positive, so ~~electric~~ field lines prefer to pass through it but χ_m for diamagnetic is negative so field lines prefer to pass through the surrounding medium.

13.

i) Transmitter

It is a device used for communication which transmits the signal by ~~con~~ amplifying it.

ii) Modulator

It is a device which merges the ~~carr~~ high frequency carrier wave and low frequency baseband signal is modulator.

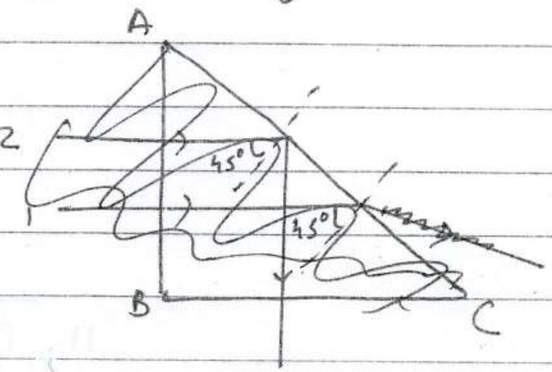
0903

Fictitious Roll No.
(To be entered by Board)

अपना अनुक्रमाँक इस उत्तर–पुस्तिका पर न लिखें
Please do not write your Roll Number on this Answer-Book

अतिरिक्त उत्तर–पुस्तिका (ओं) की संख्या
Supplementary Answer-Book(s) No.........

12. That light ray will not pass through AC for which



$i > i_c$

$\sin i > \sin i_c$

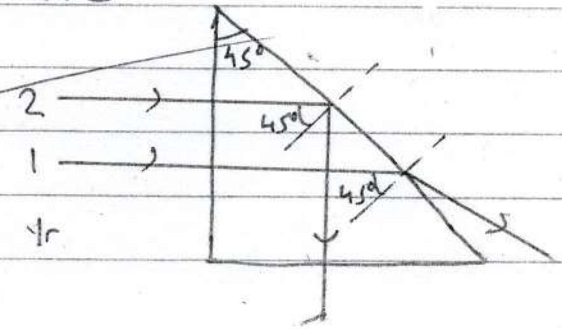
$\sin 45 > \frac{1}{\mu}$

$\frac{1}{\sqrt{2}} > \frac{1}{\mu}$

$\mu > \sqrt{2}$

$\mu > 1.41$

Hence, ray '2' will suffer total internal reflection and ray '1' will pass through face AC



For ray '1', $\frac{\sin 45}{\sin r} = \frac{1}{\mu}$

$\sin r = \sqrt{2} \sin 45 = 1$

$\Rightarrow r = 90°$

10.

~~Consider an e^- moving with radius r and speed v.~~

~~Centripetal force = Force of attraction~~

$$\frac{mv^2}{r} = \frac{k\,e\,e}{r^2} = \frac{e^2}{4\pi\epsilon_0 r^2}$$

~~$v =$~~

$v =$

11. Consider an atom with ~~total number of proton~~ atomic number Z. Let an e^- be revolving around it with speed v and radius r.

$\therefore$ Centripetal force = Force of attraction

$$\frac{mv^2}{r} = \frac{Ze \times e}{4\pi\epsilon_0 r^2} = \frac{mv^2}{r}$$

$$v = \frac{2\pi k Z e^2}{nh}$$

$$r = \frac{Ze^2}{4\pi\epsilon_0 m v^2}$$

But $$v = \frac{2\pi k Ze^2}{nh}$$

$\therefore$ radius, $$r = \frac{kZe^2}{4\pi\epsilon_0 m} \cdot \frac{n^2h^2}{4\pi^2 k^2 Z^2 e^4}$$

Radius of nth orbit, $$r_n = \frac{n^2h^2}{16\pi^3\epsilon_0} = \frac{n^2h^2}{4Ze^2\pi^2 k m}$$

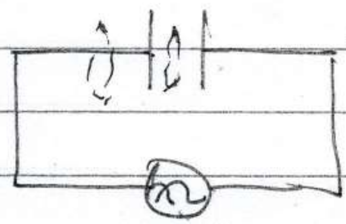
10. Original parallel Ampere Circuital law,

$$\oint \vec{B}\cdot d\vec{l} = \mu_0 I$$

For b/w the plates of capacitor,

$I = 0$

$$\therefore \oint \vec{B}\cdot d\vec{l} = 0$$



which is not possible.

∴ Modified ampere circuital law is

$$\oint \vec{B} \cdot \vec{dl} = \mu_0 (I + I_D)$$

where, I_D = Displacement Current $= \epsilon_0 \frac{d\phi_E}{dt}$

9. Given

$A = 2.5 \times 10^{-7} \ m^2$

$I = 1.8 \ A$

$n = 9 \times 10^{28} \ m^{-3}$

$I = nAev_d$

$$v_d = \frac{I}{nAe} = \frac{1.8}{9 \times 10^{28} \times 2.5 \times 10^{-7} \times 1.6 \times 10^{-19}}$$

$= \boxed{0.5 \ mA}$

8. It is experimentally difficult to detect nutrinos because these are massless and chargeless.

7. This belongs to a wave in infrared region

6. work function, $W = h\nu_0$

$W \propto \nu_0$

$\therefore$ Metal A has higher work function because $\nu_0' > \nu_0$.

5. $\frac{1}{f} = (1.5 - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

when immersed in water

$\frac{1}{f_w} = \left(\frac{1.5}{1.33} - 1\right)\left[\frac{1}{R_1} - \frac{1}{R_2}\right] > 0$

$f_w > 0$

$\therefore$ lens will behave as converging.

4. Electric field lines move from positive charge to negative charge that is why they do not form closed loops.

3. AC is preffered over DC because
i) there is less power loss in transmission of AC.
ii) AC can be stepped up or down but not DC.

2. $F = \frac{\mu_0}{4\pi} \frac{I_1 I_2}{r^2} l$

$r = l = 1\,m$

When $I_1 = I_2 = 1A$ & ~~r & l amount~~

then, $F = 10^{-7} N$

∴ ~~1A~~ One ampere is that amount of current which when through a 1 m ~~long~~ conductor placed at a distance of 1 m from a conductor ~~carrying~~ carrying the same amount of current in same direction

~~repels~~ ~~at~~ attracts it with a force equal to 10^{-7} N.

1. When current increases, flux in upward direction increases so by Lenz law, current in circular coil should be <u>clockwise</u>.