विषय: Subject: PHYSICS
विषय कोड: Subject Code: 04
परीक्षा का दिन: Day & Date of the Examination: MONDAY, 09-03-2015
उसर देने का माध्यम: Medium of answering the paper: ENGLISH
प्रश्न पत्र के अंक के संबंध में कोड का निर्देश: Write code No. as written on the top of the question paper.
अतिरिक्त उत्तर-प्रश्न पत्र (अ) की संख्या: No. of supplementary answer-book(s) used
विकल्प स्थापित: है / नहीं Person with Disabilities: Yes / No
विषयी शारीरिक अनुभव ने प्रभावित हो गया संबंधित स्थिति में स्वास्थ्य लागती है। If physically challenged, tick the category
B = बिंदुतात्मक, D = शून्य क बिंदु, H = शारीरिक राह लागू विकल्प, S = शारीरिक
C = एचलेब्रेकेशन, A = एचलेब्रेकेशन
B = विद्युत व्यक्ति, D = शून्य क बिंदु, H = शारीरिक राह लागू विकल्प, S = शारीरिक
C = अटिट्युडिल, A = अटिट्युडिल
का लेखन - विद्युत व्यक्ति कराया गया: है / नहीं Whether writer provided: Yes / No
विद्युत व्यक्ति है तो उपयोग में उनके नाम लिखें 
If Visualy impaired, name of software used:
*एक नाम में से एक नाम लिखें। तीन और अन्य नाम के बाद एक नाम दें।
कोटि विद्युत्विद्वारा नाम 24 अक्षरों से अधिक है, तो स्थान के प्राप्त 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.

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Amperé's circuit law states that the closed-loop integral of the magnetic field along an Amperian loop equals the product of μ₀ and the current passing through the loop.

Mathematically, \[ \int \mathbf{B} \cdot d\mathbf{l} = \mu_0 I \]

The toroid is as shown.
Consider 3 Amperian loops as shown.

For loop I,

Current through loop = 0

\[ B_r = 0 \]

Similarly for loop III,

Total incoming current = Total outgoing current

\[ \text{In} = 0 \]
For loop II,

Applying Ampere's circuital law,

\[ \oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I \]

\[ B \times 2\pi r = \mu_0 \times 2\pi r \times n \times I \]

\[ \therefore B = \mu_0 n I \]

\[ n \to \text{no. of turns per unit length} \]
\[ 2\pi r \to \text{length of loop} \]
\[ I \to \text{current} \]

If direction of current is as shown, then \( \mathbf{B} \) is clockwise.
b) The magnetic field lines will be as shown.

Field lines originate from North.

hence end B is North.
end A is South.

Consider a solenoid as shown.
Now take an elementary loop of width dx.

For this loop, yield at P,

\[ dB = \mu_0 dI \frac{a^2}{2 \left( \alpha^2 + (r-x)^2 \right)^{3/2}} \]
\[ \text{no. of turns per unit length} = n \]
\[ \text{current in each turn} = I. \]

Then

\[ dB = \frac{\mu_0 n I dx \ a^2}{2 \ (a^2 + (x - y)^2)^{3/2}} \]

\[ \Rightarrow y \gg x, a \]
\[ (a^2 + (y - x)^2)^{3/2} \approx y^3 \]

\[ \int dB = \int \frac{\mu_0 n I \ dx \ a^2}{2 \ y^3} \]
\[ B = \frac{\mu_0 n I a^2 \ l}{2 \ y^3} \]
\[ = \frac{\mu_0 \times 2 n I l \ \pi a^2}{4 \ \pi} \]
\[ \text{or} \]
\[ = \frac{\mu_0}{4 \ \pi} \frac{2 \times N A I}{\gamma^3} \]
\[ \text{[\because \ n \times l = N} \]
\[ \frac{\pi a^2 = A} \]
If we consider
for a bar magnet,

\[ B = \frac{\mu_0}{4\pi} \frac{2m}{y^3} \] (on axis)

If we consider
\[ NAI \propto m \]

Then in solenoid,

\[ B = \frac{\mu_0}{4\pi} \frac{2m}{y^3} \]

Which is same as bar magnet.

Hence a solenoid acts as a bar magnet of magnetic moment \[ NAI \]
At point P, on the axis,

\[ E_1 \text{ (due to +ve charge)} = \frac{kq_2}{(x+a)^2} \]

\[ E_2 \text{ (due to -ve charge)} = \frac{kq}{(x-a)^2} \]

\[ \text{Net (towards right)} = E_2 - E_1 \]

\[ = \frac{kq}{(x-a)^2} - \frac{kq}{2a+x} \]

\[ = \frac{kq}{x^2} \left( \frac{1}{1-a^2} - \frac{1}{1+a^2} \right) \]
\[
\vec{E}_{\text{nut (towards left)}} = \frac{kq}{x^2} \left( \left(1 - \frac{a}{x}\right)^{-2} - \left(1 + \frac{a}{x}\right)^{-2} \right)
\]

\[\text{if } x \gg a,\]

\[\text{then using binomial expansion}\]

\[
\vec{E}_{\text{nut}} = \frac{kq}{n^2} \left( 1 + \frac{2a}{n} - 1 + \frac{2a}{n} \right)
\]

\[
= \frac{kq \times 4a}{n^2}
\]

\[
\vec{E}_{\text{nut}} = \frac{kq \times 2a \times 2}{n^3}
\]

\[\text{also } \vec{E}_{\text{nut}} \text{ is in the direction of } \vec{p}.\]

\[\implies 2\vec{a} \vec{q} = \vec{p}\]

\[\therefore \quad \vec{E}_{\text{nut}} = \frac{2k\vec{p}}{n^3}\]

\[
\vec{E}_{\text{nut}} = \frac{2\vec{p}}{4\pi \varepsilon_0 n^3}
\]

\[\text{ANS} \]
\[ \overrightarrow{E} = 2 \mathbf{a} \hat{\mathbf{c}} \]

For the faces AEFB, AEHD, DHGC, and BFHC, \( \mathbf{d} \mathbf{s} \) \& \( \mathbf{E} \) are \( \perp \).

\[ \int \mathbf{E} \cdot \mathbf{d} \mathbf{s} = 0 \]

Since flux through these faces is zero.

For face ABCD,

\[ \mathbf{E} = 0 \]

... flux is zero.

Now, through face EFGH,

\[ \overrightarrow{E} = 2a \hat{\mathbf{c}} \]

\[ \overrightarrow{s} \mathbf{B} = a^2 \hat{\mathbf{c}} \]

\[ \int \mathbf{E} \cdot \mathbf{d} \mathbf{s} = 2a \times a^2 = \frac{1}{2} a^3 \]
Now by Gauss’s law,

\[ \oint \mathbf{E} \cdot d\mathbf{a} = \frac{Q_{in}}{\epsilon_0} \]

\[ \therefore 2a^3 = \frac{Q_{in}}{\epsilon_0} \]

\[ Q_{in} = 2a^3 \epsilon_0 \]
Considering $n_2 > n_1$,

Image formed is as shown.

Now by exterior angle property of $\Delta $,

\[ i = \alpha + \beta \quad (1) \]

and,

\[ \beta = \gamma + \delta \]

\[ \Rightarrow \gamma = \beta - \delta \quad (2) \]

Applying Snell's law at $\alpha$, 

\[ n_1 \sin i = n_2 \sin r \]

Due to small aperture, we can assume \( \sin i = r \) is true.

This assumption is true for all angles \( \alpha, \beta, \delta, i, r \).

\[ : n_1, i = n_2, r \]

\[ n_1 (\alpha + \beta) = n_2 (\beta - \delta) \]

\[ \Rightarrow n_1 (\tan \alpha + \tan \beta) = n_2 (\tan \beta - \tan \delta) \]

\[ n_1 \left( \frac{h}{oo'} + \frac{h}{oo'} \right) = n_2 \left( \frac{h}{0'c} - \frac{h}{0'I} \right) \]

\[ n_1 \left( \frac{1}{p_0} + \frac{1}{p_c} \right) = n_2 \left( \frac{1}{p_c} - \frac{1}{P'I} \right) \]

\[ \left[ \text{due to small aperture,} \right. \]

\[ oo' = p_0, \quad oo' = 0'c = p_c \]

\[ 0'I = r'I \]

\[ n_1 \left( \frac{-1}{u} + \frac{1}{R} \right) = n_2 \left( \frac{1}{R} - \frac{1}{v} \right) \]
After refraction from convex surface, an image is formed at \( I \), which acts as a virtual object for the concave surface.

Using the above relation at convex surface

\[
\frac{n_2 - n_1}{u_1} = \frac{n_2 - n_1}{R_1}
\]
new for concave surface,

\[ \frac{n_1 - n_2}{\frac{1}{n_1}} \cdot \frac{1}{R_2} = \frac{n_1 - n_2}{R_2} \]

\[ R_2 \rightarrow \text{Radius of Concave Surface} \]

Adding (1) & (3),

\[ \frac{n_1}{\nu} \cdot \frac{n_1}{u} = \frac{n_2 - n_1}{R_2} \left( \frac{1}{k_1} - \frac{1}{k_2} \right) \]

for \( \theta \rightarrow \infty \) \( u = \infty \)
\[ \frac{u}{v} = f \]

\[ \frac{n_1}{f} = \frac{n_2 - n_1}{R_2} \left( \frac{1}{k_1} - \frac{1}{k_2} \right) \]
\[ \frac{1}{f} = \frac{(n_2 - n_1)}{n_1} \left( \frac{1}{k_1} - \frac{1}{k_2} \right) \]

\[ \rightarrow \text{lens maker's formula} \]
Principle: The principle of working is that change in flux through one coil produces an emf in the neighboring coil. This phenomena is called mutual induction.

No. It cannot be used to bring down high DC voltages as DC voltages have fixed direction. Hence they do not change the flux of the coil. Hence phenomena of mutual induction is not observed with DC voltages.

Students show inquisitiveness:
- They show a desire to understand and learn new things.

Teachers show maturity:
- The teacher also shows awareness.
Fission

* When a high mass nucleus dissociates into smaller nuclei, the process is known as fission.

* The energy released is very high (of the order of 200 MeV).

* Used in nuclear reactors.

Both these processes are exothermic i.e., energy is released.

We know that nuclei of medium masses (30 < A < 170) are very stable and have high BE per nucleon.

When a nucleus of higher mass undergoes fission, then the products formed have higher BE per nucleon than the reactants. This increase in BE per nucleon is accompanied by release in energy.

\[ ^{235}U \rightarrow ^{3}He + \text{Fission} \]
When two nuclei of lower mass combine to form a stable product, then again, the BE per nucleon of products is more than that of reactants. This increase in BE per nucleon is accompanied by release of energy.

\[ \text{eg.: } ^2_1H + ^3_1H \rightarrow ^4_2He + n \]

\[ \text{mass of prod.} = 4.002603 + 1.008665 \]
\[ = 5.011268 \text{ u} \]

mass of reactants = 3.016049 + 2.014102
\[ = 5.030151 \text{ u} \]

\[ \Delta m = 5.030151 - 5.011268 \]
\[ \Delta m = 0.018883 \text{ u} \]

Energy released = \[ \Delta mc^2 = \Delta m \times 931.5 \text{ MeV} \]
E = 17.5893 KeV

21) Einstein's Eqn,

\[ KE_{\text{max}} = h\nu - \phi \]

- \( KE_{\text{max}} \rightarrow \) max energy of emitted photoelectrons
- \( \nu \rightarrow \) frequency of incident light
- \( h \rightarrow \) Planck's constant
- \( \phi \rightarrow \) work function of metal.

According to this equation, an electron absorbs a quantum of energy \((h\nu)\) and if this exceeds the work function, then an electron with max energy is emitted. Since energy cannot be negative, there is a certain minimum frequency for which emission occurs. This is known as threshold frequency.

Also, the \( KE_{\text{max}} \) is directly proportional to frequency, thus showing that \( KE_{\text{max}} \) is independent of intensity of light.
Intensity is the no. of photoelectrons per unit area per second. Thus increasing intensity increases the no. of photoelectrons and consequently photo-current is directly proportional to intensity of light.

Also since energy absorption by e- is spontaneous, this also proves the spontaneity of the reaction.

\[ KE_{\text{new} (1)} = \frac{hc}{\lambda_1} \]

\[ KE_{\text{new} (2)} = \frac{hc}{\lambda_2} \]

\[ KE_{\text{new} (2)} = 2 KE_{\text{new} (1)} \]

\[ \frac{hc}{\lambda_2} - \phi = 2 \left( \frac{hc}{\lambda_1} - \phi \right) \]

\[ \phi = \frac{hc}{\lambda_1} \left( 2 - \frac{1}{\lambda_2} \right) \]
\[ \phi = \frac{hc}{\lambda_0} \]

\[ \frac{h \lambda_0}{2} = \frac{h \lambda_0 (2 \lambda_2 - \lambda_1)}{\lambda_2 \lambda_1} \]

\[ \lambda_0 = \frac{\lambda_2 \lambda_1}{2 \lambda_2 - \lambda_1} \]

Threshold wavelength

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\[ \frac{f_m}{f_e} = \frac{|f_o|}{f_e} \]

- \( f_o \) = focal length of objective
- \( f_e \) = focal length of eyepiece

\[ |m| = \frac{15 \times 100}{1} = 1500 \]

\[ \text{image formed is inverted} \]
\[ \text{angular magnification} = +1500 \]

\[ \frac{D}{R} = \frac{d}{f_0} \]

\[ \frac{3.4 \times 10^6}{3.8 \times 10^8} = \frac{d}{15} \]

\[ d = \frac{3.4 \times 10^{-2} \times 15}{3.8} \text{ m} \]

\[ d = 13.4 \text{ cm} \]
19. a) Microwaves

* These are produced by special tubes (klystron, magnetron & Gunn diodes)

b) Infrared waves

* These are produced by hot objects and bodies.

c) X-rays

* These are produced by bombarding a metal target with high energy electrons.
\( i \) \( X_l = \omega L \) (inductive reactance)

also \( L \propto n \) (n is no. of turns)

When \( n \neq L \)

\[ X_l \neq \]

also current = \( \sqrt{\frac{V}{\sqrt{X_l^2 + R^2}}} \)

as \( X_l \) reduces,
current increases

\[ \text{Brightness of bulb increases} \]
(i) When iron core is inserted, 
\[ \mu \text{ increases (as } \mu = \mu_1 + \mu_0) \]

\[ L \propto \mu \]

\[ \therefore L \text{ also increases} \]

\[ \Rightarrow L_2 \text{ increases} \]

\[ i = \frac{V}{\sqrt{R^2 + \frac{V^2}{L^2}}} \]

\[ \therefore i \text{ reduces} \]

\[ \Rightarrow \text{heating bulb will glow less brightly.} \]
In an LCR circuit

\[ \text{current} = \frac{V}{\sqrt{L_c - x_j^2 + R^2}} \]

initially, \[ i = \frac{V}{\sqrt{x_c^2 + R^2}} \]

\[ x_c = x_j \]

finally, \[ i = \frac{V}{R} \]

\[ \therefore \text{current increases} \]

\[ \text{hence brightness also increases} \]
17a) In double slit experiment, angular fringe width = \( \frac{\lambda}{d} \)

\[ 0.1 = \frac{\lambda}{d} \]

\[ 0.1 = \frac{600 \times 10^{-9}}{d} \]

\[ d = 600 \times 10^{-9} \text{ m} \]

\[ d = 6 \times 10^{-6} \text{ m} \]

\[ d = 6 \mu \text{m} \]

\[ \text{incident ray \quad reflected ray \quad air} \]

\[ \text{refracted ray \quad water (p)} \]

\[ \text{refracted ray \quad light is same in all mediums} \]

\[ * \text{We know that frequency of reflected light is same in all mediums} \]
Thus, frequency of reflected and refracted rays is same.

\[ f = \frac{v_2}{\lambda} = \frac{3 \times 10^8}{5000 \times 10^{-10}} = 0.6 \times 10^{15} \]

\[ = 0.6 \times 10^{15} \text{ Hz} \]

If wavelength in air is \( \lambda_1 \) and that in water is \( \lambda_2 \),

\[ \frac{\mu_1}{\mu_2} = \frac{v_2}{v_1} = \frac{\lambda_2}{\lambda_1} \]

\[ \therefore \frac{\mu_1}{\mu_2} = \frac{\lambda_2}{\lambda_1} \]

\[ \lambda_2 = \frac{5000 \text{ \AA}}{\mu} \]

Wavelength of refracted ray decreases by a factor of \( \mu \)
While wavelength of reflected ray remains same.
Transistor as amplifier in CE configuration.

1) Input Resistance ($R_i$) = \( \left( \frac{\Delta V_{BE}}{\Delta I_B} \right) \)

It is defined as the ratio of change in input voltage ($\Delta V_{BE}$) and the change in base current ($\Delta I_B$) for a fixed value of $V_{CE}$.

It can be determined from the graph of input characteristics.

It is the reciprocal of slope of the linear part of the graph.

\( V_{BE} \) \( I_B \)
1) Current amplification factor ($\beta_a$) = \frac{\Delta I_c}{\Delta I_B}

It is defined as the ratio of change in output current ($\Delta I_c$) to the change in input current ($\Delta I_B$) for a fixed value of $V_{CE}$.

For a fixed value of $V_C$, we take the value of $I_c$ as $I_0$.

Here clearly $\beta_a = \frac{I_{c3} - I_{c1}}{I_{b3} - I_{b1}}$

15. Photodiode is a semiconductor device that is used to detect optical signals.

+ Photodiode is operated in reverse bias.

+ Photodiode consists of a transparent window that allows light to fall on the junction of the diode.
Working:

When sunlight falls on the diode, e-h pairs are generated.

These are separated before they combine as the field in the junction is very high.

e reach the n-side while holes reach p-side.

When this is connected to an external circuit current flows and hence we can detect the optical signal.
The photodiode works in reverse bias as change in intensity of light is more detectable in reverse bias.

In forward bias, $n >> h$

Let $\Delta n$ and $\Delta h$ be the extra $e^-$ & holes created,

then $\Delta n = \Delta h$.

$\Rightarrow \frac{\Delta n}{n} << \frac{\Delta h}{h}$

Thus change in forward bias will be very less.

Also from graph

Thus, change in reverse bias is easily detectable.
The principle of galvanometer is that when current is passed through a coil in uniform magnetic field, a torque acts on the coil.

\[ \mathbf{T} = I_0 \times \mathbf{B} \]

- \( I_0 \) - magnetic moment
- \( \mathbf{B} \) - magnetic field

This way a galvanometer detects the flow of current in a circuit.

\[ V = I_0 (R_g + R_1) \]

\[ V = I_0 (R_y + R_5) \]

\[ 2 \times 2 \times I_0 (R_g + R_2) = I_0 (R_y + R_1) \]

\[ 2R_0 + 2R_2 = R_g + R_1 \]
\[ R_g = R_1 - 2R_2 \quad \text{(ANS)} \]

\[ \frac{2V}{R_g + R} \]

\[ 2V = i_g (R_g + R) \]

From (1),

\[ 2V = \frac{V}{R_g + R} (R_g + R) \]

\[ 2R_g + 2R_1 = R_g + R \]

\[ R = R_g + 2R_1 \]

\[ R = R_1 - 2R_2 + 2R_1 \]

\[ R = 3R_1 - 2R_2 \quad \text{(ANS)} \]
In (II)

\[ \frac{E}{2} = \frac{1}{2} C_{eq} V^2 \]

\[ E = \frac{1}{2} C_{eq} V^2 \]

\[ E = \frac{1}{2} (C_1 + C_2) V^2 \]

\[ 0.045 = \frac{1 \times C_1 C_2}{100 \times 100} \]

\[ 0.09 \times 10^{-4} = \frac{C_1 C_2}{0.5 \times 10^{-4}} \]

\[ C_1 + C_2 = 0.5 \times 10^{-4} \]

\[ C_1 C_2 = 0.045 \times 10^{-8} \]
Solving we get \[ C_1 = \frac{2.5 \times 10^{-5}}{2}, \quad C_2 = 3.6 \times 10^{-5} \, \text{F} \]

In parallel \[ V = \frac{5 \times 10^{-5} \times 100}{C_1 + C_2} \]

\[ Q_1 = \frac{C_1}{C_1 + C_2} \cdot V \]

\[ Q_2 = \frac{C_2}{C_1 + C_2} \cdot V \]

\[ Q_2 = \frac{C_2}{5 \times 10^{-5}} \times 5 \times 10^{-3} = \frac{C_2 \times 100}{2} = \frac{2.5 \times 10^{-5} \times 100}{2} = 2.5 \times 10^{-3} \, \text{C} \]

\[ Q_1 = \frac{C_1 \times 100}{2} = \frac{3.6 \times 10^{-5} \times 100}{2} = 3.6 \, \text{mC} \]

\[ Q_2 = 1.25 \, \text{mC} \rightarrow \text{Charge on } C_2 \]

\[ Q_1 = 3.6 \, \text{mC} \rightarrow \text{Charge on } C_1 \]
The plot as:

From 0 & 0,

\[ V = I \times R \]

\[ V = \frac{E}{1 + \frac{1}{R}} \]

\[ V = \frac{E}{R} \]

\[ V = E - V' \]

\[ V = E - V' \]

\[ V = E - V' \]

\[ \frac{R}{E} = \frac{E}{V} \]
\[ V = \frac{E}{(1+\frac{R}{r})} \]

\[ V = IR \]

\[ V = \varepsilon \]

\[ i = \frac{E}{R+y} \]

When \( R = 4.5 \Omega \), \( R = 9.5 \)

\[ i = 1A \quad i = 0.5A \]

\[ \therefore 1 = \frac{E}{4+y} \quad (1) \]

\[ 0.5 = \frac{E}{y+9} \quad (2) \]

\[ \Rightarrow \frac{E}{4+y} = \frac{2E}{y+9} \quad \Rightarrow \quad y+9 = 8+2y \]
Putting in 1, 

\[ E = 5V \]

**Diagram: AM Wave Detection**

- Receiving antenna
- Amplifier
- IF Stage
- Detector
- Amplifier
- Output

**Detector:**

- AM Wave
- Rectifier
- Envelope Detector
- Message
The AM waveform is as shown.

On passing this through the rectifier, only the true half of the cycle is passed.

Envelope detector detects the original message and rejects the sidebands.

This way, we get the original message from AM wave.
(10) proton → \( ^1_1 \text{H} \)
\( \alpha \text{ particle} → \frac{1}{2} \text{He} \)

\[
\lambda = \frac{h}{\sqrt{2m_e V}} = \frac{\hbar}{m_e^*}
\]

\( V \rightarrow \text{accelerating potential} \)
\( \lambda \rightarrow \text{deBroglie wavelength} \)

\[
\lambda_p = \lambda_\alpha
\]
\[
\frac{h}{\sqrt{2m_p e V_p}} = \frac{\hbar}{\sqrt{2m_e^* 2e x V_x}}
\]
\[
\frac{\sqrt{2 m_e^* 2e x V_x}}{2 m_p e V_p} = 1
\]
\[
\frac{m_e}{m_p} = 4 \leq \frac{2 e x V_x}{V_p}
\]
\[
\frac{4 x 2}{V_p} = 1
\]
\[ V_k = \frac{1}{8} \]

\[ h = \frac{h}{m_k V_k} = \frac{m_p V_p}{m_k} \]

\[ V_k = \frac{m_p}{V_p} \]

\[ \frac{V_k}{V_p} = \frac{1}{4} \]

In balance condition \( I_g = 0 \).

\[ I = I_1 + I_2 \]

Also applying Kirchhoff's voltage law in I & II:

1. \( I_1 R_1 = I_2 R_2 \)
2. \( I_1 R_4 = I_2 R_3 \)
(1) \( \frac{R_1}{R_2} = \frac{R_4}{R_3} \)

\[ R_1 = \frac{R_4}{R_3} \]

\[ R_2 \]

\[ R_3 \]

\[ \Rightarrow \]

Condition for balanced Wheatstone bridge.

On passing unpolarised light through \( R_1 \),

\[ I' = \frac{I_0}{2} \]

If at any instance,

\[ \angle \text{ between } R_2 \text{ and } P_3 = 0 \]

Then \( \angle \text{ between } P_2 \text{ and } P_3 = 90 - \theta \)

From Malus's law,
Intensity transmitted from $P_2 = \frac{I_0 \cos^2 \theta}{2}$

Intensity transmitted from $P_3 = \frac{I_0 \cos^2 \theta \cos^2 (90^\circ - \phi)}{2}$

Final intensity of light obtained = $\frac{I_0 \cos \phi \sin \phi}{2}$

\[ I = \frac{I_0 \sin^2 \phi}{8} \]

For $I_{\text{max}} \quad \theta = \frac{\pi}{4}$

\[ \theta = 45^\circ \]
<table>
<thead>
<tr>
<th>Intrinsic</th>
<th>Extrinsic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure semiconductors such as Si &amp; Ge are called intrinsic semiconductors.</td>
<td>Semiconductor that are doped with an external atom such as As or B, it is called extrinsic semiconductor.</td>
</tr>
<tr>
<td>Only thermally generated holes &amp; electrons.</td>
<td>Both thermally generated as well as impurity donated holes/ electrons.</td>
</tr>
<tr>
<td>Low conductivity at room temp</td>
<td>High conductivity.</td>
</tr>
<tr>
<td>High band gap</td>
<td>Lower band gap</td>
</tr>
</tbody>
</table>

The centripetal force required is given by the coulombic force.

\[
\frac{m v^2}{r} = \frac{kZe^2}{r^2}
\]
also from Bohr theory \[ mvr = \frac{nh}{2\pi} \]

\[ Mv^2 = \frac{ke^2}{r} \]

\[ mvrv = ke^2 \]

\[ v = \frac{ke^2}{nh} \times 2\pi \]

\[ r = \frac{nh}{2\pi \times m \times ke^2 \times 2\pi} \]

\[ r = \frac{n^2}{Z} \times \frac{h^2}{4\pi^2 me^2 k} \]

Clearly \( r \propto n^2 \)
5. \[ X_c = \frac{1}{\omega C} \]
units = ohm

Capacitive reactance is the resistance offered by a capacitor to current in an LCR circuit connected to an AC power supply of any frequency \( \omega \).

4(i) DE (slope is -ve)

4(ii) BC (\( \propto I \))

3. In an amplitude modulated wave, the frequencies present are \( \omega_c, \omega_c - \omega_m, \omega_c + \omega_m \).

\( \omega_c \) = any frequency of carrier wave
\( \omega_m \) = any frequency of message.

Here \( \omega_c - \omega_m \) & \( \omega_c + \omega_m \) are side bands.
\[ \begin{align*}
\text{\textit{A}}_{\text{c}}(t) &= \left( \text{\textit{A}}_{\text{c}} + \text{\textit{A}}_{\text{m}} \sin \omega t \right) \sin \omega t \\
\text{\textit{A}}_{\text{c}} &= \text{\textit{A}}_{\text{c}} (1 + \mu \sin \omega t) \sin \omega t \\
\text{\textit{A}}_{\text{c}}(t) &= \text{\textit{A}}_{\text{c}} \sin \omega t + \mu \text{\textit{A}}_{\text{c}} \cos (\omega t - \phi) - \mu \text{\textit{A}}_{\text{c}} \cos (\omega t + \phi)
\end{align*} \]

Side bands.

2. \[ f = \left( \frac{\mu_m - 1}{\mu_m} \right) \left( \frac{1}{r_1} + \frac{1}{r_2} \right) \rightarrow \text{Lens maker's formula.} \]

\[ \mu_m = 1.5 \]
\[ \mu_m = 1.65 \]

\[ \therefore \frac{\mu_m - 1}{\mu_m} < 0 \]

Also \[ \frac{1}{r_1} - \frac{1}{r_2} < 0 \] for concave lens.

\[ f \text{ is true} \]

Here it is a \underline{Convex lens} or \underline{Converging lens} (converging lens).
1) Since electric dipole is made up of \( \pm q \)

\[ \mathbf{E} = 0 \]

\[ \therefore \text{ flux} = 0 \]