Solution

PREBOARD EXAM- 2 2025-26

Class 12 - Physics

Section A

1.

(c) more than dc value

Explanation:

The output of a rectifier consists of an AC component called ripple and a DC component. The ratio of the AC and DC components will be greater than one for a half-wave rectifier, while it will be less than one for a full-wave rectifier.

2.

(d) $m^2 V^{-1} s^{-1}$

Explanation:

$m^2 V^{-1} s^{-1}$

3.

(b) Full image will be formed but will be less bright

Explanation:

Image will be formed at the same position and same height but intensity of image formed will be less hence its brightness will be less as less number of light rays will form the image. Light rays from the covered portion will not contribute to image formation.

4.

(d) $\frac{\sqrt{3}}{1}$

Explanation:

For a tangent galvanometer,

$\frac{\mu_0 NI}{2R} = B_H \tan\theta$

For same I and B_H, N $\times$ tan θ

$\therefore \frac{N_1}{N_2} = \frac{\tan 60^\circ}{\tan 45^\circ} = \frac{\sqrt{3}}{1}$

5.

(d) 1.6×10^{-18} J

Explanation:

1.6×10^{-18} J

6.

(d) angle between them can have any value other than zero and 180°

Explanation:

When the angle between $\vec{v}$ and $\vec{B}$ has any value other than zero and 180° (so that $\sin\theta$ is non-zero), the magnetic force on the charged particle will be non-zero.

7. **(a)** doubled

Explanation:

$L = \frac{\mu_0 N^2 A}{l}$

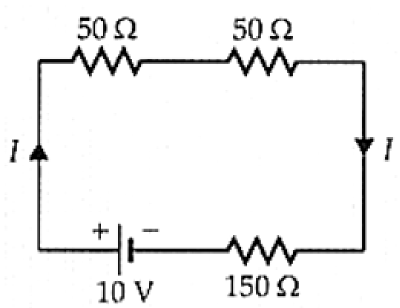
$L' = \frac{\mu_0 (2N)^2 A}{2l} = 2L$

8. **(a)** Sodium Chloride
Explanation:
Sodium Chloride

9.
(d) $\frac{R}{2}$
Explanation:
A plane wave reflecting off a concave mirror will focus at the focal point, which means that the radius of the spherical wave will be equal to the focal length of the mirror, that is, $\frac{R}{2}$.

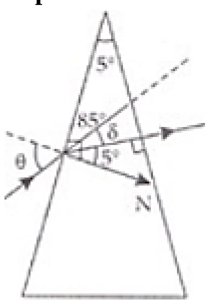
10.
(b) Coulomb
Explanation:
The unit of electric charge is Coulomb (C).

11. **(a)** 0.04 A
Explanation:
Diode D_1 is forward biased and offers 50 Ω resistance. Diode D_2 is reverse biased and offers infinite resistance. The equivalent circuit is



Current through the 150Ω resistance,
I = $\frac{10}{50+50+150}$
= $\frac{10}{250}$ = 0.04 A

12.
(c) 7.5°
Explanation:



A = 5^o
$\mu = 1.5$
$i_2 = 0^o$
$r_2 = 0^o$
$r_1 + r_2 = A$
$r_1 = A - r_2 = 5 - 0 = 5^o$
$\mu = \frac{\sin i_1}{\sin r_1}$
$\Rightarrow \sin i_1 = \mu \sin r_1$
$sini_1 = 1.5 \times \sin 5^\circ$
$sini_1 = 1.5 \times 0.087$

$\sin i_1 = 0.1305$

thus $i_1 = 7.5^o$

13. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
Photoelectrons produced by monochromatic light have different velocities and hence different energies. Actually all the electrons do not occupy the same level of energy. So, electrons coming out from different levels have different velocities and hence different energies. So, the assertion is true. The electrons coming out from inside the metal surface, face collisions with the other atoms in the metal. So, energies become different. Hence the reason is true and it explains the assertion.

14. **(c)** Assertion is correct statement but reason is wrong statement.
Explanation:
If two points P and Q in an electric field are separated by an infinitesimal distance Δx and have a potential difference ΔV between them, E= $-\frac{\Delta V}{\Delta x}$. Here, negative sign implies that $\vec{E}$ has got a direction opposite to the potential gradient, i.e, in the direction of $\vec{E}$, the potential decreases, i.e, positive charge always moves from a higher potential point to a lower potential point.

15. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
As given in the expression $\beta = \frac{D\lambda}{d}$, fringe width β is independent of n (position of fringe), hence all the fringes are of same width.

16. **(c)** A is true but R is false.
Explanation:
Faraday's laws of electromagnetic induction are consequences of the conservation of energy. It involves only the transformation of energy into electrical energy. In a purely resistive circuit, current and voltage are in the same phase.

Section B

17. i. Initially Q = CV
Finally $q_A = C_A V_1$ & $q_B = C_B V_1$
$\frac{q_A}{q_B} = \frac{C_A}{C_B} = \frac{1}{2}$
ii. $q_A + q_b = Q$
$\therefore q_A = \frac{Q}{3} \& \quad q_B = \frac{2Q}{3}$
$\frac{U_f}{U_i} = \frac{U_A + U_B}{U_{Ai}}$
$= \frac{\frac{q_A^2}{2C_A} + \frac{q_B^2}{2C_B}}{\frac{Q^2}{2C_A}}$
$= \frac{1}{3}$

18. i. Here B = 0.2 T, $\theta = 30^o$, τ = 0.06 Nm
Magnetic moment,
m = $\frac{\tau}{B\sin\theta} = \frac{0.06}{0.2\sin 30^\circ} = \frac{0.06}{0.2\times0.5}$ = 0.6 Am^2
ii. The P.E. of a magnetic dipole in a uniform magnetic field is
U = -mB cos θ
In stable equilibrium, the P.E. is minimum. So,
cos θ = 1 or $\theta = 0^o$
Hence the bar magnet will be in stable equilibrium when its magnetic moment $\vec{m}$ is parallel to the magnetic field $\vec{B}$.

OR

Dipole moment of each atomic dipole,

m = 1.5×10^{-23} JT^{-1}

Total number of atomic dipoles, N = 2.0×10^{24}

Initial total magnetic moment at temperature T_1 = 4.2 K is

M_1 = 15% of mN

= $\frac{15}{100} \times 1.5 \times 10^{-23} \times 2.0 \times 10^{24}$ JT^{-1} = 4.5 JT^{-1}

According to Curie's law,

M = Constant $\times \frac{B}{T}$

$\therefore \frac{M_2}{M_1} = \frac{B_2}{B_1} \times \frac{T_1}{T_2}$

Now B_1 = 0.84 T, T_1 = 4.2 K, B_2 = 0.98 T, T_2 = 2.8 K

Hence the final dipole moment at temperature T_2 = 2.8 K is

$M_2 = M_1 \times \frac{B_2}{B_1} \times \frac{T_1}{T_2} = 4.5 \times \frac{0.98}{0.84} \times \frac{4.2}{2.8} \mathrm{JT}^{-1}$

= 7.9 JT^{-1}

19. i. As the hole concentration increases, the p-type semi-conductor is obtained after doping.
 ii. As $n_e n_h = n_i^2$

 $\therefore n_e = \frac{n_i^2}{n_h} = \frac{(2\times10^8)^2}{4\times10^{10}} = 10^6\ m^{-3}$
 iii. Energy gap decreases with doping.

20. The nucleus of a hydrogen atom is a proton (mass $1.67 \times 10^{-27} kg$) which has only about one-fourth of the mass of an alpha particle $(6.64 \times 10^{-27} kg)$. Because the alpha particle is more massive, it won't bounce back in even a head on collision with a proton. It is like a bowling ball colliding with a ping pong ball at rest. Thus, there would be no large angle scattering in this case. In Rutherford's experiment, by contrast, there was large angle scattering because a gold nucleus is more massive than an alpha particle. The analogy there is a ping pong ball hitting a bowling ball at rest.

21. $\vec{B}_p = \frac{\mu_0 I}{2R}$, vertically upwards

$\vec{B}_Q = \frac{\mu_0 \sqrt{3} I}{2R}$, along with horizontal

The resultant field at the centre is

B = $\sqrt{B_P^2 + B_Q^2} = \left[\left(\frac{\mu_0 I}{2R}\right)^2 + \left(\frac{\mu_0 \sqrt{3} I}{2R}\right)^2\right]^{1/2}$

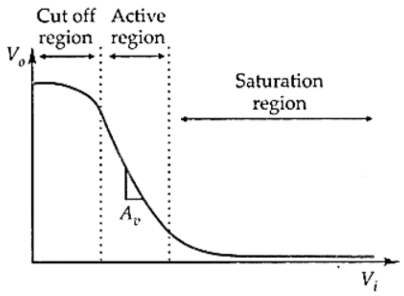
= $\frac{\mu_0 I}{2R}(1+3)^{1/2} = \left(\frac{\mu_0 I}{R}\right)$

$\tan\theta = \frac{BP}{BQ} = \frac{1}{\sqrt{3}}$

$\Rightarrow \theta = 30^o$

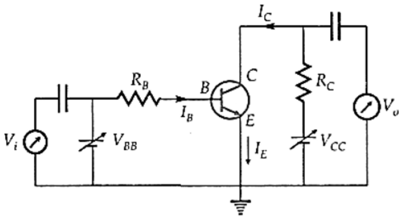
Section C

22. i. **Emitter:** It is of moderate size and heavily doped semiconductor.
 Base: It is very thin and lightly doped.
 Collector: It is moderately doped and larger in size than the emitter.
 ii. A transistor is said to be in active state when its emitter-base junction is forward biased and the base-collector junction is reverse biased. A Si transistor is in active state when its input (E-B) voltage is between 0.6 V and 1.0 V.
 iii. A transfer characteristic is a graph of output voltage (V_0) vs. input voltage (V_i) for a base-biased transistor. It is of the type shown in the figure.



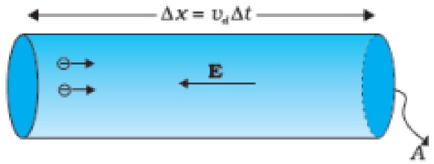
 The active region of the transfer characteristic is used for the amplification purpose. This is because in this region, I_C increases almost linearly with the increase of V_i.

iv. The circuit diagram for the base biased n-p-n transistor amplifier, in CE configuration, is shown in the figure.



Working: When a small sinusoidal voltage is superposed on the dc base bias, the base current will have sinusoidal variations superposed on the value of I_B. As a consequence, the collector current also will have sinusoidal variations superposed on the value of I_C. The output, between the collector and the ground, will be an amplified version of the input sinusoidal voltage.

23. a.

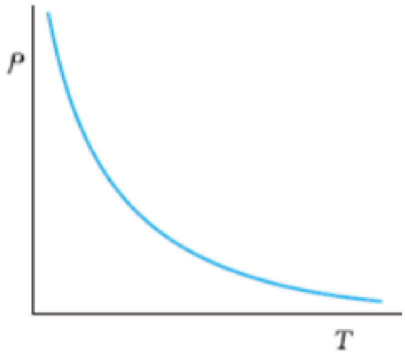


Drift Velocity , Vd = $(V_i)_{av} = 0 - \frac{eE}{m}\tau$ where $\tau =$ relaxation time

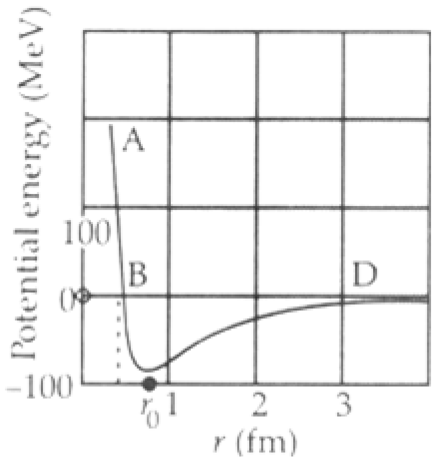
$I = \frac{\Delta q}{\Delta t} = \frac{enA|v_d|\Delta t}{\Delta t} = enAv_d$

$I = neAv_d$

b. Clearly resistivity decreases with rise in temperatur. As temperature coefficient of resistivity of a semi conductor is negative



24. From the observations made (parts A and B) on the basis of Einstein's photoelectric equation, we draw the following conclusions:
    1. For surface A, the threshold frequency is more than 10^{15} Hz, hence no photo-emission is possible.
    2. For surface B, the threshold frequency is equal to the frequency of given radiation. Thus, photoemission takes place but kinetic energy of photo-electrons is zero.
    3. For surface C, the threshold frequency is less than 10^{15} Hz. So photo-emission occurs and photoelectrons have some kinetic energy.
25. There are two types of forces: Coulomb force and nuclear force which are acting between protons in the nucleus. The gravitational force between two protons is very weak. Between these two forces, nuclear force is stronger as compared to Coulomb force but it is a very short-range force. Coulomb force is repulsive in nature for two protons dominant over nuclear force when the distance between two protons increases more than a few femtometer. As the nuclear size is in the order of the femtometer, hence in the nucleus, nuclear force between protons dominates over the Columbian force. It is attractive in nature and binds together. Moreover, neutrons in nucleus also act as glue to held protons together as there is no Coulomb force between protons and neutrons but there is an attractive nuclear force between them.



It is clear from the graph, as the nucleons come closer under attractive nuclear force, the potential energy decreases and PE becomes more and more negative. When the distance between two nucleons falls below 10^{-15} m, the nuclear force becomes repulsive and potential energy increases rapidly. Hence negative PE shows that force between nucleons is attractive.

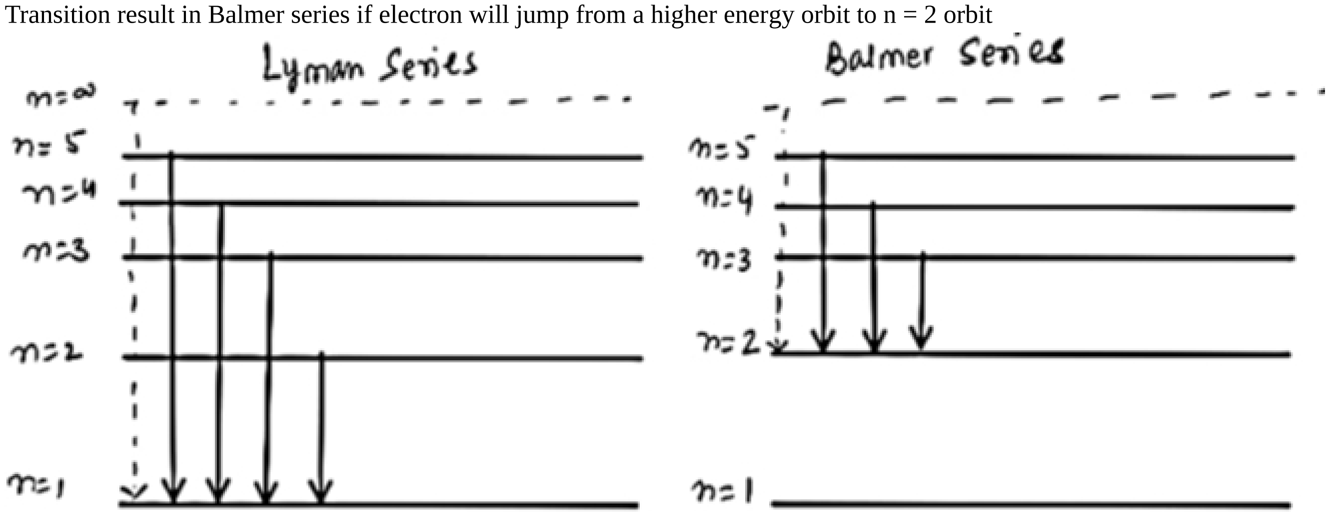
The characteristic properties of nuclear force:

i. The nuclear force is short-range force.

ii. The nuclear force is independent of electric charge.

26. a. Transition result in Lyman series if electron will jump from a higher energy orbit to n = 1 orbit

Transition result in Balmer series if electron will jump from a higher energy orbit to n = 2 orbit



b. Longest wavelength in Lyman Series

$\frac{1}{\lambda_L} = R \cdot \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = R\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3R}{4}$

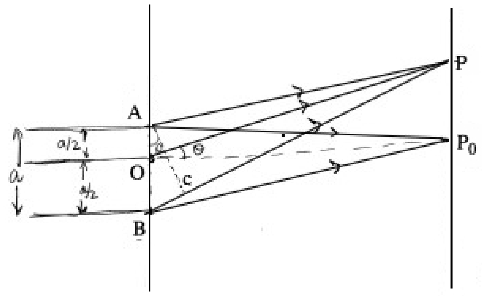
Shorted wavelength in Balmer Series

$\frac{1}{\lambda_S} = R\left[\frac{1}{{n_1}^2} - \frac{1}{n_2^2}\right] = R\left[\frac{1}{2^2} - \frac{1}{\infty}\right] = \frac{R}{4}$

Ratio $\frac{\lambda_2}{\lambda_S} = \frac{4}{3R} \times \frac{R}{4} = \frac{1}{3}$

27. Let us consider consider a slit AB is made up of two slits each of width $\frac{a}{2}$.

As P_0 is point equidistant from all the huygen's sources therefore all will be in phase to give central maxima for first minima path differences between waves from A and O = $\frac{\lambda}{2}$



Let OP subtends angle θ at the slit then in $\triangle^s$ ABC and OP_0P

With P as the centre and PA as radius, strike an are intersecting PB at C

AC can be considered as straight line at right angle to PB thus $\triangle^s$ ABC $\sim$ OP_0P

$\therefore$ BC = a sin θ

(PB - PO) + (PO - PA) = a sin θ

$\frac{\lambda}{2}+\frac{\lambda}{2}$ = λ = a sin θ

sin θ = $\frac{\lambda}{a}$

and θ is small so, $\theta_n=\frac{n\lambda}{a}$

n = 1, 2, 3 dark fringes

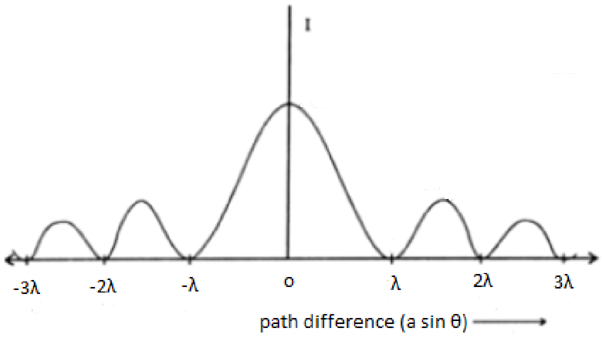
Similarly for secondary maxima

a sin θ = $\frac{\lambda}{2}$

sin θ = $\frac{\lambda}{2a}$

θn = $\left(n+\frac{1}{2}\right)\frac{\lambda}{a}$

n = 1, 2, 3...... bright fringes

a. 

b. θn = $\left(n+\frac{1}{2}\right)\frac{\lambda}{a}$

$\frac{x}{D}=\frac{3}{2}\frac{\lambda}{a}$

n = 1 for first maxima

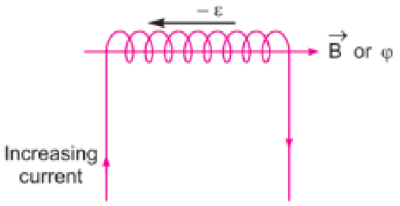
x = $\frac{3\lambda D}{2a}$

28. Using formula, $|-\varepsilon|=L\frac{dI}{dt}$

If $\frac{dI}{dt}=1$ A/s, then L = $|-\varepsilon|$

Self inductance of the coil is equal to the magnitude of induced emf produced in the coil itself when the current varies at rate 1 A/s.

Expression for magnetic energy:



When a time varying current flows through the coil, back emf $(-\varepsilon)$ produces, which opposes the growth of the current flow. It means some work needs to be done against induced emf in establishing a current I. This work done will be stored as magnetic potential energy.

For the current I at any instant, the rate of work done is

$\frac{dW}{dt}=(-\varepsilon)I$

Only for inductive effect of the coil $|-\varepsilon|=L\frac{dI}{dt}$

$\therefore \quad \frac{dW}{dt}=L\left(\frac{dI}{dt}\right)I \quad \Rightarrow dW=LIdI$

From work-energy theorem,

dU = LIdI

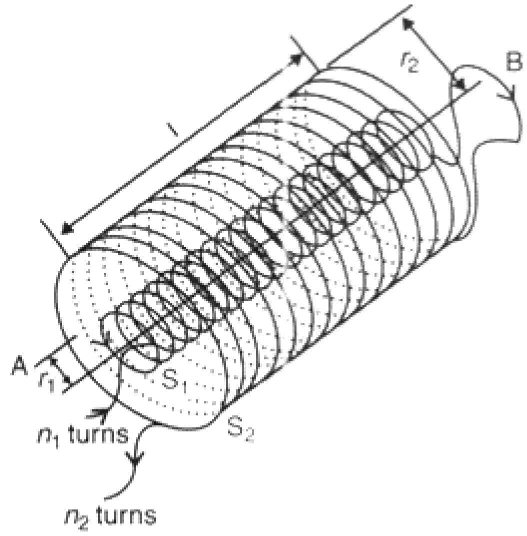
$\therefore U=\int_0^I LIdI=\frac{1}{2}LI^2$

OR

i. Self-Inductance is the property by which an opposing induced emf is produced in a coil due to a change in current, or magnetic flux, linked with the coil.

   The S.I. unit of self-inductance is Henry (H).

ii. In this question, a long co-axial solenoids S_1 and S_2 wound one over the other, each of length L and radii r_1 and r_2 and n_1 and n_2 number of turns per unit length, when a current I is set up in the outer solenoid S_2.



Let a current l_2 flow in the secondary coil

$\therefore B_2 = \frac{\mu_0 N_2 i_2}{l}$

$\therefore$ Flux linked with the primary coil = $\frac{\mu_0 N_2 N_1 A_1 i_2}{l}$

= $M_{12} i_2$

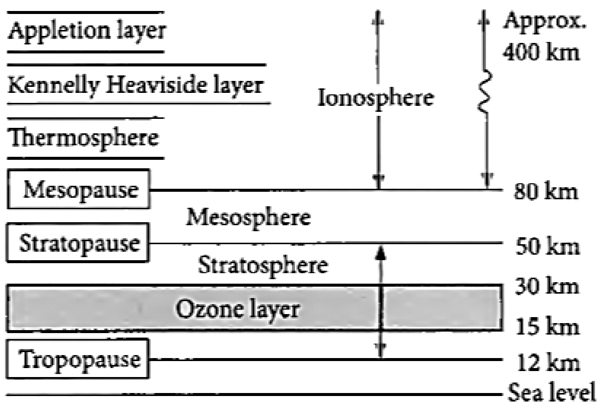
Hence, $M_{12} = \frac{\mu_0 N_2 N_1 A_2}{l}$

$\mu_0 n_2 n_1 A_1 l \left(n_1 = \frac{N_1}{l}; n_2 = \frac{N_2}{l}\right)$

Section D

29. **Read the text carefully and answer the questions:**

Radio waves are produced by the accelerated motion of charges in conducting wires. Microwaves are produced by special vacuum tubes. Infrared waves are produced by hot bodies and molecules also known as heat waves. UV rays are produced by special lamps and very hot bodies like Sun.



(i) **(d)** Option (i)
Explanation:
transverse electromagnetic wave

(ii) **(c)** Infrared rays
Explanation:
Greenhouse effect is due to infrared rays.

(iii) **(b)** it stops ultraviolet rays
Explanation:
Ozone layer absorbs the harmful ultraviolet radiations coming from the sun.

OR

(d) infrared
Explanation:

The atmosphere of earth is richest in infrared radiation.

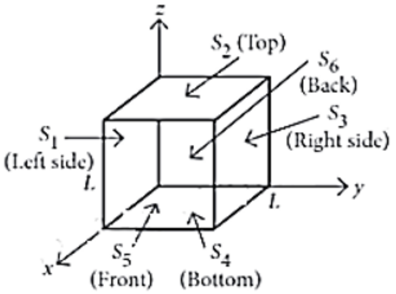
(iv) **(c)** stratosphere

Explanation:

Ozone layer lies in stratosphere.

30. **Read the text carefully and answer the questions:**

Net electric flux through a cube is the sum of fluxes through its six faces. Consider a cube as shown in figure, having sides of length L = 10.0 cm. The electric field is uniform, has a magnitude E = 4.00 $\times$ $10^3 NC^{-1}$ and is parallel to the xy plane at an angle of 37^o measured from the +x -axis towards the +y -axis.



(i) **(a)** -32 Nm^2 C^{-1}

Explanation:

Electric flux, $\phi = \vec{E} \cdot \vec{A} = EA\cos\theta$

where $\vec{A} = A\hat{n}$

For electric flux passing through S_6, $\hat{n}_{S_6} = -\hat{i}$ (Back)

$\therefore \phi_{S_6}$ = -(4 $\times$ 10^3 NC^{-1})(0.1 m)^2 cos 37^o

= -32 N m^2 C^{-1}

(ii) **(c)** -24 Nm^2 C^{-1}

Explanation:

For electric flux passing through S_1, $\hat{n}_{S_1} = -\hat{j}$ (Left)

$\therefore \phi_{S_1}$ = -(4 $\times$ 10^3 NC^{-1})(0.1 m)^2 cos 90^o = 0

= -24 Nm^2 C^{-1}

(iii) **(d)** S_2 and S_4

Explanation:

Here, $\hat{n}_{S_2} = +\hat{k}$ (Top)

$\therefore \phi_{S_2}$ = -(4 $\times$ 10^3 NC^{-1})(0.1 m)^2 cos 90^o = 0

$\hat{n}_{S_3} = +\hat{j}$ (Right)

$\hat{n}_{S_4} = -\hat{k}$ (Bottom)

$\therefore \phi_{S_4}$ = -(4 $\times$ 10^3 NC^{-1})(0.1 m)^2 cos 90^o = 0

And, $\hat{n}_{S_5} = +\hat{i}$ (Front)

$\therefore \phi_{S_5}$ = +(4 $\times$ 10^3 NC^{-1})(0.1 m)^2 cos 37^o

= 32 N m^2 C^{-1}

S_2 and S_4 surface have zero flux.

(iv) **(c)** zero

Explanation:

As the field is uniform, the total flux through the cube must be zero, i.e., any flux entering the cube must leave it.

OR

(d) [M L^3 T^{-3} A^{-1}]

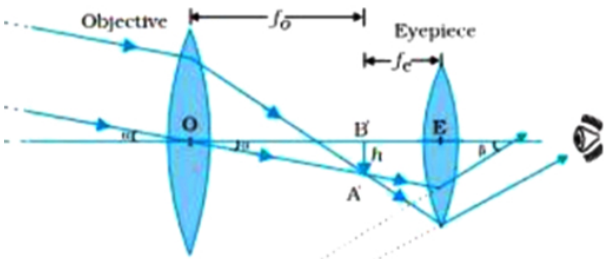
Explanation:

Surface integral $\oint \vec{E} \cdot d\vec{S}$ is the net electric flux over a closed surface S.

$\therefore [\phi_E]$ = [M L^3 T^{-3} A^{-1}]

Section E

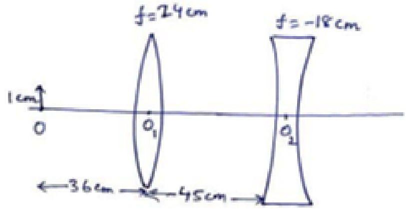
31. i.



From the diagram $\beta = \frac{h}{f_e}$ and $\alpha = \frac{h}{f_o}$

Magnifying Power = $\frac{f_O}{f_e}$

ii.



Fr lens L_1,

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

$\frac{1}{v} - \frac{1}{-36} = \frac{1}{24}$

$\frac{1}{v} = \frac{1}{24} - \frac{1}{36}$

$\frac{1}{v} = \frac{3-2}{72} = \frac{1}{72}$

v = 72 cm

For lens L_2:

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

$\frac{1}{v'} - \frac{1}{(72-45)} = \frac{1}{-18}$

$\frac{1}{v'} = \frac{1}{-18} + \frac{1}{27}$

$\frac{1}{v'} = \frac{-3+2}{54} = \frac{-1}{54}$

v = -54 cm

Final distance v_1' = -54 - (-45)

v_1' = -9 cm (to the left of convex lens)

Magnification $\frac{h_i}{h_o} = \frac{v_1'}{u}$

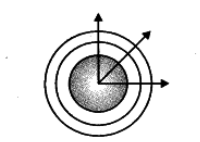
$\frac{h_i}{1} = \frac{-9}{-36} \Rightarrow$ **h_i = +$\frac{1}{4}$ cm**

hence,height of the image formed $\frac{1}{4}$ **cm**

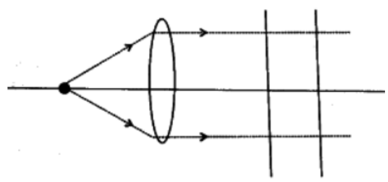
OR

i. A wave front is defined as a surface of constant phase. The ray, at each point of a wave front, is normal to the wave front at that point. The ray indicates the direction of propagation of wave while the wave front is the surface of constant phase.

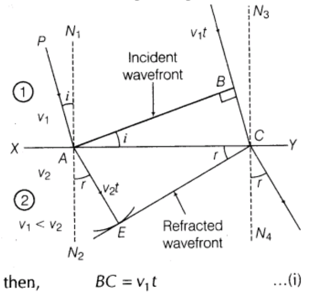
ii. (a) In case of light diverging from a point source, the shape of wave-front is a spherical as shown in the figure:



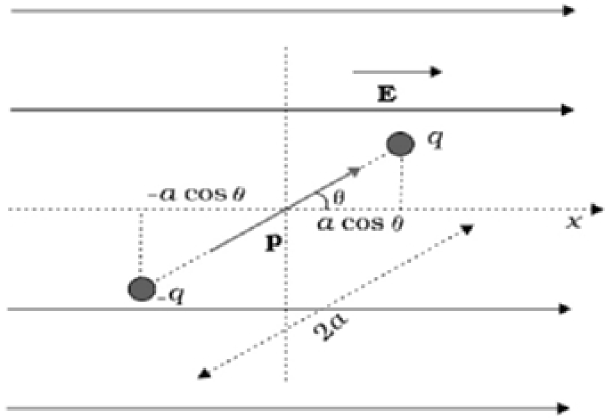
(b) In case of light emerging out of a convex lens when a point source is placed at its focus, the wave-front is a plane wave front as shown below:



(c) The following diagram shows the passage of a plane wavefront from a denser into a rarer medium.



32. a.



Since torque acting on dipole

$\vec{\tau} = \vec{\mathrm{p}} \times \vec{\mathrm{E}}$

$\vec{\tau} = \mathrm{pE}\sin\theta \cdot \hat{\mathrm{n}}$

work done $\mathrm{d}\omega = \tau . \mathrm{d}\theta$

$= \mathrm{pE}\sin\theta \mathrm{d}\theta$

$\mathrm{w} = \int_{\theta_1}^{\theta_2} \mathrm{dw} \quad \mathrm{pE}\int_{\theta_1}^{\theta_2} \sin\theta \mathrm{d}\theta$

$\mathrm{w} = \mathrm{pE}[-\cos\theta]_{\theta_1}^{\theta_2}$

$= \mathrm{pE}\left[\cos\theta_1 - \cos\theta_2\right]$

if $\theta_1 = 0, \theta_2 = \theta$

w = pE (1 - cosθ)

Conditions-

For stable equilibrium - When electric dipole is parallel to electric field.

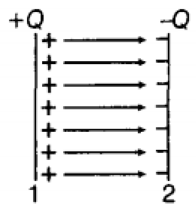
For unstable equilibrium - Anti Parallel to electric field.

b. No.

Inside equipotential surface

OR

i. Let the total charge on the plates of the below capacitor is +Q and -Q respectively.



∴The potential difference between the plates of the above capacitor of capacitance C for an infinitesimal charge q is q/C.

∴ Potential of condenser = q/C

Small amount of work done in giving an additional charge dq to the condenser,

$dW = \frac{q}{C} \times dq$

∴Total work done in giving a charge Q to the condenser,

$W = \int_{q=0}^{q=Q} \frac{q}{C} dq = \frac{1}{C}\left[\frac{q^2}{2}\right]_{q=0}^{q=Q} \Rightarrow W = \frac{1}{C}\frac{Q^2}{2}$

As, an electrostatic force is conservative, this work is stored in the form of potential energy (U) of the condenser.

$U = W = \frac{1}{2}\frac{Q^2}{C}$

$\because \quad Q = CV \Rightarrow U = \frac{1}{2}\frac{(CV)^2}{C} = \frac{1}{2}CV^2$

$\because \quad CV = Q \Rightarrow U = \frac{1}{2}QV$

Hence, $U = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}CV^2 = \frac{1}{2}QV$

Energy density (u) is defined as the total energy per unit volume of the condenser.

i.e., $u = \frac{\text{Total energy } (U)}{\text{Volume } (V)} = \frac{\frac{1}{2}CV^2}{Ad}$

Using, $C = \frac{\varepsilon_0 A}{d}$ and V = Ed (Where V is the potential difference and E is the Electric field existing between the plates)

We get, $u = \frac{1}{2}\left(\frac{\varepsilon_0 A}{d}\right)\left(\frac{E^2 d^2}{Ad}\right) = \frac{1}{2}\varepsilon_0 E^2$

Here, Energy density between plates of capacitors is directly proportional to electric field that exists between the plates of capacitor.

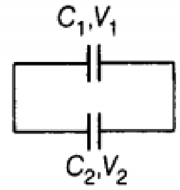
ii. Initial condition :

If we consider a charged capacitor of capacitance C with potential difference V, then its charge would be given, q = CV

and energy stored in it is given by

$U_1 = \frac{1}{2}CV^2$ .....(i)

When this charged capacitor is connected to uncharged capacitor,



Let the common potential be V_1, the charge flow from first capacitor to the other capacitor unless both the capacitor attains the common potential.

$\Rightarrow Q_1 = CV_1$ and $Q_2 = CV_2$

Applying conservation of charge,

$Q = Q_1 + Q_2 \Rightarrow CV = CV_1 + CV_2$

$\Rightarrow V = V_1 + V_2 \Rightarrow V_1 = \frac{V}{2}$ [hence voltage will be equally divided between the capacitors]

Total energy stored in both the capacitor is

$U_2 = \frac{1}{2}CV_1^2 + \frac{1}{2}CV_1^2 \Rightarrow U_2 = \frac{1}{2}C\left(\frac{V}{2}\right)^2 + \frac{1}{2}C\left(\frac{V}{2}\right)^2$

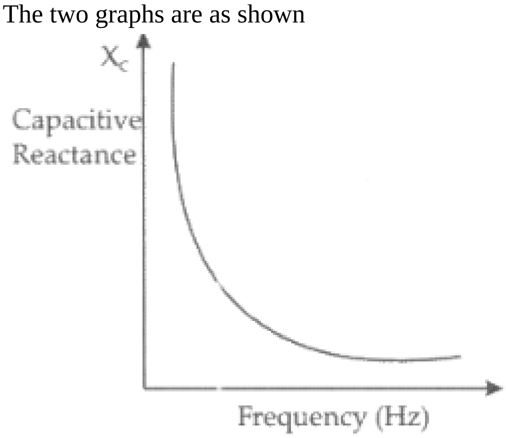
$U_2 = \frac{2CV^2}{8} = \frac{1}{4}CV^2$

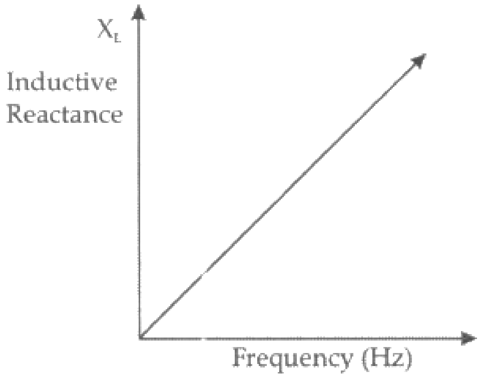
From Eqs. (i) and (ii), we get, $U_2 < U_1$

It means that energy stored in the combination is less than that stored initially in the single capacitor. It is due to the fact that when the charge is transferred from one capacitor to another capacitor energy is wasted in transferring the charge.

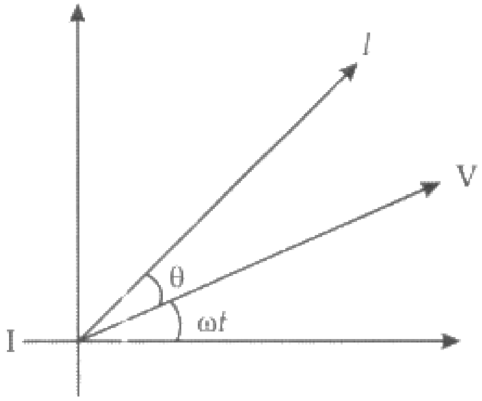
33. a. Drawing the two graphs the graph shows the variation of capacitive resistance with frequency and inductive resistance with frequency.

The two graphs are as shown





b. Drawing the phaser diagram
(the current leads the voltage by an angle θ where $0 < \theta < \frac{\pi}{2}$) . The required phaser diagram is as shown.



[Here, $\theta = \tan^{-1}\left[\frac{1}{\omega CR}\right]$

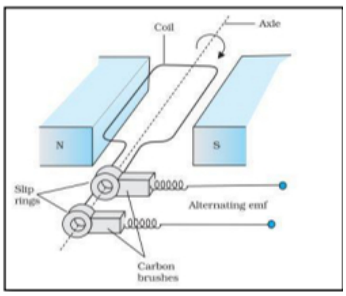
c.

i. In device X:
Current lags behind the voltage by $\frac{\pi}{2}$
$\therefore$ X is an inductor.
In device Y:
Current in phase with the applied voltage.
$\therefore$ Y is resistor.

ii. We are given that
0.25 = $\frac{220}{X_L}$
or X_L = $\frac{220}{0.25}\Omega$ = 880 Ω
Also 0.25 = $\frac{220}{X_R}$
$\therefore X_R = \frac{220}{0.25}\Omega$ = 880 Ω
For the series combination of X and Y,
Equivalent impedance = $\sqrt{X_L^2 + X_R^2} = (880\sqrt{2})\Omega$
$\therefore$ Current flowing $\frac{220}{880\sqrt{2}}$ A = 0.177 A

OR

i. Diagram



Principle - It is based on the principle of electromagnetic induction. Whenever there is a change in magnetic flux linked with a coil , an emf is induced in the coil.

Working - When a rectangular coil is rotated in a magnetic field, the magnetic flux changes continuously which induces an emf and the direction of current changes periodically.

$\varepsilon = \frac{-Nd\phi}{dt}$

$= -NBA\frac{d}{dt}(\cos\omega t)$

$\varepsilon = NBA\omega\sin\omega t$

ii. $\varepsilon = NBA\omega$

= 100 $\times$ 0.8 $\times$ 0.5 $\times$ 60

= 2400 V

hence, the maximum emf generated will be 2400 V.

Power dissipated, P = $\frac{\varepsilon_{rms}^2}{R}$

$= \frac{\left(\frac{2400}{\sqrt{2}}\right)^2}{100}$

= 28.8 kW