Class : XII || *CBSE* || Pre Board Examination , 2024-25

Subject : Physics ||Full marks : 70||Time : 3hours|| Set - 01

(The figures in the margin indicate full marks for the questions)

Section A

1. The cations and anions are arranged in alternate form in

a) ionic crystal   b) semiconductor crystal

c) covalent crystal   d) metallic crystal

Answer-(a) ionic crystal

2. Current density of a conductor is

a) Is always zero

b) the net charge flowing through the area

c) measure of the flow of electric charge in amperes per unit area of cross-section

d) the net charge flowing through the area per unit time

Answer-(d)

3. The focal length of a concave mirror is f. An object is placed at a distance x from the focus.The magnification is

a) f / (f + x)   b) (f +x) / f   c) f / x   d) x / f

Answer - (c)

u=f+x

Using mirror formula,

$$1/v + 1/u = 1/f$$

$$\text{Or}, 1/v - 1/(f+x) = -1/f$$

$$\therefore v = -f(f+x)/x$$

So, the magnification $= |m| = v/u = f/x$

4.A magnet of magnetic moment M is suspended in a uniform magnetic field B. The maximum value of torque acting on the magnet is

a) zero b) MB c) 2MB d) ½MB

Answer-(B)

5. A parallel plate capacitor of plate area A has a charge Q. The force on each plate of the capacitor is

a) $\frac{2q^2}{\epsilon_o A}$ b) zero c) $\frac{q^2}{\epsilon_o A}$ d) $\frac{q^2}{2\epsilon_o A}$

Answer-

Force on one plate due to another is

$$F = QE = Q \times \frac{\sigma}{2\varepsilon_0} = Q\left[\frac{Q}{2A\varepsilon_0}\right] = \frac{Q^2}{2A\varepsilon_0}$$

6. An electron is travelling along the X-direction. It encounters a magnetic field in the Y-direction. Its subsequent motion will be:

a) a circle in the Y Z-plane

b) straight line along the X-direction

c) a circle in the XZ-plane

d) a circle in the X Y-plane

Answer-

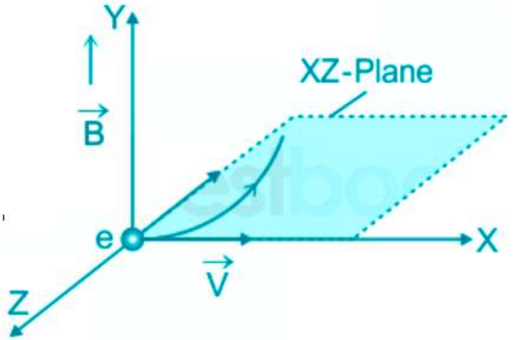
The force on an electron (charged particle) due to a magnetic field (B) is

$\vec{F} = e(\vec{V} \times \vec{B})$

Here, $\vec{V} = v_x\hat{i}$ and $\vec{B} = B_y\hat{j}$

$\therefore \vec{F} = e\, v_x B_y (\hat{i} \times \hat{j}) = e\, v_x B_y \hat{k}$

Therefore the subsequent motion of a charged particle will be **a circle in the xz plane.**



7. A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from O to 20 A in 0.5 s, change of flux linkage with the other coil is

a) 45 Wb b) 35 Wb c) 30 Wb d) 40 Wb

Answer-

Mutual inductance of a pair of coils, μ = 1.5 H

Initial current, $I_1 = 0$ A

Final current $I_2 = 20$ A

Change in current, $dI = I_2 - I_1 = 20 - 0 = 20$ A

Time taken for the change, t = 0.5 s

Induced emf, $e = \frac{d\phi}{dt}$ ... (1)

Emf is related with mutual inductance as:

$$e = L\frac{dI}{dt} \qquad (2)$$

Equating (1) and (2), we get $\frac{d\phi}{dt} = L\frac{dI}{dt}$

$$d\phi = 1.5 \times (20) = 30 \text{ Wb}$$

8. An aeroplane having a wingspan of 35m files due north with the speed of 90 m/s, given B = 4 x 10 $^{-5}$ T. The potential difference between the tips of the wings will be

a) 0.126 V b) 1.26 V c) 0.013 V d) 12.6 V

Answer-

Here : Length $l = 35\,m$

Speed of the aeroplane $v = 90\,m/s$

The induced emf is given by

$= Bvl = 4 \times 10^{-5} \times 90 \times 35 = 0.126\,V$

9. The shape of the wavefront of the portion of the wavefront of light from a distant star intercepted by the earth is

a) plane b) spherical c) conical d) hyperboloid

Answer- (a) plane

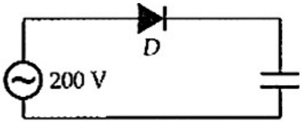
10. If an electron is accelerated by 8.8 x 10^{14}m/s^2, then electric field required for acceleration is (given specific charge of the electron = 1.76x 10^{11} C/kg)

a) 52 V/cm b) 50 V/cm c) 54 V cm d) 56 V cm

Answer-(b)

F = ma =qE => E = ma/q =m/ (q/m)

11. In the circuit given in the figure, an a.c. source of 200 V is connected through a diode D to a capacitor. The potential difference across the capacitor will be



a) 283 V b) 100 V
c) 310 V d) 200 V

Answer- (a) -

Junction diode conductors during alternate half-cycles of conduction, the capacitor will change itself to peak value of supply voltage.

$\therefore$ Voltage across capacitor $= E_{rms}\sqrt{2} = 200 \times \sqrt{2}V \approx 283V$

12. Green light of wavelength 5,460 Å is incident on an air-glass interface. If the refractive index of glass is 1.5 , the wavelength of light in glass would be (c = 3 x 10^8 m/s)

a) 6731 Å b) 3640 Å c) 5460 Å d) 4861 Å

Answer- (b) 3640Å

$$\lambda_g = \frac{\lambda_a}{\mu} = \frac{5460}{1.5} = 3640\,\text{Å}$$

13. Assertion (A): The photoelectrons produced by a monochromatic light beam incident on a metal surface, have a spread in their kinetic energies.
Reason (R): The work function of the metal varies as a function of depth from the surface.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false. d) A is false but R is true.

Answer - (a)

14.Assertion: For a charged particle moving from point P to point Q, the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q .

Reason: The net work done by a conservative force on an object moving along a closed loop is zero.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

Answer - (a)

15. Assertion (A): Light added to light can produce darkness.

Reason (R): When two coherent light waves interfere, there is darkness at position of destructive interference.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false. d) A is false but R is true.

Answer - (a)

16. Assertion (A): A step-up transformer cannot be used as a step-down transformer.

Reason (R): A transformer works only in one direction.
a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false. d) A is false but R is true.

Answer - (d)

Section B

17. A light beam travelling in the x-direction is described by the electric field: $E_y = 270 \sin \omega (t - x/c)$. An electron is constrained to move along the y-direction with a speed of 2×10^7 m/s. Find the maximum electric force and maximum magnetic force on the electron.

Maximum Electric field $E_0 = 300V/m$

maximum electric Force

$$F = qE_0 = (1.6 \times 10^{-19})(300) = 4.8 \times 10^{-17} N$$

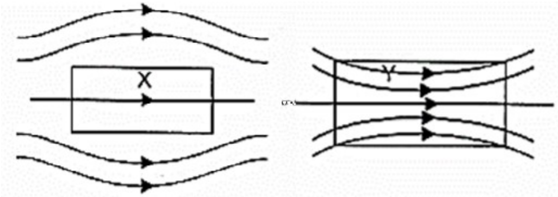
From the equation, $c = \frac{E_0}{B_0}$

Maximum Magnetic field $B_0 = \frac{300}{3.0 \times 10^8} = 10^{-6} T$

$\therefore$ maximum magnetic force = $B_0 qv$

$$= (10^{-6})(1.6 \times 10^{-19})(2.0 \times 10^7) = 3.2 \times 10^{-18} N.$$

18. A uniform magnetic field gets modified as shown below, when two specimens X and Y are placed in it.



i) Identify the two specimens X and Y.

Ii) State the reason for the behaviour of the field lines in X and Y.

i) Xis diamagnetic and Y is ferromagnetic.

ii) Diamagnetic materials have permeabilities less than 1 one and have negative susceptibility. Their atoms and molecules do not have permanent dipole moment. The field lines get expelled in them. Ferromagnetic materials have permeability more than one and susceptibility positive. Their atoms and molecules have permanent dipole moment. So the field lines get concentrated in them.

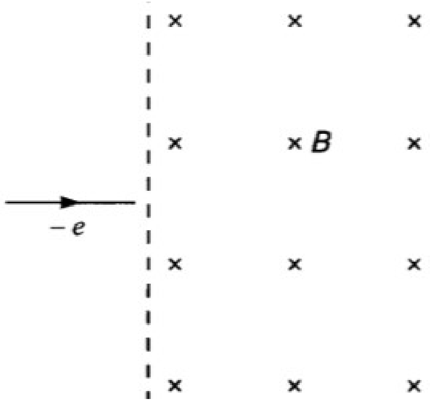
19. Explain the formation of potential barrier and depletion region in a p-n junction diode.

What is effect of applying forward bias on the width of depletion region?

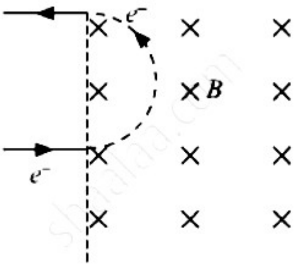
20. If the short series limit of the Balmer series for hydrogen is 3646 Å , calculate the atomic number of the element which gives X-ray wavelengths down to 1.0 Å. Identify the element.

21. An electron moving horizontally with a velocity of 4 x 10^{4} m/s enters a region of uniform magnetic field of 10

$^{-5}$ T acting vertically upward as shown in the figure. Draw its trajectory and find out the time it takes to come out of the region of magnetic field.



Answer-



Velocity of the electron, $v = 4 \times 10^4$ m/s

Magnetic field, $B = 10^{-5}$ T

Mass of the electron, $m = 9 \times 10^{-31}$ kg

Trajectory of Electron

Let the time taken by the electron to come out of the region of magnetic field be t.

We know $t = \frac{\pi r}{v}$ where r $= \frac{mv}{Bq}$

Now,

$$t = \frac{\pi m}{Bq} = \frac{3.14 \times 9 \times 10^{-31}}{10^{-5} \times 1.6 \times 10^{-19}} = 17.66 \times 10^{-7} s = 1.76 \mu s$$

Thus, the time taken by the electron to come out of the region of magnetic field is 1.76 μs.

b. A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid air by a uniform magnetic field B. What is the magnitude of the magnetic field?

Mass of the wire, $m = 200\text{ g} = 0.2\text{ kg}$

Length of the wire, $l = 1.5\text{ m}$

Current in the wire, $I = 2\text{ A}$

In the equilibrium position, the net force on the rod will be zero.

Thus, $mg = BIl \Rightarrow B = \frac{mg}{Il} = \frac{0.2 \times 9.8}{2 \times 1.5} = 0.65T$

Or

What information would you wish to know about the galvanometer before converting it into an ammeter or voltmeter?

Before converting the galvanometer into an ammeter or voltmeter we require the following two informations.

(i) The resistance of galvanometer and

(ii) the current for full scale deflection of galvanometer.

Section C

21. Two cells of EMFs 1 V, 2 V and internal resistance 2 Ω and 1 Ω respectively are connected in (i) series and (ii) parallel. What should be the external resistance in the circuit so that the current through the resistance be the same in the two cases? In which case, more heat is generated in the cells?

Given, $\varepsilon_1 = 1$ V, $\varepsilon_2 = 2$ V, and $r_1 = 2\ \Omega$, $r_2 = 1\ \Omega$, $R_{ext} = R$

For series combination,

Net emf, $\varepsilon = \varepsilon_1 + \varepsilon_2$ Net internal resistance $r_{int} = r_1 + r_2$

$$\therefore \quad \text{Current,} \quad I_1 = \frac{\varepsilon_1+\varepsilon_2}{r_1+r_2+R} = \frac{1+2}{2+1+R} = \frac{3}{3+R}\ A \quad \ldots(i)$$

For parallel combination,

$$\text{Net emf, } \varepsilon = \frac{\varepsilon_1 r_2+\varepsilon_2 r_2}{r_1+r_2}$$

$$\text{Net internal resistance, } r_{int} = \frac{r_1 r_2}{r_1+r_2}$$

$$\text{Current,} \quad I_2 = \frac{(\varepsilon_1 r_2+\varepsilon_2 r_1)/(r_1+r_2)}{R+\{(r_1 r_2/(r_1+r_2)\}} \ldots(ii)$$

$$\text{Current, } I_2 = \frac{(1\times1+2\times2)/(2+1)}{R+(2\times1)/(2+1)} = \frac{5/3}{R+\frac{2}{3}} = \frac{5}{3R+2}$$

Given $I_1 = I_2$

$$\therefore \quad \frac{3}{3+R} = \frac{5}{3R+2} \quad \text{or} \quad 9R+6 = 15+5R$$

$$4R = 9 \Rightarrow R = \frac{9}{4} = 2.25\ \Omega$$

Heat generated in external resistance (I^2R) is same in both cases but heat generated in cells ($I^2 r_{int}$) is more in series than that in parallel combination of cells.

23. Distinguish between n-type and p-type semiconductors on the basis of energy band diagrams. Explain .

24. Photoelectrons are emitted from a metal surface when illuminated with UV light of wavelength 330 nm. The minimum amount of energy required to emit the electrons from the surface is 3.5×10^{-19} J. Calculate :

(a) the energy of the incident radiation, and (b) the kinetic energy of the photoelectron.

ANS-

Here, $\lambda = 300nm = 300 \times 10^{-9}m = 3 \times 10^{-7}m$

$V_0 = 0.54V$

(i) Energy of the incident photon.

$$E = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34}) \times (3 \times 10^{8})}{3 \times 10^{-7}}$$

$$= 6.63 \times 10^{-19} J = \frac{6.63 \times 10^{-19}}{1.6 \times 10^{-19}} eV = 4.14eV$$

(ii) Max. K.E. of emitted photoelectron is

$K_{\max} = eV_0 = e \times 54V = 0.54eV$

(iii) As, $K_{\max} = \frac{hc}{\lambda} - \phi_0 = \frac{hc}{\lambda} - K_{\max}$

$$= 4.14eV - 0.54eV = 3.6eV$$

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25. (a) Differentiate between nuclear fission and nuclear fusion.

(b) Deuterium undergoes fusion as per the reaction:

$$\mathbf{{}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1 + 3{,}27\ MeV}$$

Find the duration for which an electric bulb of 500 W can be kept glowing by the fusion of 100 g of deuterium.

ANS-

Number of deuterium atoms is 2 kg $= \frac{6.023 \times 10^{23}}{2} \times 2000$ = 6.023 × 10^{26}

Energy released when 6.023 × 10^{23} nuclei of deuterium fuse together

$= \frac{3.2}{2} \times 6.023 \times 10^{26} MeV$ $= \frac{3.2 \times 6.023 \times 10^{26}}{2} \times 1.6 \times 10^{-13} J$

= 15.42 × 10^{13} J = 15.42 Ws

Power of lamp = 100 W

If the lamp glows for time t, then electric energy consumed = 100 t

∴ 100 t = 15.42 × 10^{33}

∴ t = 0.1542 × 10^{13} s $= \frac{0.1542 \times 10^{13}}{365 \times 86400} y$ = 4.0 × 10^4 y

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26. Show that the radius of the orbit in hydrogen atom varies as $\mathbf{n^2}$, where n is the principal quantum number of the atom .

27. A beam of light consisting of two wavelengths, 650 nm and 520 nm, are used to obtain interference fringes in a Young's double slit experiment.

a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.

B) What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide?

Wavelength of the light beam, $\lambda_1 = 650$ nm

Wavelength of another light beam, $\lambda_2 = 520$ nm

Distance of the slits from the screen = D

Distance between the two slits = d

(a) Distance of the nth bright fringe on the screen from the central maximum is given by the relation,

$$x = n\lambda_1\left(\frac{D}{d}\right)$$

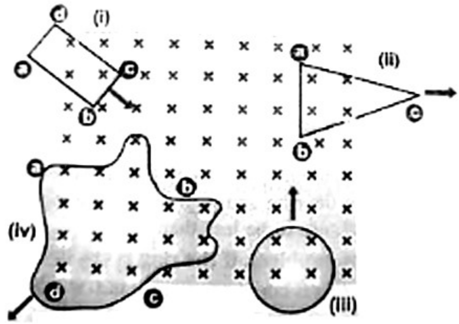
For third bright fringe, $n = 3$

$$\therefore x = 3\times 650\frac{D}{d} = 1950\left(\frac{D}{d}\right) \text{ nm}$$

28. Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of the same length wound one over the other.

Or

The figure below shows planer loops of different shapes moving out of or into a region of the magnetic field which is directed normal to the plane of the loops away from the reader. Determine the direction of induced current in each loop using Lenz's law. Check if you would obtain the same answers by considering the magnetic force on the charge inside the moving loops.



Section D

29.Read the text carefully and answer the questions:

Microwave oven: The spectrum of electromagnetic radiation contains a part known as microwaves. These waves have frequency and energy smaller than visible light and wavelength larger than it. What is the principle of a microwave oven and how it work? Our objective is to cook food or warm it up. All food items such as fruit, vegetables, meat, cereals, etc., contain water as a constituent. Now, what does it mean when we say that a certain object has become warmer? When the temperature of a b(Xly rises, the energy of the random motion of atoms and molecules increases and the travel or vibrate or rotate with higher energies. The frequency of rotation of water is about 2.45 gigahertz (GHz). If water receives microwaves of this frequency, its molecules absorb this radiation, which is equivalent to heating up water. These molecules share this energy with neighbouring food molecules, heating up the food. One should use vessels and non-metal containers in

a microwave oven because of the danger of getting a shock from accumulated electric charges. Metals may also melt from heating. The porcelain container remains unaffected and cool, because its large molecules vibrate and rotate with much smaller frequencies, and thus cannot absorb microwaves. Hence, they do not get eaten up. Thus, the basic principle of a microwave oven is to generate microwave radiation of appropriate frequency in the
working space of the oven where we keep This way energy is not wasted in heating up the vessel. In the conventional heating methcxl, the vessel on the burner gets heated first and then the inside gets heated because of transfer of energy from the vessel. In the microwave oven, on the other hand, energy is directly delivered to water molecules which is shared by the entire food.

(a) As compared to visible light microwave has frequency and energy

a) Frequency is less but energy is more

b) less than visible light

c) more than visible light

d) equal to visible light

Answer-(b)

(**b**) When the temperature of a body rises

a) the energy of the random motion of atoms and molecules decreases.

b) the energy of the random motion of atoms and molecules remains same.

c) the energy of the random motion of atoms and molecules increases

d) the random motion of atoms and molecules becomes streamlined.

Answer-(c)

(**c**) The frequency of rotation of water molecules is about

a) 2.45 THz b) 2.45 kHz c) 2.45 MHz d) 2.45 GHz

Answer-(d)

(d) In the microwave oven

a) Energy is directly delivered to the food grains.

b) The vessel gets heated first and then the water molecules collect heat from the body of the vessel

c) Energy is directly delivered to water molecules which is shared by the entire food

d) The vessel gets heated first, and then the grains inside

Answer-(c)

OR

Why should one use porcelain vessels and non-metal containers in a microwave oven?

a) Because it will prevent the food items to become hot

b) Because it will get too much hot

c) Because of the danger of getting a shock from accumulated electric charges

d) Because it may crack due to high frequency

Answer -(c)

30. Read the text carefully and answer the questions:

Section E

31. A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image

(a) at the least distance of distinct vision (25 cm), and

(b) at infinity?

What is the magnifying power of the microscope in each case?

Focal length of the objective lens, $f_1 = 2.0$ cm

Focal length of the eyepiece, $f_2 = 6.25$ cm

Distance between the objective lens and the eyepiece, d = 15 cm

(a) Least distance of distinct vision, d' = 25

$\therefore$ Image distance for the eyepiece, $v_2 = -25$ cm

Object distance for the eyepiece = u_2

According to the lens formula, we have the relation:

$$\frac{1}{v_2} - \frac{1}{u_2} = \frac{1}{f_2} \Rightarrow \frac{1}{u_2} = \frac{-1-4}{25} = \frac{-5}{25} = \frac{-1}{5}$$

$$\therefore u_2 = -5 \text{ cm}$$

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Image distance for the objective lens, $v_1 = d - |u_2| = 15 - 5 = 10$ cm

Object distance for the objective lens = u_1

According to the lens formula, we have the relation:

According to the lens formula, we have the relation:

$$\frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{f_1}$$

$$\frac{1}{u_1} = \frac{1}{v_1} - \frac{1}{f_1} \Rightarrow \frac{1}{u_1} = \frac{1}{10} - \frac{1}{2} = \frac{1-5}{10} = \frac{-4}{10}$$

$$\therefore u_1 = -2.5 \text{ cm}$$

The magnifying power of a compound microscope is

$$m = \frac{v_1}{|u_1|}\left(1 + \frac{d'}{f_2}\right) = \frac{10}{2.5}\left(1 + \frac{25}{6.25}\right) = 4 \times (1+4) = 20$$

Hence, the magnifying power of the microscope is 20.

(b) The final image is formed at infinity.

$\therefore$ Image distance for the eyepiece, $v_2 = \infty$

Object distance for the eyepiece = u_2

According to the lens formula, we have the relation:

$$\frac{1}{v_2} - \frac{1}{u_2} = \frac{1}{f_2} \Rightarrow \frac{1}{\infty} - \frac{1}{u_2} = \frac{1}{6.25} \qquad \therefore u_2 = -6.25 \text{ cm}$$

Image distance for the objective lens, $v_1 = d - |u_2| = 15 - 6.25 = 8.75$ cm

Object distance for the objective lens = u_1

According to the lens formula, we have the relation:

$$\frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{f_1} \Rightarrow \frac{1}{u_1} = \frac{1}{8.75} - \frac{1}{2.0} = \frac{2 - 8.75}{17.5} = -\frac{6.75}{17.5}$$

$$\Rightarrow u_1 = -\frac{17.5}{6.75} = -2.59 \text{ cm}$$

The magnifying power of a compound microscope is given by

$$m = \frac{v_1}{|u_1|}\left(\frac{d'}{|u_2|}\right) = \frac{8.75}{2.59} \times \frac{25}{6.25} = 13.51$$

Hence, the magnifying power of the microscope is 13.51.

Or

When a parallel beam of a monochromatic source of light of wavelength λ is incident on a single slit of width a, show how the diffraction pattern is formed at screen by the interference of the wavelets from the slit. Show that,besides the central maxima at $\theta = 0$, secondary maxima are observed at $\theta = (n + \frac{1}{2})\lambda/a$ and the minima at = $n\lambda/a$. Why do secondary maxima get weaker in intensity with increasing n?

32. A parallel plate capacitor is charged by a battery. After time the battery is disconnected and a dielectric slab with its thickness equal to the plate separation is inserted tptween the plates. What change, in any will take place in

i) charge on the plates

ii) electric field intensity between the plates

iii) the capacitance Of the capacitor,

iv) a potential difference between the plates and

v) the energy stored in the capacitor? Justify Ymir answer in each case.

Or

Derive an expression for the potential at a point due to an electric dipole. Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge.

33. (i) Prove that an ideal capacitor in an ac circuit does not dissipate power.

(ii) An inductor of 200 mH, a capacitor of 400 μF and a resistor of 10 Ω are in series to ac source of 50 V of variable frequency. Calculate the angular frequency at which maximum power dissipation occurs in the circuit and the corresponding value of the effective current and the value of Q-factor in the circuit.

Ans -

Here, $L = 200mH = \frac{2}{10}H \qquad R = 10ohm, E_v = 50V$

$C = 400\nu F = 400 \times 10^{-6}F = 4 \times 10^{-4}F$

(i) Maximum power dissipation occurs in the circuit at resonance, i.e., when

$$\omega L = \frac{1}{\omega C}$$

or $\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\frac{2}{10} \times 4 \times 10^{-4}}} = \frac{1}{\sqrt{80 \times 10^{-6}}} = \frac{10^3}{8.944}$
$= 111.8 rad/s$

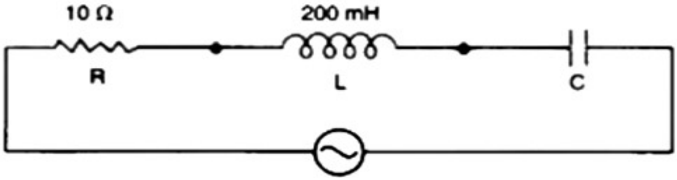
$$I_v = \frac{E_v}{Z} = \frac{E_v}{R} = \frac{50}{10} = 5A$$

(ii) $Q = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{10}\sqrt{\frac{2/10}{4 \times 10^{-4}}} = \frac{1}{10} \times \frac{100}{1.47} = 2.237$

Or

In the following circuit, calculate the of the capacitor,if the power factor of the circuit is unity Calculate the Q factor of this circuit . What is the significance of the

Q-factor in ac circuit? Given the angular frequency of the ac source to be 1 rad/s. Calculate the average power dissipated in the circuit.



Ans-

(i) power factor, cos ϕ = R/z = 1 or z = R

$$\therefore \quad X_C = X_L \quad \text{or} \quad \frac{1}{2\pi f C} = 2\pi f L$$

$$\text{or } C = \frac{1}{4\pi^2 f^2 L} = \frac{1}{4 \times 9.87 \times (50)^2 \times 200 \times 10^{-3}} = 5 \times 10^{-5}\text{F} = \mathbf{50\ \mu F}$$

$$(ii)\ \text{Q-Factor} = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{10}\sqrt{\frac{200 \times 10^{-3}}{5 \times 10^{-5}}} = \mathbf{6.32}$$

Average power dissipation

$$P_{av} = \frac{V_{rms}^2}{R} = \frac{(50)^2}{10} = 250W$$

For angular frequency of the ac source ω = 1 rad/s

Here, R $= 10\ \Omega$, $L = 200mH = 0.2H, V_{rms} = 50V$,

power factor $\cos\phi = 1$ and $\omega = 1s^{-1}$

(a) For power factor to be one, $X_L = X_C \Rightarrow L\omega = \frac{1}{C\omega}$

$\Rightarrow$ Capacitance

$$C = \frac{1}{L\omega^2} = \frac{1}{0.2 \times (1)^2} = 5\ F$$

(b) The Q-factor $= \frac{X_L}{R} = \frac{L\omega}{R} = \frac{0.2 \times 1}{10} = 0.02$