CBSE Physics Set I Outer Delhi Board 2012

SelfStudy.in

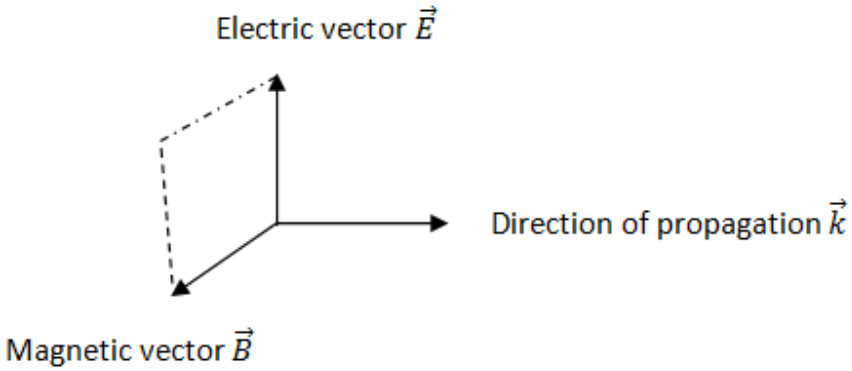
Q1. Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker?

Answer: We know that resistance of a wire is given by $\mathrm{R} = \frac{\rho l}{\mathrm{A}} = \frac{\rho l}{\pi \mathrm{r}^2}$

Since by nature resistivity ρ of manganin is much greater than that of copper, therefore to keep same resistance R, for same length of wire, the manganin wire (radius should be more) must be thicker.

Q2. What are the direction of electric and magnetic field vectors relative to each other and relative to the direction of propagation of electromagnetic waves?

Answer: In electromagnetic waves the electric and magnetic field vectors are perpendicular to each other and are perpendicular to the direction of propagation of wave.

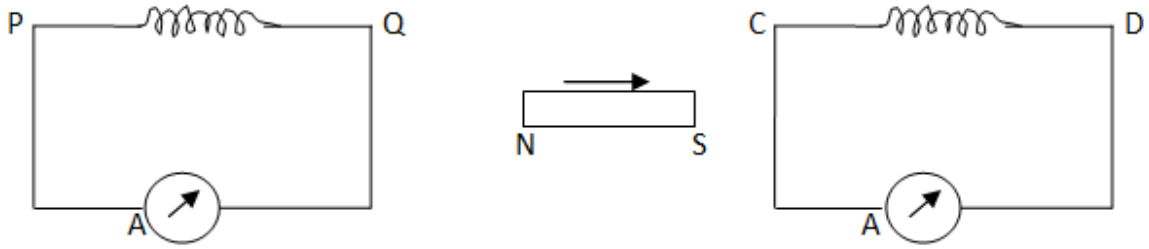


Q3. How does the angular separation between fringes in single-slit diffraction experiment change when the distance of separation between the slit and screen is doubled?

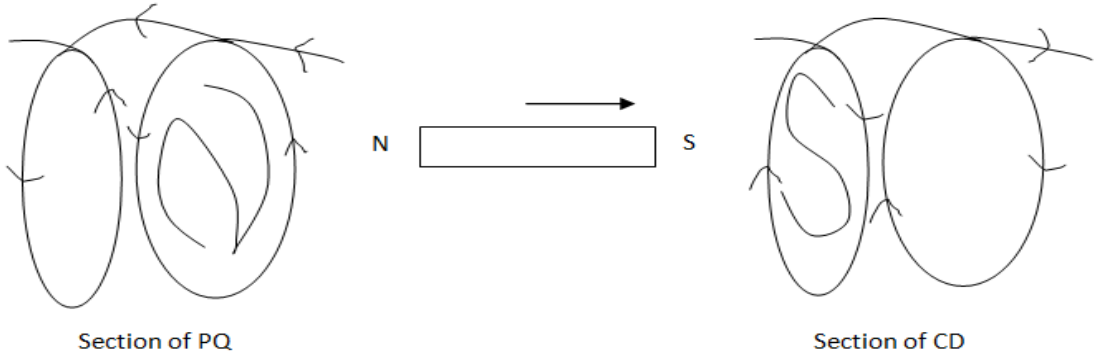
Answer: The angular width of central diffraction band $= \frac{2\lambda}{\mathrm{a}} \propto \frac{1}{\mathrm{a}}$, when slit width is doubled the width of central band becomes half of the initial value. As intensity of central maximum $\propto \mathrm{a}^2$, if slit width is doubled, the intensity becomes four times.

Answer: The separation is not the function of distance beween the slit and the screen , it would not change

Q4. A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the direction of induced current in each coil.



Answer: We know that as per Lenz's law direction of induced emf is such that it opposes the very cause due to which it is produced. So if South Pole approaches to CD then direction of current should be such that S pole produced in CD, so south will oppose approaching south (as shown), similarly if North Pole approaches PQ then direction of current in PQ is such that North Pole is produced in PQ.



Just if we write the letter S and N, direction of current is self explanatory.

Q5. For the same value of angle of incidence, the angles of refraction in three media A, B and C are 15^0, 25^0 and 35^0 respectively. In which medium would the velocity of light be minimum?

Answer: For Snell's law, $n = \frac{\sin i}{\sin r} = \frac{C}{v}$

For given i, $v \propto \sin r$

$\sin 15^0 < \sin 25^0 < \sin 35^0$

Thus r is minimum in medium A, so velocity of light is minimum in medium A.

Q6. A proton and an electron have same kinetic energy. Which one has greater de-Broglie wavelength and why?

Answer: An electron has the larger wavelength.

Reason: de-Broglie wavelength in terms of kinetic energy is

$\lambda = \frac{h}{\sqrt{2mE_K}}$ or $\lambda \propto \frac{1}{\sqrt{m}}$ for the same kinetic energy. Mass of an electron is smaller than mass of proton therefore an electron has larger de-Broglie wavelength than a proton when both have the same kinetic energy.

Q7. Mention the two characteristic properties of the material suitable for making core of a transformer.

Answer:

1. High permeability: to reduce flux leakage, less hysteresis loss.

2. Soft magnetic property: to reduce loss of power as heat material must have soft magnetic property so that it can be magnetised and demagnetised with minimum heat loss.

Q8.A charge 'q' is placed at the centre of a cube of side *l*. What is the electric flux passing through each face of the cube?

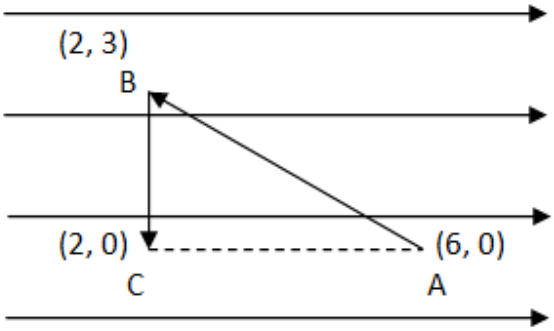
Answer:

According to Gauss's theorem, the total electric flux through the six faces of cube $= \frac{q}{\epsilon_0}$.

Therefore flux through each face = $\frac{q}{6\epsilon_0}$

Q9. A test charge 'q' is moved without acceleration from A to C along the path from A to B and then from B to C in electric field E as shown in the figure.

I. Calculate the potential difference between A and C.
II. At which point of the two is the electric potential more and why?



Answer: Distance between point A and C

AC = 6 – 2 = 4

$\therefore \mathrm{dr} = \mathrm{AC} = 4$

$\mathrm{E} = \frac{\mathrm{dV}}{\mathrm{dr}}$ Therefore Potential difference = $V_A - V_C$=dV= E.dr=E(6-2)=4E

Work done against field is stored as potential when it is against field work is more thus while moving from A to C work is done against the direction of electric field , i.e Potential at C will be more.

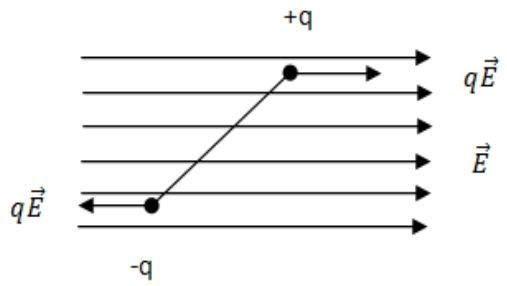
$\therefore V_C > V_A$

Q10. An electric dipole is held in a uniform electric field.

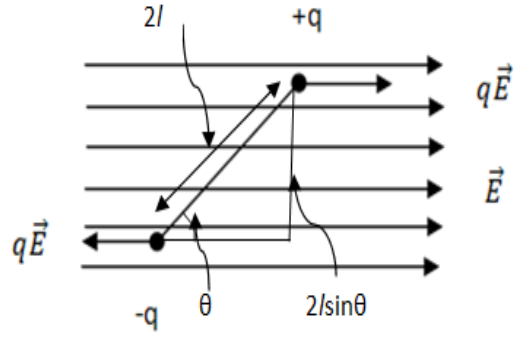
I. Show that the net force acting on it is zero.

II. The dipole is aligned parallel to the field.
Find the work done in rotating it through the angle of 180^0.

Answer:



I. Force on electric dipole kept in uniform electric field: An electric dipole is placed in uniform electric field ($\vec{E}$). The force acting on +q charge $q\vec{E}$ which is along the direction of electric field and force in –q charge is $q\vec{E}$ but this force is acting in opposite direction as shown in the figure. Since these two forces are equal in magnitude and opposite in direction hence net force is zero. However these two forces constitute couple.



II. Moment of the force =force X perpendicular distance

=qEx2l/sinθ=PEsinθ (P=qx2l = dipole moment)

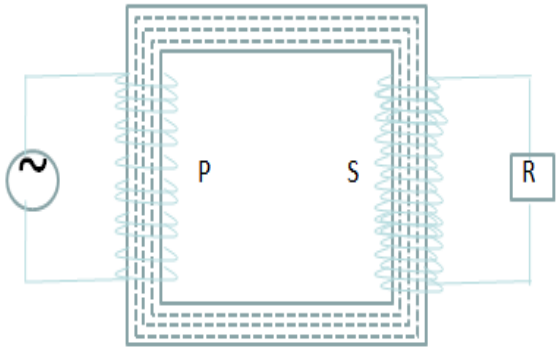
Work done to move by an angle dθ, dw = PEsinθdθ

Therefore work done to rotate from θ=0 to θ=180^0

$$W = \int dw = \int_0^{\pi} PESin\theta d\theta = PE[-cos\theta]_0^{\pi}$$
$$= -PE[cos\pi - cos0] = -PE[-1-1] = 2PE\ Joule$$

Q11. State the underlying principle of transformer. How is the large scale transmission of electric energy over long distances done with the use of transformers?

Answer:



Principle: It is a device which converts high voltage, A.C. into low voltage A.C. and vice versa. It is based upon the principle of *mutual induction*. When alternating current passed through a coil (Primary), an induced e.m.f. is set up in the neighbouring coil(Secondary).

Construction: A transformer consists of two coils of many turns of insulated copper wire wound on a closed laminated iron core. One of the coils known as primary (P) is connected to A.C. supply. The other coil known as Secondary (S) is connected to the load.

Working: It consists of two coils known as Primary (P) and Secondary(S) having different no. of turns and are would on two opposite arms of a thick laminated iron core. The alternating emf to be transformed is connected across the primary coil. The varying current flowing through the primary coil produces varying magnetic lines of force. The magnetic ion core provides an easy path for the flow of lines of force hence the lines of force flowing through the core cuts the secondary coil and induces an emf across the secondary. An induced current flow through the secondary coil and thus a potential drop is obtained across the resistance which is known as output voltage.

Theory: Given

N_p and N_s are number of turns in the primary and secondary respectively

V_p and V_s are their respective voltages.

$$\therefore V_p = -N_p \frac{d\phi}{dt} \text{ and } V_s = -N_s \frac{d\phi}{dt}$$

Where, N_p and N_s are number of turns in the primary and secondary respectively and V_p and V_s are their respective voltages.

$$\therefore \frac{V_s}{V_p} = \frac{N_s}{N_p} \text{ This ratio } \frac{N_s}{N_p} \text{ is called the turns ratio.}$$

$$In\ a\ step-up\ transformer: N_s > N_p,\ so\ V_s > V_p.$$

$In\ a\ step-down\ transformer:\ N_s < N_p,\ \ so\ V_s < V_p$

The larger scale transmission and distribution of electrical energy over long distances is done with the use of transformers. In order to reduce loss due to heat produced during transmission, for the power generation station using step up transformer high voltage low current transmitted(Heat=i^2Rt) since current is low hence less heat is produced hence less loss. Near consumers locality area sub-station it is stepped down low voltage but high current. It is further stepped-down at distributing sub-stations and utility poles before a power supply of 240 V reaches our homes.

Q12. A capacitor of capacitance 'C' is being charged by connecting it across a *dc* source along with an ammeter. Will the ammeter show a momentary deflection during the process of charging? If so, how would you explain this momentary deflection and the resulting continuity of current in the circuit? Write the expression for the current inside the capacitor.

Answer: Yes, during the process of charging ammeter will show momentary deflection.

When the Capacitor is connected, initially charge in capacitor is zero, as the charge flows potential will raises. The flow of charge continues till the potential difference across the capacitor becomes equal to the emf of the source. Thus as long as charge flows it gives current in the circuit and ammeter will show deflection. When the capacitor gets fully charged there will not be any difference in potential so at steady state charge flow will be negligible (almost zero), deflection in ammeter will not be observed.

$e.m.f\ equataion\ \frac{Q}{c}+iR=E, Solving\ we\ get\ Q=Q_0\left(1-e^{t/RC}\right) where\ Q_0=EC$

R= Resistance, E= emf of dc source, C=Capacitance this gives the growth of charge.

Since $i=\frac{dQ}{dt}=i=\frac{Q_0}{RC}e^{-t/RC}=i_0e^{-t/RC}\ where\ i_0=\frac{Q_0}{RC}$.

Expression for current $i=i_0e^{-t/RC}$