SECTION B

SHORT QUESTION

Q NO 02

(iv)

ANSWER:

Volt: The 'term' volt' represent unit of potential differences and 1 volt is the potential difference when one joule of work is done in moving 1 Coloumb charge between two points against electric field.

Electron Volt: Electron-volt (ev) is the unit of energy and 1 ev is the kinetic energy gained or lost by an electron when it moves through a P.D of 1 volts.

Relation: The energy E in electron-volts (ev) is equal to the voltage v in volts times the electric charge Q in elementary units (e)

$$E\ (ev) = V\ (v) \times Q\ (e)$$

Thus 1 ev energy is equivalent to,

$$1\ ev = 1V \times 1e$$

$$1\ ev = 1\ V \times 1.6 \times 10^{-19}\ C$$

$$1\ ev = 1.6 \times 10^{-19}\ J$$

Difference: Volt and electron-volt (ev) are two difference physical quantities. Electric potential is a property associated with the field, while the energy is associated with the particle you place into that field and it depends on the particle.

Question No 02

(i)

Answer:

Given Data:

charge = $q = 3\mu C = 3 \times 10^{-6} C$

distance = $30\ cm = \frac{30}{100} m = 30 \times 10^{-2} m$

Required:

Electric field $E = ?$

Solution:

We know that

$$E = \frac{kq}{r^2}$$

$$E = \frac{(9\times 10^{9})(3\times 10^{-6}C)}{(30\times 10^{-2})^{2}}$$

$$E = \frac{27\times 10^{3}}{900\times 10^{-4}}$$

$$E = 0.03\times 10^{3}\times 10^{4}$$

$$E = 0.03\times 10^{7}$$

$$E = 3\times 10^{5}\ N/C$$

(QUESTION NO 02)

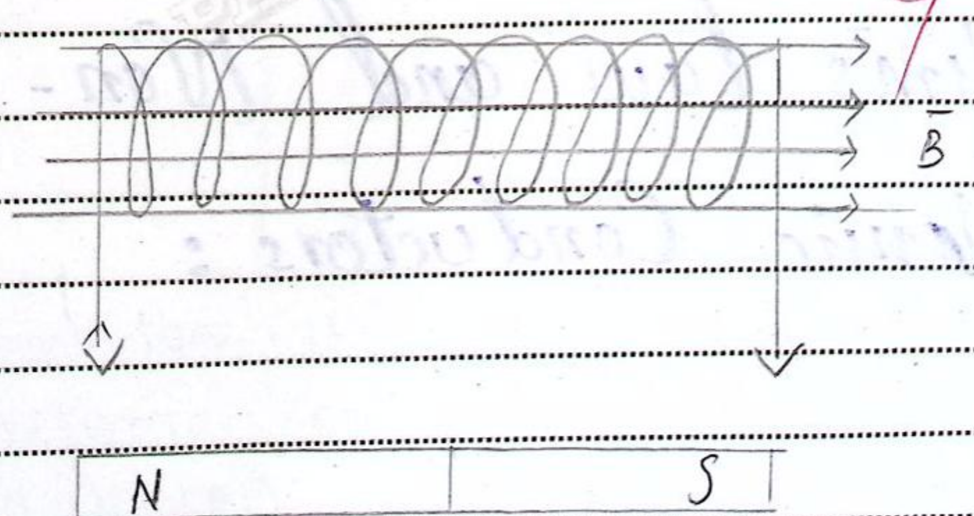
(VII)

Answer:

A current carrying coil behaves like a bar magnet.

Reasons and Explanation:

Consider a coil as shown in the figure. when current passes through the coil, a Uniform magnetic field is produced inside the turns of the coil. The magnetic field lines originated from one side and ends at the other side Now if we Suspend the coil freely, it will rotate and will settle down along North-South direction. As the earth's magnetic field exists along North-South direction, so the Currents Carrying coil behaves like a North-pole and the other and behaves like a South-pole.



Question No 02

(V)

Answer:

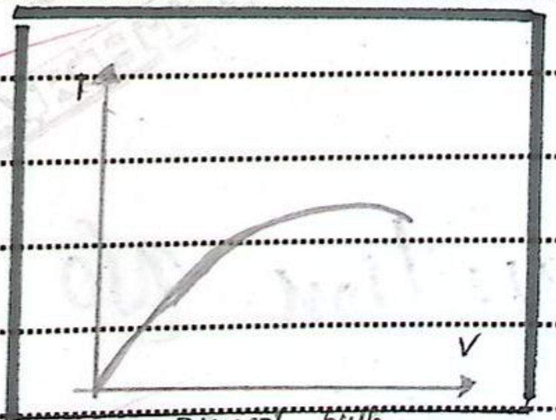
Ohm's Law:

This law states that "the magnitude of the current in metals is proportional to the applied voltage if the physical state of the conductor remain unchanged.

Ohm's law and Non-Ohmic Conductors:

→ The ohm's law is not valid for all conducting materials. Those materials for which the slope of "I" varses "V" graph is not constant are called non-ohmic materials. for example

1. The filament of an electric bulb behaves like non-ohmic bulb shows that the graph bends ever as "V" and "I" increases. It shows that a given change of "V" cause a correspondingly smaller change in "I" at larger values of "V". Thus the slope of graph decreases with the increases of voltage.

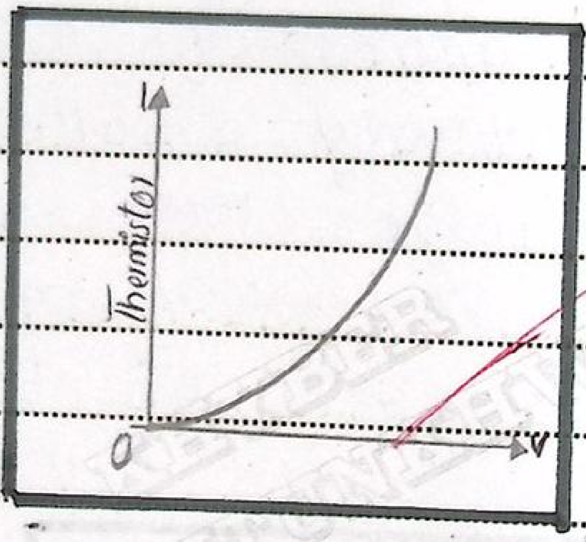


Filament bulb

2. Thermistor is also an example of non-ohmic conductor. The I-V graph for thermistor bends

upwards which shows that their resistance decreases sharply as their temperature rises and hence current increases.

3. Semi conductor diode is another example of non-ohomic conductor.



(Question No 02)

(iii)

Answer:

Dielectric :

An isulating material that becomes polarized is an electric field.

Dipole :

A pair of equal and opposite charges separated by a small distance.

Dipole Moment :

A vector quantity defined as $\vec{p} = q \cdot \vec{d}$, where q is charge and $\vec{d}$ is the separation.

Polarization :

The aligment of electric dipoles within a dielectric when placed in an electric field.

(Question No 02)

(XI)

Answer:

β - Factor in Terms of α - Factors :

As $\beta = \frac{I_C}{I_B}$ —— (1)

Here. $I_B = I_E - I_C$, so equation (1)

$\Rightarrow \beta = \frac{I_C}{(I_E - I_C)}$ —— (2)

$\beta = \frac{I_C}{I_E\left(1 - \frac{I_C}{I_E}\right)}$ —— (3)

As $\frac{I_C}{I_E}$ = alpha factor = a, so

equation (3)

$$\beta = \frac{a}{(1-a)}$$

Questions No 02

(xii)

Answer:

For same De-Broglie wavelength the speed of electron will be greater than the speed of proton.

Reasons and Explanation:

We know that the De-Broglie wavelength is given by,

$$\lambda = \frac{h}{mv} \quad \text{—— (1)}$$

For electron, equation (1) can be written as,

$$\lambda_e = \frac{h}{mv} \quad \text{—— (2)}$$

For proton, equation (1) can be written as,

$$\lambda_p = \frac{h}{mv} \quad \text{—— (3)}$$

For same De-Broglie wavelength we have

$$\lambda_p = \lambda_p \Rightarrow \frac{h}{m_e v_e} = \frac{h}{m_p v_p}$$

$$\Rightarrow m_e v_e = m_p v_p \Rightarrow v_e = \left[\frac{m_p}{m}\right] v_p \quad \text{—(4)}$$

As mass of proton is greater than mass of electron i.e.

$$m_p > m_e \Rightarrow \frac{m_p}{m_e} > 1$$

So equation (4) becomes.

$$\boxed{v_e > v_p}$$

Thus for same De-Broglie wavelength the speed of electron will be greater than the speed of proton.

(Question No 02)

(viii)

Answer:

When we double the frequency then the reactance of an inductor will also be double. While that of the capacitor will becomes half.

Reasons and Explanation:

Part (a): In case of an inductor we have:

$$X_L = 2\pi f L \quad \text{—— (1)}$$

When frequency becomes double then equation (1) becomes,

$$X_L = 2\pi f L \Rightarrow X_L = 2\pi (2f) L$$

$$X_L = 2(2\pi f L) \quad \text{—— (2)}$$

Putting equation (1) in equation (2) we get

$$\boxed{X_L = 2 X_L} \quad \text{—— (3)}$$

Equation (3) shown that the reactants of the inductor will becomes double if the frequency two times:

In case of a capacitor, we have.

$$X_C = \frac{1}{2\pi fC} \quad \text{— (4)}$$

Now when the frequency becomes double, then we have, $f = 2f$, so equation (4) becomes

$$X'_C = \frac{1}{2\pi f' C} \Rightarrow X'_C = \frac{1}{2\pi (2f) C}$$

$$X'_C = \frac{1}{2}\left(\frac{1}{2\pi fC}\right) \quad \text{— (5)}$$

Putting equation (4) in equation (5), we get,

$$X'_C = \frac{1}{2} X_C \quad \text{— (6)}$$

Equation (6) shown that the reactance of the capacitor becomes half the frequency becomes double.

Questions No 02

(1X)

Answer:

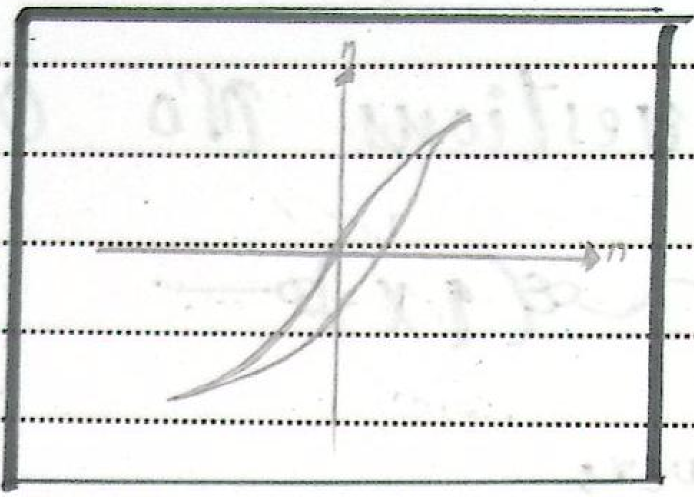
Soft Magnetic Materials:

Material with narrow magnetic hysteresis loop are easily magnitud and demagnitude and are called magnetic materials.

Explanation:

Soft materials have narrow hysteresis loop thus they possess small amount of residual magnetism and to overcome less coessive force is required. work must be done in closing hysteresis.

Soft magnetic material

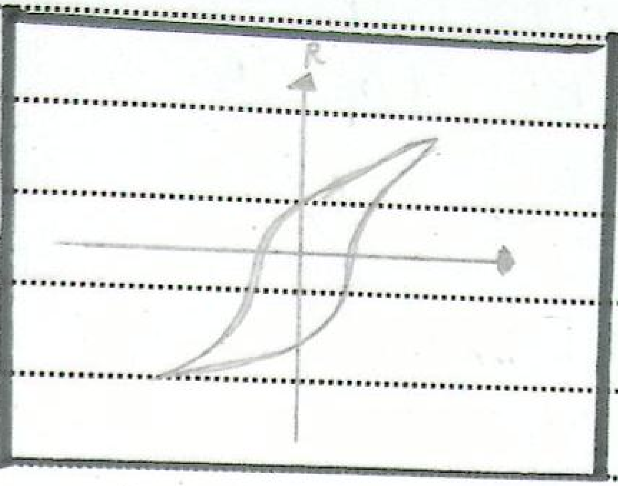


Hard Magnetic Materials:

Materials with broad magnetic hysteresis loop are dificult to magnetisme and demagnetism and are called hard magnetic materials.

Explanation:

Hard materials have fat hysteresis loop. Thus they posses large amount of residual magnetism and to overcome large coeicave force is required. Thus once magnetized they stay magnetized are substantial magnetic flux density.



Hard magnetic material.

Question No 02

(II)

Answer:

Relation between electric Field and Potential gradient

Let us consider a uniform field for which the lines of force are parallel and equidistance from each other. Let A and B be two points which are very close to each other so that the electric field intensity is almost constant as show in the figure.

$$work = W_{AB} = \vec{F} \cdot \Delta\vec{r} = F \Delta r \cos\theta \rightarrow (1)$$

As the electric force acting on the charge is Eq_0 so, in order to move the charge against electric field uniformly a force equal in magnitude but opposite in direction must applied on the charge i.e

$$F = -Eq_0$$

$$W_{AB} = Eq_0 \Delta r \cos 0''$$

$$W_{AB} = Eq_0 \Delta r$$

$$\frac{W_{AB}}{q_0} = E\Delta r$$

$$\Delta V = -E\Delta r$$

$\frac{\Delta V}{\Delta r} = -E$

or $E = -\frac{\Delta V}{\Delta r}$

SECTION C

QUESTION NO 03

Part a

Answer:

Alternating Current (AC)

Generator:

Definition: The device with converts mechanical energy into electrical energy of the form in which the flow of electric charges periodically reverse direction.

Working principle:

The working of an electric generator is based on faraday's law of electromagnetic induction. The e.m.f generator is dynamically induced e.m.f.

Contruction:

It consists of coil CDEF, two slipe rings and two carbon bruches. When the coil CDEF rotates between the poles of magnet, an electromotive force is induced. A_1 is connected to side CD as always in contact with the brush B_1 and A_2 with the brush B_2.

Working:

When side CD moves upwards, Fleming's Right hand rules that the direction of the current is form C to D and E to F. Current direction is reversed. i.e it is form F to E and D and C. The current now enters the circuit at B and leaves at B, force and the current changes every half revolution.

(Part b)

Given data:

Initial current = I_1 = 5A

Final current = I_2 = 0A

Change in time = Δt = 0.1s

Change in current = $\Delta I = (I_2 - I_1) = (0 - 5) = -5A$

Self Induced emf = ε = 200 volts

Required data:

Self inductance = ?

Calculation :

We know that =

$$\rightarrow \varepsilon = -L \frac{\Delta I}{\Delta t}$$

$$\Rightarrow L = -\frac{\varepsilon \Delta t}{\Delta I}$$

$$\rightarrow L = \frac{-(200 \times (0.1))}{-5}$$

$$\rightarrow L = \frac{-20}{-5}$$

$$\rightarrow \boxed{L = 4H}$$

Fig. No.

109

(صرف بورڈ کے استعمال کیلئے) اُمیدوار یہاں کچھ نہ لکھیں

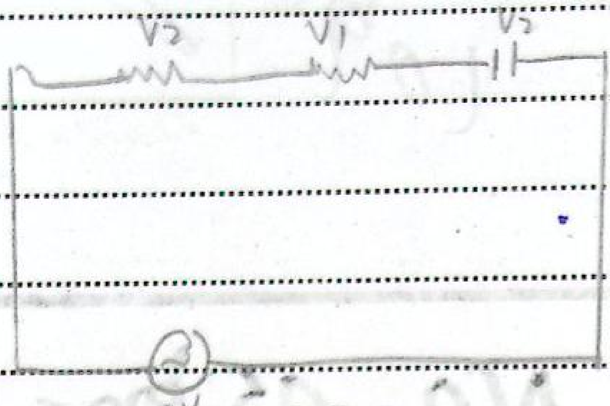
~(QUESTION NO 05)~

~(Part a)~

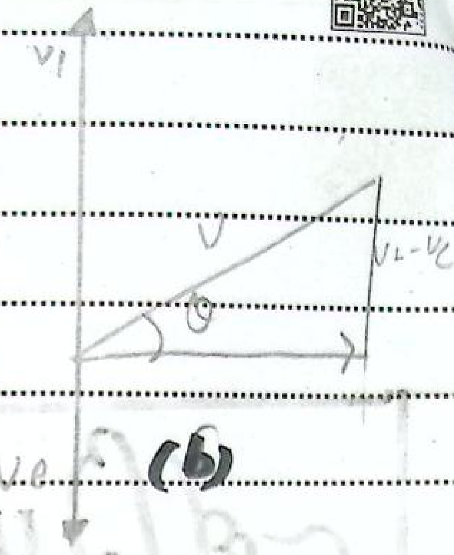
Answer:

RLC SERIES AC CIRCUIT:

Many ac circuit used in practical electronics involves resistor, inductor and capacitor. Fig shown a RLC circuit which is exiceded by a Sinusoidal ac voltage source of angular frequency ω. In practice R may be the resistance of the inductor.



(a)



(b)

Cuhole the rms Current that flow and phase difference between source voltage and current.
The p.d V_R across R is in phase with I. The voltage Vt across L leads on I by 90° wherase Vc lags behind I by 90°. V_L and Vc are therefore 180° out of direction VL the vector of $(V_L - V_C)$ and V_R equals the applied voltage V. Therefore

$$V' = V_R + (V_1 - V_c)$$

But $V_R = I R$, $V_L = I X_L$ and $V_C = I X_C$ Hence

$$V_1 = I'(R^2 + (X_2 \pm X_L)^2)$$

$$V = I\sqrt{R + (X_1 - X_1)^2}$$

$$Z = \frac{V}{I} = \sqrt{R + (X_L - X_C)^2}$$

Also $\cos\theta = \frac{V_R}{V} = \frac{IR}{IZ} = \frac{R}{Z}$

Finally, we can determine the power dissipated in the LCR series circuit the average power dissipated per cycle is

$$\langle P \rangle = I_{rms} V_{rms} \cos\theta .$$

SERIES Resonance AC Circuit:

From Eq it follows that the rms current in a series RCL circuit of impedance

$$I_{max} = \frac{V_{max}}{Z} = \frac{V_m}{(R^2 + (X_L - X_C)^2}$$

(Part b)

Given data:

Mass of 6.02×10^{26} atoms of $_6C^{12}$ = 12kg

mass of 1 atom of $_6C^{12} = \frac{12}{6.02 \times 10^{26}}$ kg

Mass of $\frac{1}{12}$ th atom of $_6C^{12}$ =

$$\frac{1}{12} \times \frac{12}{6.02 \times 10^{26}} \text{ kg}$$

$1U = 1a.m.u = 1.66 \times 10^{-27}\,kg$

Unit of energy in terms of amu:

In atomic and nuclear physics the mass is often expressed in terms energy.

$E = (1.66 \times 10^{-27}\,kg)(3 \times 10^{8}\,m/s)\; 1.49 \times 10^{-10}\,J$

Since $1eV = 1.60 \times 10^{-19}\,J = 1J\ \frac{1}{1.60 \times 10^{-19}}\,eV$

So $E = 1.49 \times 10^{-10} \times \frac{1}{1.60 \times 10^{-19}}\,eV = 931\,MeV$

This is equivalent to amu or 1U.

So $1\,amu$ or $1U = 931\,MeV$

Question No 06

Part a

Answer.

Consider a paralel plate capacitor as ~~Sh~~ let the medium between the plates is air and "d" be the distance between the plates. Now we know that.

$$Q = CV$$

$$C = \frac{Q}{V} \quad — ①$$

We also know that.

$$V = Ed \quad — ②$$

Putting equation ② in equ ①

$$C = \frac{Q}{Ed} \quad — ③$$

For two oppositely charged paralle plates, we have

$$E = \frac{\sigma}{\varepsilon_0} \quad — (4)$$

Putting equ (4) in equ (3)

$$C = \frac{Q\varepsilon_0}{\sigma d} \quad — (5)$$

$$\sigma = \frac{Q}{A}$$

$$Q = \sigma A \quad — (6)$$

Putting equ (6) in equ (5)

$$C = \frac{\sigma A \varepsilon_0}{\sigma d}$$

$$C = \frac{A\varepsilon_0}{d} \quad — (7)$$

equ 7 represent the capacitance of a paralle plates capacitor having air as medium between its plates.

b) When Medium is Dielectric:

In case of dielectric medium

we replace "ε_0" by so equation 7 becomes

$$C = \frac{A\varepsilon}{d} \quad — (8)$$

Equ 8 represents the capacitance of parallel plate capacitor between their plates.

Comparison of "C" and "C'"

In order to compare "C" and "C'" we introduce relative permittivity "ε_r" which is

$$\varepsilon_r = \frac{\varepsilon}{\varepsilon_0} \;.\;= \varepsilon = \varepsilon_r \varepsilon_0 \quad — (9)$$

$$C = \frac{A \varepsilon_r \varepsilon_0}{d}$$

$$C' = \varepsilon_r \left[\frac{A\varepsilon_0}{d}\right]$$

$$C' = \varepsilon_r C$$

(Part b)

Answer:

Wheatstone Bridge:

Defenition: A simple circuit is used to measure unknown resistance precisely and accurately is called as wheatstone bridge.

Contruction:

The bridge was designed by a british professor charless wheatstone.

The circuit diagram of wheatstone P, Q R and X are arranged in such way that they form a closed loop ABCD a single emf source E is attached with the circuit.

Working principle:

The working of wheatstone bridge is based on the balancing of bridge.

Working:

The resistance of P and Q are fixed whereas R can be varied. The potential drop across AB is equal to potential drop across AD, therefore,

$$I_2 P = I_2 R \quad -(1)$$

$$I_1 Q = I_2 X \quad -(2)$$

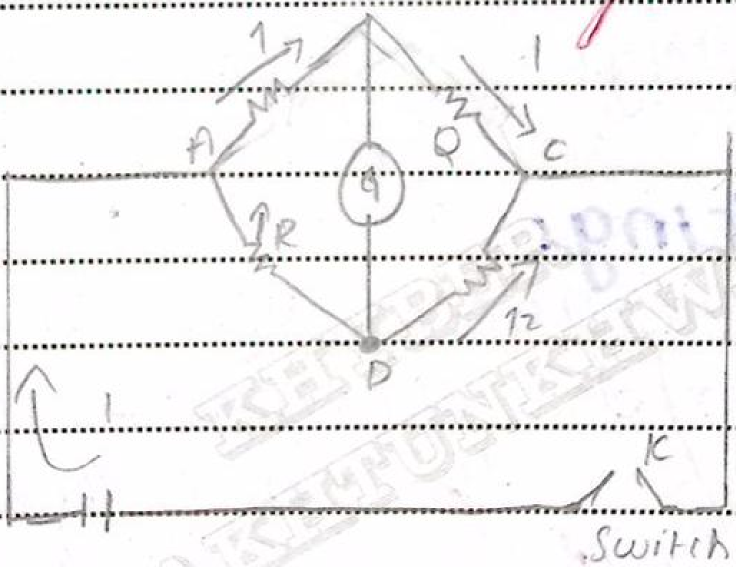
Dividing Eq (2) and (1)

$$\frac{I_1 Q}{I_2 P} = \frac{I_2 X}{I_2 R}$$

$$\frac{Q}{P} = \frac{X}{R}$$

$$X = \frac{RQ}{P}$$

Thus by knowing the values of resistance P, Q, R the value of Unknown resistance X can be determined.



wheatstone bridge