SECTION B

SHORT QUESTIONS

Q.NO.1:-

→ **Answer:-**

→ **Given data:-**

$r = 30cm$

$r = \frac{30}{100} \Rightarrow 0.3m$

$q = 3\mu C \Rightarrow 3\times10^{-6}C$

→ **Required:-**

→ Electric field $E = ?$

→ **Calculation:-**

We know that

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

Putting values.

$$E = \frac{9\times10^9(3\times10^{-6})}{0.3m}$$

$$E = \frac{27\times10^{9-6}}{0.3} \Rightarrow \frac{27\times10^3}{0.3}$$

$$E = 90\times10^3 \; N/C$$

→ **Q.No.2:**

→ **Answer:**

→ **Soft magnetic materials:**

→ Materials with narrow magnetic hystgersis loop are easily magnetized and demagnetized and are called soft magnetic materials

Hard magnetic materials:-

→ Material with broad magnetic hysteresis loop are difficult to magnetized and demagnetized and are called hard magnetic materials.

Q.No.3:-

→ Answer:-

→ Electron will suffer greater deflection than proton when both are projected with the same de-Broglie wavelengths because the de-Broglie's wavelength is given by: $\lambda = h/mv \Rightarrow v = h/m\lambda$

Explanation:-

→ As given that, wavelength of ....

both electron and proton is same, so;

$$v \propto \frac{1}{m}$$

→ This relation shows that particle with smaller mass will have higher speed. As mass of electron is less, so; it will have higher speed.

→ **Q.No.4:-**

→ **Answer:-**

→ Frequency effect the reactance of an inductor and a capacitor.

→ **An inductor:-**

→ By doubling the frequency the reactance of a given inductor increases two times.

The reactance of an inductor is given by

$$X_L = 2\pi f L$$

As, $f = 2f$

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

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

$$X_L' = 2(X_L)$$

A capacitor:-

→ By doubling the frequency the reactance of a capacitor decrease. The reactance of a capacitor is given by:

$$X_C = \frac{1}{2\pi f C}$$

As $f = 2f$

$$X_C' = \frac{1}{2\pi(2f)C}$$

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

Q.No.5:

Answer:-

Volt:-

Volt is the unit of electric potential, potential difference or emf defined as:

" the difference of potential between two points on a conductor carrying a constant current of one ampere when the power dissipated between the points is one watt.

It is named after Alessandro volta to honour him.

Electron volt:-

It is the unit of energy. One eV

is equal to the amount of energy that an electron acquires by accelerating (from rest) through a potential difference of one volt.

→ It is usually used as a measure of particle energies although it is not an SI unit.

→ The SI unit of energy is joule.

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

→ It may help to realize that the electric potential is a property associated with the field in the space, while the energy is associated with the particle you place into that field and it depends on the particle

Q.NO.6:-

→ Answer:-

→ Pair production:- → Pair production is the phenomenon in which the high energy photons are converted into electron and positron.

→ Explanation:- → High energy photons are used in this process.

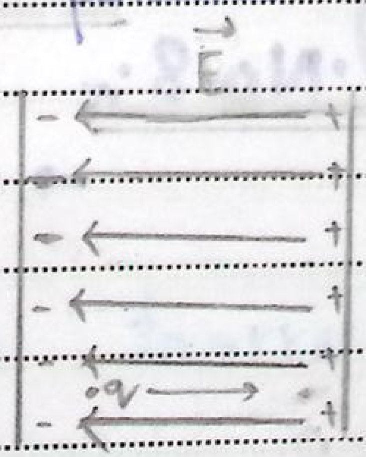
→ Usually X-rays are used.

→ When the high energy photons fall on an atom its energy is so high that they penetrate all shells and reach to neucte nucleus and here they interact with strong electric field and split into electron and positron and disappear.

Q.No.7:-

→ **Answer:-**

$E = -\frac{\Delta V}{r}$:- Consider two oppositively charged parallel plates.



→ As work done on test charge is:

$$W = F \times \Delta r \rightarrow (i)$$

→ A In electric field the force acting on an point charge is

$$F = q_0 E \rightarrow (ii)$$

→ Work done will be given by

$$\Delta W = q_o E \times \Delta r \rightarrow (iii)$$

→ The work done can also be given by

$$\Delta W = -\Delta V q_o \rightarrow (iv)$$

→ Comparing eq (iii) and (iv)

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

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

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

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

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

→ **Q.No.8:-**

→ **Answer:-**

→ **Current carrying coil behaves like a bar magnet:-**

→ The pattern of magnetic field lines

of a current carrying wire behaves like a bar magnet because the two ends of a current carrying coil behaves like north and south poles just like a bar magnet

Explanation:-

→ When current passes through a coil, magnetic field is set-up around the coil. Direction of field can be determined by right hand rule.

Right hand rule states that curl the fingers are in the direction of current. Then the thumb will point in the direction of North pole and the other side will behave like south pole.

→ Imaginary north and south poles are generated in the coil that's why a current carrying coil behaves like a bar magnet.

→ Q.NO.9:-

→ Answer:-

→ Dielectric:-

→ The space between plates of a capacitor is called ~~pt~~ dielectric.

→ Dipole:- moment:-

→ Dipole moment is the product of charge and distance.

→ Represented by μ

→ $\mu_o = q \times r$

Polarization:-

→ The slightly shifting of charges due to applied magnetic field.

→ It is not the complete shifting of charges.

Dipole:-

→ The induce partial charges on a molecule +Ve and -Ve is called dipole.

→ For example in NaCl, the Na has +Ve charge and Cl have -Ve charge.

→ Q.No.10:-

→ Answer:-

→ Factors affecting induction:-

→ Following are the some factors that effect induction

→ Shape and number of turn.

→ The material of the core.

→ Coil area and length.

→ Inductors play great role in electronic and electrochemical wireless, circuits etc.

SECTION. C

LONG QUESTIONS:-

Q.No:5:-

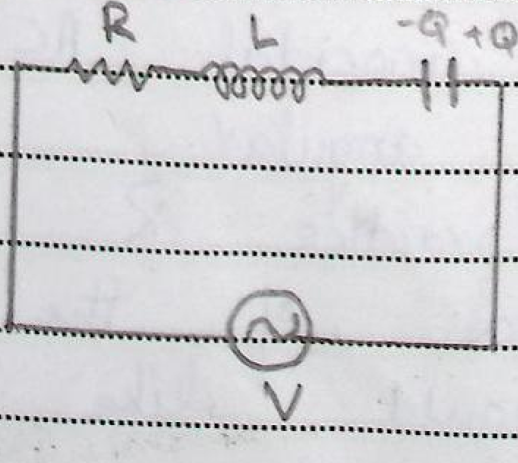
:(a):-

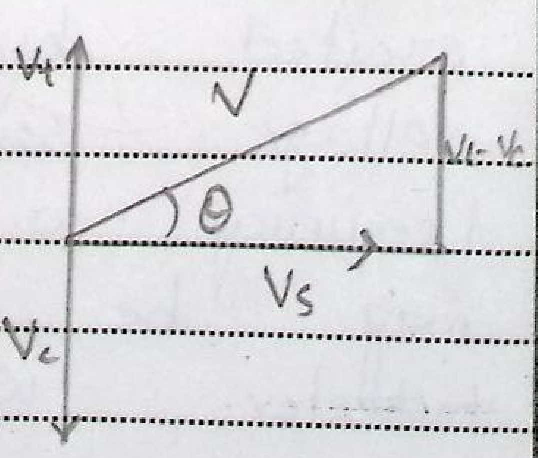
R.L.C series AC circuit:-

→ Many AC circuits are used in practical electronics involve resistors, inductors, and capacitors

→ RLC series AC circuit is excited by a sinocidal AC voltage source of angular frequency ω. In practice R may be resistance of the inductor. We would like to find the impedence of the circuit as a whole, the rms current that flows and the phase difference between soure voltage and current.

First we note that current at any instant must be same at all points. In the RLC series circuit. Thus the current in each element are in phase with each other although the voltages are not. The phasor for current is taken as reference and is drawn as horizontal directed to right.





The p.d across R is in phase with I. The voltage V_L across L leads I by 90° whereas V_C lags behind I by 90°. V_L and V_C are therefore 180° out of phase. If V_L is greater than V_C their resultant $(V_L - V_C)$ is in direction of V_L. The vector sum of $(V_L - V_C)$ and V_R equals the applied voltage.

$V^2 = V_R^2 + (V_L - V_C)^2$ But $V_R = iR$. $V_L = IX_L$ and $V_C = IX_C$. Hence

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

The impedence of RCL is given by

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

The phase angle by which I lags behind V is given by : $\tan\theta = V_L - V_C / V_R$ $= X_L - X_C / R$ also $\cos\theta = V_R/V = IR/IZ = R/Z$

Power dessipated is given by

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

Where θ is the phase angle b/w I and V in the RLC circuit.

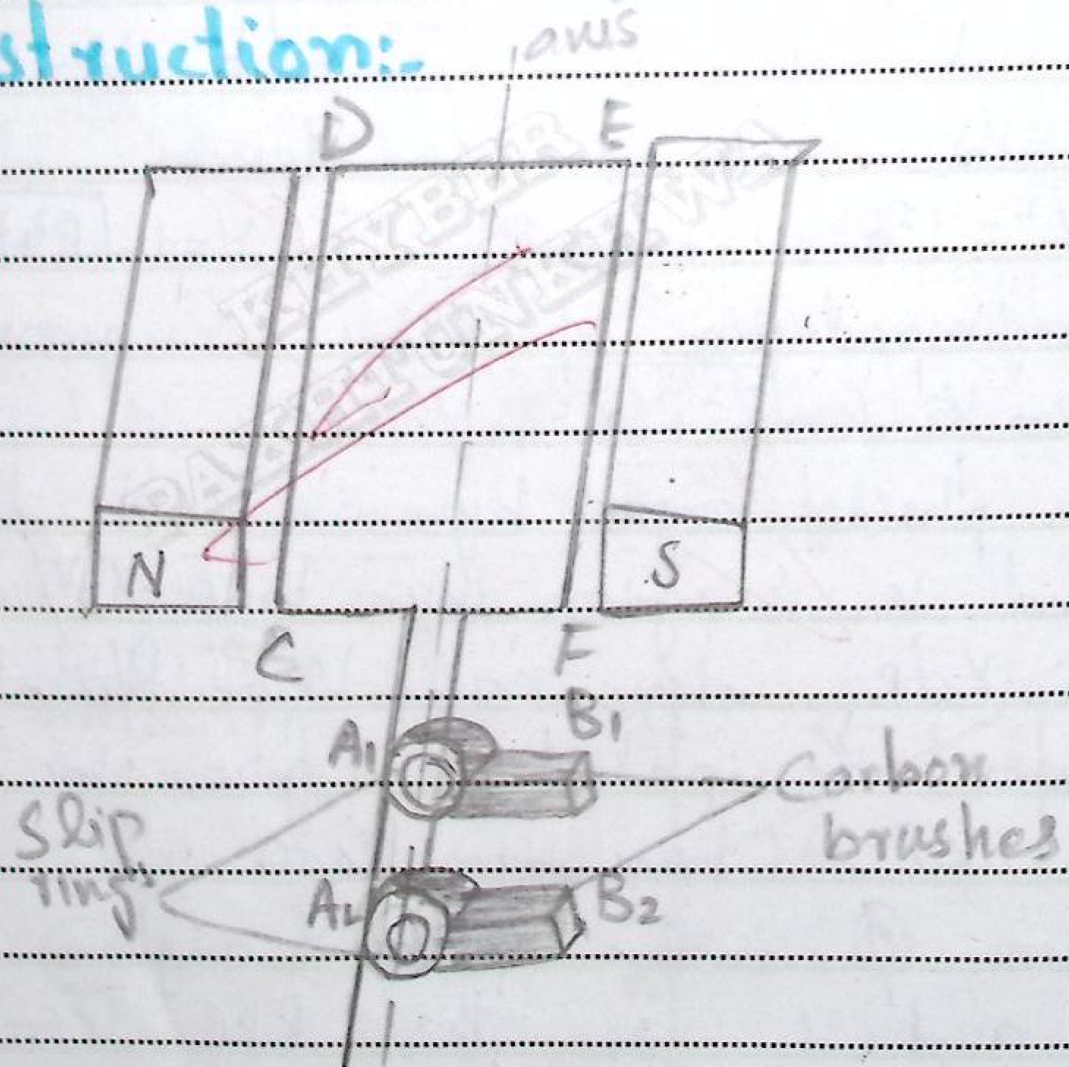
Q.No.3:-

-:(a):-

AC generator:-

→ A AC generator is a device that convert mechanical energy into electrical energy.

Construction:-



Consider a coil CDEFC of an AC generator which is placed between permanent magnets.
Two slips rings (A_1 & A_2) and two carbon brushes (B_1 & B_2) are connected to the coil.
A_1 is always connected to B_1 and A_2 is always connected to B_2.

Working:

→ When the coil rotates the current flow starts.
The Fleming's right hand rule shows that the flow of current is from C to D and E to F.
That is, current enters at B_1 and leaves at B_2.

→ After a half revolution the CD is in that position previosly occupied by EF.

→ The current flow changes.

→ The ~~...~~ current flow is now from E to F ~~...~~ D to C.

→ It means that current enters at B_2 and leaves at B_1.

→ Thus current flow in an AC generator changes every half a revolution.

-:(part. b):-

Given:-

$\Delta I = I_1 - I_2 = 5.0A - 0A = 5.0A$

$\Delta t = 0.1 sec$

$\varepsilon = 200V$

Required:-

Calculation:-

we know that

$L = \mathcal{E} / \frac{\Delta I}{\Delta t}$

$L = \frac{200}{\frac{5.0}{0.1}} \Rightarrow \frac{200 \times 0.1}{5.0}$

$L = \frac{20}{5.0} \Rightarrow 4$ Henry

Q.No.5:-

-:(part . b):-

→ It is often convenient, in nuclear physics to express certain masses in energy unit

we know :- $E = mc^2$

Hence. $1U = 1.66 \times 10^{-27} kg \times (3 \times 10^3 m/s)^2$

$1U = 1.4924 \times 10^{-27} \times 10^9$

$1U = 1.4924 \times 10^{-18}$

Since : $1 u eV = 1.6 \times 10^{-9}$

$$1u = (1.66 \times 10^{-27} / 1.6 \times 10^{-9})$$

$$1u = 9.315 \times 10^{8} eV$$

$$1u = 931.5 MeV$$

Q.No.6:-

→ Answer:-

-:(a):-

→ Capacitance of parallel plate capacitor:-

→ Let's consider that charge on the plates of a capacitor is $+Q$ and $-Q$

→ Then the electric field strength is given by

$$E = V/d$$

→ where V in P.d b/w the plates and d is separation b/w plates.

→ By applying guass's law

$$E = \frac{\sigma}{\varepsilon_0} \quad \text{where} \quad \sigma = Q/A$$

$$E = \frac{1}{\varepsilon_0}\frac{Q}{A}$$

$$\frac{V}{d} = \frac{Q}{\varepsilon_0 A}$$

$$Q = \frac{\varepsilon_0 V A}{d} \Rightarrow C_{vac} = \frac{Q}{V}$$

$$C_{vac} = \frac{\varepsilon_0 A}{d}$$

Above equation shows that capacitance of parallel plate capacitor depends on

(i) Area of plates
(ii) The separation b/w plates
(iii) The medium b/w them.

→b:- Wheatstone bridge:-

→ Wheatstone bridge is The arrangement of resistors to find an unknown resistance.

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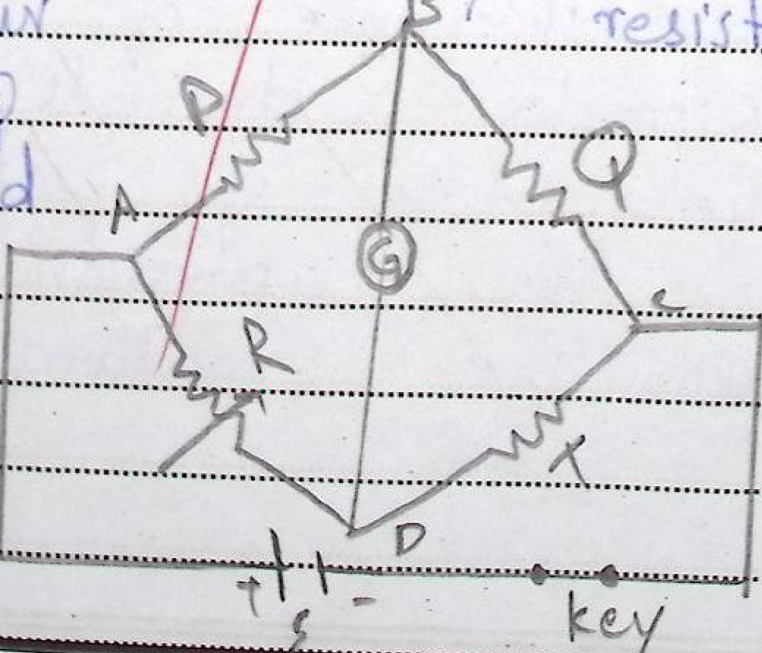
Construction:-

→ Consider four resistors are connected in such a way that they form a close loop. ABCDA

→ A single emf source is connected across A and C through a key.

→ Among four resistors P and Q are fixed and resistor R is varried to find X.



→ Working:-

→ When current is applied the current split b/w AB and AD as I_1 and I_2 respectively.
→ The resistance R is varried till the galvanometer show zero deflection.
→ When galvanometer show zero deflection the wheatstone brigde is balanced.
→ The current in AB is equal to current AD.
→ Simillarly the current in BC is equal CD.
→ Since the fall of potential over AB equal over AD.

$$R_Q I_2 = R_P I_1 \longrightarrow (I)$$

Similarly: $R_R I_2 = R_x I_1 \longrightarrow (II)$

Divinding (i) by (ii)

$$\frac{R_Q \cancel{I_2}}{R_R \cancel{I_2}} = \frac{R_P \cancel{I_1}}{R_x \cancel{I_1}}$$

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$$\frac{R_P}{R_R} = \frac{R_Q}{R_x}$$

$$R_x = \frac{R_P \times R_Q}{R_R}$$

Hence the three resistors R_P, R_R and R_Q are known, putting values of these we can find R_x.