(Section B)

Q No2:-

(i):- Answer:-

Given:-

Distance from point charge = 30 cm

magnitude of point charge (q) = 3 μC.

Required:-

Electric field (E) = ?

Solution:-

We know that electric field of a point charge at distance "r" is given by the equation;

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

$q = 30 \mu C = 3 \times 10^{-6} C$

$r = 30 cm = 30 \times 10^{-2} m$

putting these values in equation;
we get:-

$$E = \frac{3 \times 10^{-6} C \times 9 \times 10^{9} Nm^2/C^2}{30 \times 10^{-2} m}$$

$$E = \frac{27}{30} = 9 \times 10^{-1} = 0.9$$

(V) Answer:-

Ohm's Law:-

Statement:-

The magnitude of current in a conductor is proportional to applied voltage as long as temperature of the conductor is kept constant.

Discovery:-

This law was presented

by German Scientist George simon Ohm in 1826.

Ohmic Substances	Non-ohmic Substances
Those Substances which strickly obeys ohm's law are called ohmic substances. For ohmic substance, the current verses voltage graph is linear / Straight lines.	Those substance which does not strickly obeys ohm's law are called non-ohmic substance. Graph of I-V is curve for non-ohmic substances.
Examples:- Most metals are ohmic in nature such as Gold, Copper etc.	**Examples:-** Filament of bulb, tungsten, thermistor, Semiconductor diodes etc.

(X) **Answer:-**

Coercivity:-

The intensity of the applied magnetic field required to reduce the magnetization of a given material to zero is know as coercivity.

Retentivity:-

The capacity of an object to retain magnetization after the action of the magnetizing forces has ceased is known as Retentivity.

Comparison of steel with iron:-

From the hysteresis loop, it is clear that coercive force required to demagnetized steel is greater than soft iron, where as

retentivity of steel is slightly less than soft iron.
Since materials with greater coercivity are used as permanent magnet, therefore steel is also used for making permanent magnets.

(ix) Answer:-

Soft magnetic materials:-	Hard magnetic materials:
Materials with narrow magnetic hysteris loop are easily magnetized and demagnetized and are called soft magnetic materials.	Material with broad magnetic hysteris loop are difficult to magnetized and demagnetized and are called hard magnetic materials.
	They posses large amount of residual

	magnetism, Hence require large Coecive force.
Examples:- soft magnetic material include, sillicon, Nickel-iron alloy, amorphous and Nano-crystalline alloys etc.	**Examples:-** Hard magnetic meterials include Tungsten, Cobalt rare earth, Sintered ferite etc.
Uses:- soft magnetic materials are used in devices like relays, transformers and solenoids etc	**Uses:-** Hard magnetic materials are used in making permanent magnets.

(iv) Answer:-

Volt :-

The term volt represents unit of potential difference

1 Volt :-

1 volt is the potential difference ~~between~~ when one joule of work is done on moving 1 coulomb charge between points against electric field.

Electron Volt :-

Electron volt is the unit of energy.

1 Electron - Volt :-

1 eV is kinetic energy gained or lost by electron when it moves through a potential difference of 1 volt.

Relation between Volt and Electron - Volt :-

$E = V \times Q$

$Q = e$

$E = eV$

so $1\ eV = 1V \times 1e$

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

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

Difference between Volt and Electron-Volt :-

Volt and electron-Volt are units of two different physical quantities. Electric potential is a property of the field, has unit Volt while energy is associated with the particle placed in that field and has unit "eV".

(ii) **Answer:-**

Potential Gradient:-

Rate of change of electric potential ΔV with respect to displacement "Δr" is known as potential gradient.

Relation between Electric field and potential gradient:-

Electric field is negative of potential gradient

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

prove that $E = -\Delta V / \Delta r$:-

Workdone in moving the charge from plate one to another against the electric field is given by:-

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

As electric field acting on a charge is

$$E = F / q_o$$

$$F = E q_o \longrightarrow (2)$$

direction of electric field and charge's motion is opposite so negative charge in induse in eq ②

$$F = -Eq_o$$

Substitute eq ② in eq ①

$$W = -Eq_o \Delta r \cos\theta$$

$$W = -Eq_o \Delta r \cos 0^\circ \quad \because \cos 0^\circ = 1$$

$$W = -Eq_o \Delta r$$

$$\frac{W}{q_o} = -E \Delta r \quad \because W/q_o = \Delta V$$

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

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

Hence proved.

(xii) Answer:-

If electron and proton have same de-Broglie wave-length then speed of electron is greater than speed of proton.

Explanation:-

De-Broglie wavelength for moving particle is given by:

$$\lambda = h/mv$$

$$\lambda_{proton} = h/m_p V_p$$

$$\lambda_{electron} = h/m_p V_p$$

As De-Broglie wavelength for proton and electron is same so;

$$\lambda_{electron} = \lambda_{proton}$$

$$h/m_e V_e = h/m_p V_p$$

$$m_e V_e = m_p V_p$$

So mass and speed is inversely related

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

We know that

$$m_p > m_e$$

So $V_e > V_p$.

So electron has greater speed than

proton, if both have same DeBroglie wavelength.

(xiii) Answer:-

Pair production:-

Creation of a particle and its antiparticle from fast moving photon is called pair production

OR

The phenomenon in which energy is converted into mass.

Explanation:-

Electron and its anti-particle positron is created when a photon is converted into matter by Einstein equation:

$$E = mc^2$$

$$\gamma \longrightarrow e^- + e^+$$

In order to create an electron-positron pair, a minimal of $2mc^2$

is needed, the surplus energy is taken by electron and positron as their kinetic energy.

Mathematically:-

$$hf = 2m_oC^2 + K.E_{\bar{e}} + K.E_{p^+}$$

For minimal energy availability $K.E_{\bar{e}} = 0$ and $K.E_{e^+} = 0$

So $hf = 2m_oC^2 \rightarrow (1)$

$m_o = 9.11 \times 10^{-31}$ kg

$C = 3 \times 10^8$ m/s

$h = 6.63 \times 10^{-34}$ Js

putting value in eq (1)

$$hf = 2(9.11 \times 10^{-31} kg)(3 \times 10^8)^2$$

$$= 1.023 \times 10^6 eV = 1.02 MeV$$

Thus, pair production is caused by a photon whose minimal energy is 1.02 MeV.

(xi) **Answer:-**

Alpha factor:-

ratio of I_C and I_E is called alpha factor

$\alpha = I_C / I_E$

Beta factor:-

ratio of collector current I_C to base current I_B is called as beta factor.

$\beta = I_C / I_B$

Relation between alpha (α) and Beta (β):-

Since ratio of collector current I_C to base current I_B is called β factor

$$\beta = I_C / I_B \rightarrow (1)$$

In a transistor, the emitter current is given by:-

$I_E = I_B + I_C$

$I_B = I_E - I_C \longrightarrow (2)$

putting values from eq ② in eq ①
we get;

$$\beta = \frac{I_C}{I_B - I_C}$$

Dividing numerator and denominator by by I_E

$$B = \frac{I_C / I_E}{(I_E - I_C)/I_E}$$

$$\beta = \frac{I_C/I_E}{I_E/I_E - I_C/I_E} \quad \because I_C/I_E = \alpha$$

$$\beta = \frac{\alpha}{1-\alpha}$$

Hence proved.

(Vii) Answer:-

Magnetic field of a current carrying coil resemble like a bar magnet therefore, current carrying coil behaves like a bar magnet.

Explanation:-

A bar magnet is a permanent magnet, having North and South poles. Magnetic field lines originate from north and ends on south pole.

Now, considered a coil having "N" numbers of turns. When current passes through the coil, magnetic field is setup around it. Direction of this field can be determined by Right hand Rule III. By comparing both the fields, it is cleared that both are alike. Therefore, a current carrying coil behave like a bar magnet.

(Section C)

Q NO 4:-

(a) Answer:-

Bohr's postulates of Hydrogen atom:-

The Basic postalates of Bohr's atomic model about hydrogen atom are given

(1) The electron moves around the nucleus in circular orbit. It require centripetal force which is provided by the force of attraction between electron and nucleus

$$F_{coulombic} = F_{centripetal}$$

$$\frac{k q_1 q_2}{r^2} = \frac{mv^2}{r}$$

For electron $q = e$

so

$$\frac{ke^2}{r^2} = \frac{mv^2}{r}$$

(2) Electron cannot revolve around the nucleus in any orbitrary circular orbit. But only those orbits are possible for which angular momentum is integral multiple of $h/2\pi$

$$mvr = \frac{nh}{2\pi} \longrightarrow (2)$$

when $n = 1, 2, 3 \cdots \infty$

(3) The electron in stable or stationary orbit does not radiate energy. Electron only radiate energy when it make transition from higher energy orbit to lower energy orbit. Photon of energy "hf" is emitted

$hf = E_n - E_p \rightarrow$ (3)

Radii of Quantized Orbit:-

Expression for radii of quantized orbit can be calculated as:-
According to Bohr's second postulate

$$mvr_n = \frac{nh}{2\pi}$$

$$v = \frac{nh}{2\pi r_n m} \rightarrow (1)$$

According to first postulate:-

$$\frac{mv^2}{r_n} = \frac{ke^2}{r_n^2}$$

$$mv^2 = \frac{ke^2}{r_n}$$

$$v^2 = \frac{ke^2}{r_n m} \rightarrow (2)$$

Putting (2) in (1) we get;

$$\not{m}\left(\frac{nh}{2\pi \not{m} r_n}\right)^2 = \frac{ke^2}{r_n}$$

$$\frac{n^2h^2}{4\pi^2 m r_n^{\not{2}}} = \frac{ke^2}{\not{r_n}}$$

$$r_n = \frac{n^2h^2}{4\pi^2 ke^2 m} \rightarrow (3)$$

$$\frac{h^2}{4\pi^2 ke^2 m} = r^o = 0.53 \times 10^{-10} m$$

$$r_n = r_o n^2$$

where $n = 1, 2, 3 ——— \infty$.

Q no 4:-

(b) Answer:-

Given:-

$n = 4$

Required:-

wavelength of electron = ?

Solution:-

we know that

$$\lambda_n = \frac{h}{mV_n}$$

for $n=4$

$$\lambda_4 = \frac{h}{mV_4}$$

velocity of electron in 4th orbit is given by

$$V_4 = \frac{V_0}{4} = \frac{2.18 \times 10^6 \text{ m/s}}{4}$$

$$V_4 =$$

$$\lambda_4 = \frac{6.63 \times 10^{-34} \text{ Js}}{9.11 \times 10^{-31} \text{ kg} \times 5.45 \times 10^5 \text{ m/s}}$$

$$\lambda_4 = \frac{6.63 \times 10^{-34}}{49.64 \times 10^{-26}}$$

$$\lambda_4 = 0.133 \times 10^{-8}$$

$$\lambda_4 = 1.33 \times 10^{-9} = 1.33 \text{ nm}.$$

QNo 3:-

(a) Answer:-

AC Generator:-

Definition:-

The device which converts mechanical energy into electrical energy of the form in which the flow of electric charges periodically reverses direction.

Working principle:-

The working principle of electric generator is based on faraday's law of electromagnetic induction. The emf generated by a generator is dynamically induce emf.

Construction of Ac Generator:-

It consist of coil CDEF, two slips rings and two carbon brushes. When the coil CDEF rotates between the poles of a magnet, an electromotive force is induced. The current follow through the external circuit by slip rings A_1 and A_2 which are made of copper. A_2 is connected to the side EF of the coil and A_1 is always in contact with the brushes B_1 and A_2 with the brush B_2.

Working:-

When the side CD moves upward, fleming's right hand rules show that the direction of the current is from C to D and E to F

Thus the current enters the circuit at B_1 and leaves at B_2. Half a revolution later FE will be in the position previously occupied by CD and the current direction is reversed. It is from F to E and D to C. The current now enters the circuit at B_2 and leaves at B_1. The direction of et induced electromotive force and the current changes every half revolution.

Q No 3:-

(b) Answer:.

Given:-

Initial current $I_i = 5A$

final current $I_f = 0A$

Change in current $= 0A - 5A = -5A$

Time taken $\Delta t = 0.1s$

induced emf $= \mathcal{E} = 200V$

Required:-

self inductance $L = ?$

Solution:-

Self inductance is given by

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

putting values:-

$$L = \frac{-200V \times 0.1s}{-5A} = \frac{20V \times s}{5A}$$

$$\boxed{L = 4H}$$ Ans.

Q NO 5

(a) Answer:-

R.L.C Series AC Circuit:

when a pure resistor "R", an inductor "L" and a capacitor 'C" are connected together in series combination with each other. then such circuit is known as R.L.C series A C circuit.

Explanation:-

Consider a circuit in which a resistor, inductor and capacitor are connected in series. In resistive circuit, the current and voltage "V_R" are in phase. In inductive circuit, the voltage V_L lead the current by 90°.

Determination of impendance of R.L.C circuit:-

According to the phasor diagram, the voltage "V" of the source is equal to the phasor sum of V_R and $V_L - V_C$:.

$$V^2 = V_R^2 + (V_L - V_C)^2 \rightarrow (1)$$

Since $V_R = IR$, $V_L = IX_1$ and $V_C = IX_C$

$$V^2 = I^2R^2 + (IX_L - IX_C)^2$$
$$V^2 = I^2\{R^2 + (X_L - X_2)^2\}$$
$$V^2 = I^2\{R^2 + (X_L - X_2)^2\}$$

Board Of Intermediate & Secondary Education Khyber Pakhtunkhwa

CONTINUATION SHEET

Fic. No. 142

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

By taking square root

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

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

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

eq (2) represents the impendence of R.L.C series AC circuit.

Q NO 5
(b) Answer:-
(i)
$1U = 1.66 \times 10^{-27} kg$

proof:-

$$1u = \frac{\text{mass of one } ^{12}C \text{ atom}}{12}$$

$$1u = \frac{12 \text{ amu}}{12}$$

$$1u = \frac{12kg / 6.023 \times 10^{23}}{12}$$

$$1U = \frac{1}{2}\left(\frac{12}{6.023 \times 10^{23}}\right)$$

$$1u = 1.66 \times 10^{-27} kg.$$

Q No 5(b)
(ii) Answer:-

$$me = \frac{9.11 \times 10^{-31}}{1.66 \times 10^{-27}}$$

$$me = 0.00054 \, u$$

$$E = mc^2$$

$$E = 0.00054 \times \text{931 Mev} \; (3 \times 10^8)^2$$

$$E = 938.5 \text{ MeV.}$$