SHRI KRISHNA ACADEMY

NEET, JEE & BOARD EXAM (10th, +1,+2) COACHING CENTRE
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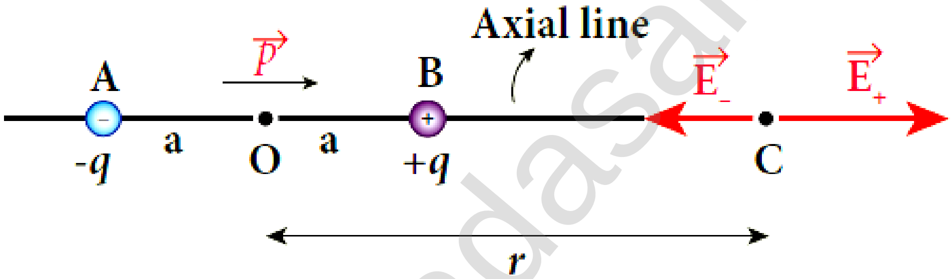
PREPARATORY TEST - 3– JUNE - 2021

STD: XII **DATE : 04.06.2021**

SUBJECT: PHYSICS **ANSWER KEY** **MARKS : 50**

Q.N	SECTION-I		MARKS
	OPTION	ANSWER	
1	(c)	uniformly charged infinite plane	1
2	(c)	C remains same, Q doubled	1
3	(a)	100 k Ω	1
4	(c)	ρ1 = ρ 2	1
5	(a)	$\frac{\mu_0 I}{4r}$	1
6	(a)	45°	1
7	(d)	2rBv and R is at higher potential	1
8	(a)	Z = R	1
9	(a)	1.414×10^{-8} T	1
10	(a)	Ultra violet	1
11	(a)	30^o	1
12	(c)	plane polarised	1
13	(d)	$\lambda p \ \alpha \ \lambda e^2$	1
14	(d)	$2h/\pi$	1
15	(b)	$\frac{A-Z-2}{Z-6}$	1

16	(c)	0^0–180^0	1
17	a)	1	1
18	(d)	The breaking of the covalent bond	1
19	(a)	Amplitude modulation	1
20	(b)	Bottom up approach	1
Q.N	**SECTION-II**		**MARKS**
21	**Electric field due to an electric dipole at points on the axial line** • Consider an electric dipole placed on the x-axis as shown in Figure. A point C is located at a distance of *r* from the midpoint O of the dipole along the axial line.  • The electric field at a point C due to +q is $\vec{E}_+ = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2}$ along BC • Since the electric dipole moment vector is from –q to +q and is directed along BC, the above equation is rewritten as $\vec{E}_+ = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2}\hat{p}$ • where $p$is the electric dipole moment unit vector from –q to +q. • The electric field at a point C due to –q is $\vec{E}_- = -\frac{1}{4\pi\varepsilon_0}\frac{q}{(r+a)^2}\hat{p}$ • The total electric field at point C is calculated using the superposition principle of the electric field.		5

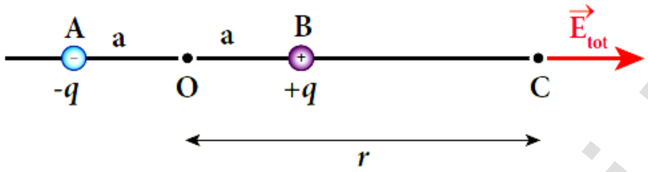
$$\vec{E}_{tot} = \vec{E}_{+} + \vec{E}_{-}$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2}\hat{p} - \frac{1}{4\pi\varepsilon_0}\frac{q}{(r+a)^2}\hat{p}$$

$$\vec{E}_{tot} = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right)\hat{p}$$

$$\vec{E}_{tot} = \frac{1}{4\pi\varepsilon_0}q\left(\frac{4ra}{(r^2-a^2)^2}\right)\hat{p}$$

- Note that the total electric field is along , since is closer to C than –q.



- If the point C is very far away from the dipole then (r >> a). Under this limit the term Substituting this into equation

$$\vec{E}_{tot} = \frac{1}{4\pi\varepsilon_0}\left(\frac{4aq}{r^3}\right)\hat{p} \quad (r >> a)$$

since $2aq\,\hat{p} = \vec{p}$

$$\vec{E}_{tot} = \frac{1}{4\pi\varepsilon_0}\frac{2\vec{p}}{r^3}$$

- If the point C is chosen on the left side of the dipole, the total electric field is still in the direction of $\vec{p}$.

(OR)

(i) Continuous absorption spectrum

- When the light is passed through a medium, it is dispersed by the prism, we get continuous absorption spectrum. For instance, when we pass white light through a blue glass plate, it absorbs everything except blue. This is an example of continuous absorption spectrum.

(ii) Line absorption spectrum

- When light from the incandescent lamp is passed through cold gas (medium), the spectrum obtained through the dispersion due to prism is line absorption spectrum.
- Similarly, if the light from the carbon arc is made to pass through sodium vapour, a continuous spectrum of carbon arc with two dark lines in the yellow region of sodium vapour is obtained.

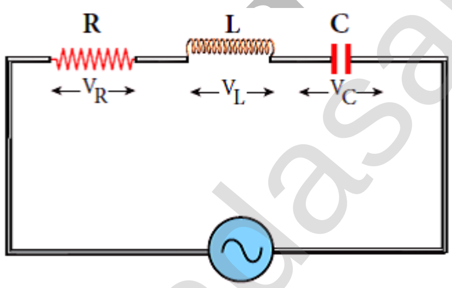
(iii) Band absorption spectrum

- When the white light is passed through the iodine vapour, dark bands on continuous bright background is obtained.
- This type of band is also obtained when white light is passed through diluted solution of blood or chlorophyll or through certain solutions of organic and inorganic compounds.

22 (5 marks)

- Consider a circuit containing a resistor of resistance *R*, a inductor of inductance *L* and a capacitor of capacitance *C* connected across an alternating voltage source.
- The applied alternating voltage is given by the equation.

$$\upsilon = V_m \sin\omega t$$



- Let *i* be the resulting circuit current in the circuit at that instant. As a result, the voltage is developed across *R*, *L* and *C*.
- We know that voltage across *R* (V_R) is in phase with *i*, voltage across *L* (V_L) leads *i* by π/2 and voltage across *C* (V_C) lags *i* by π/2.
- The phasor diagram is drawn with current as the reference phasor. The current is represented by
- The length of these phasors are

$$OI = I_m,\ OA = I_mR,\ OB = I_mX_L;\ OC = I_mX_C$$

- The circuit is either effectively inductive or capacitive or resistive that depends on the value of $V_L$or V_C. Let us assume that $V_L > V_C$so that net voltage drop across *L*-*C* combination is $V_L - V_C$which is represented by a phasor $\overrightarrow{OD}$.
- By parallelogram law, the diagonal $\overrightarrow{OE}$gives the resultant voltage υ of $V_R$and ($V_L - V_C$) and its length *OE* is equal to V_m. Therefore,

$$V_m^2 = V_R^2 + (V_L - V_C)^2$$

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

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

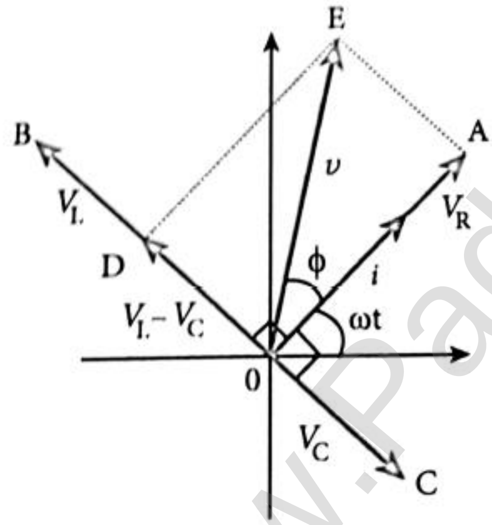
$$\text{or} \quad I_m = \frac{V_m}{\sqrt{R^2 + (X_L - X_C)^2}}$$

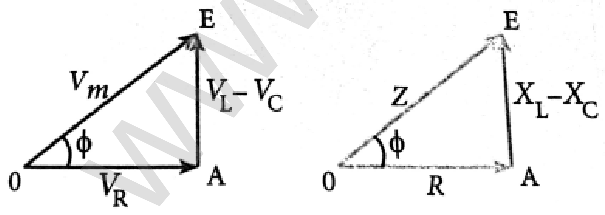
$$\text{or} \quad I_m = \frac{V_m}{Z}$$

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

is called impedance of the circuit which refers to the effective opposition to the circuit current by the series *RLC* circuit.

- The voltage triangle and impedance triangle are given in the Figure





(a) (b)

- From phasor diagram, the phase angle between υ and i is found out from the following relation

$$\tan\phi = \frac{V_L - V_C}{V_R} = \frac{X_L - X_C}{R}$$

Special cases

(i) If $X_L > X_C$, $(X_L - X_C)$ is positive and phase angle ϕ is also positive. It means that the applied voltage leads the current by ϕ (or current lags behind voltage by ϕ). The circuit is inductive.

$$\therefore \upsilon = V_m \sin\omega t;\; i = I_m \sin(\omega t - \phi)$$

(ii) If $X_L < X_C$, $(X_L - X_C)$ is negative and ϕ is also negative. Therefore current leads voltage by ϕ and the circuit is capacitive.

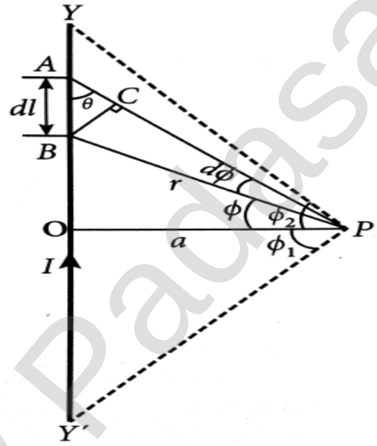
$$\therefore \upsilon = V_m \sin\omega t;\; i = I_m \sin(\omega t + \phi)$$

(iii) If $X_L = X_C$, ϕ is zero. Therefore current and voltage are in the same phase and the circuit is resistive.

$$\therefore \upsilon = V_m \sin\omega t;\quad i = I_m \sin\omega t$$

(OR)

- Let YY' be an infinitely long straight conductor and I be the steady current through the conductor.
- To calculate magnetic field at a point P which is at a distance a from the wire, let us consider a small line element dl (segment AB).



- The magnetic field at a point P due to current element Idl can be calculated from Biot Savart's law which is

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{Idl\sin\theta}{r^2}\hat{n}$$

- Where $\hat{n}$ is the unit vector which points into the page at P, θ is the angle between current element Idl and line joining dl and the point P.
- Let r be the distance between line element at A to the point P.

$$\text{In triangle } \Delta ABC,\ \sin\theta = \frac{AC}{AB}$$

$$\Rightarrow AC = AB\sin\theta$$

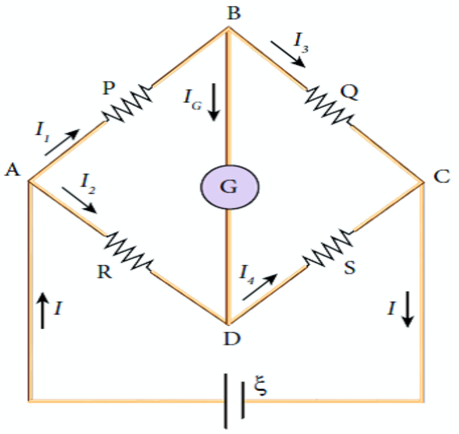
$$\text{But } AB = dl \Rightarrow AC = dl\sin\theta$$

$$\text{i.e., } \angle APB = \angle BPC = d\phi$$

	In a triangle $\Delta APC, \sin(d\phi) = \frac{AC}{AP}$ Since, $d\phi$ is very small, $\sin(d\phi) \simeq d\phi$ But $AP = r \Rightarrow AC = rd\phi$ $\therefore AC = dl\sin\theta = rd\phi$ $\therefore d\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{r^2}(rd\phi)\hat{n} = \frac{\mu_0}{4\pi}\frac{Id\phi}{r}\hat{n}$ $\cos\phi = \frac{OP}{BP} = \frac{a}{r}$ $\Rightarrow r = \frac{a}{\cos\phi}$ $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{a/\cos\phi}d\phi\,\hat{n}$ $\Rightarrow d\vec{B} = \frac{\mu_0 I}{4\pi a}\cos\phi d\phi\,\hat{n}$ • The total magnetic field at point P due to conductor YY' is $\vec{B} = \int_{-\phi_1}^{\phi_2} d\vec{B} = \int_{-\phi_1}^{\phi_2} \frac{\mu_0 I}{4\pi a}\cos\phi d\phi\,\hat{n}$ $= \frac{\mu_0 I}{4\pi a}[\sin\phi]_{-\phi_1}^{\phi_2}\,\hat{n}$ $\vec{B} = \frac{\mu_0 I}{4\pi a}(\sin\phi_1 + \sin\phi_2)\,\hat{n}$ For infinitely long conductor, $\phi_1 = \phi_2 = 90°$ $\therefore \vec{B} = \frac{\mu_0 I}{4\pi a} \times 2\hat{n} \Rightarrow \vec{B} = \frac{\mu_0 I}{2\pi a}\hat{n}$	
23	• An important application of Kirchhoff 's rules is the Wheatstone's bridge. • It is used to compare resistances and also helps in determining the unknown resistance in electrical network. • The bridge consists of four resistances P, Q, R and S connected as shown in Figure. A galvanometer G is connected between the points B and D. • The battery is connected between the points A and C. The current through the galvanometer is I_G and its resistance is G. • Applying Kirchhoff 's current rule to junction B $I_1 - I_G - I_3 = 0$	5

- Applying Kirchhoff 's current rule to junction D,

$$I_2 + I_G - I_4 = 0$$



- Applying Kirchhoff 's voltage rule to loop ABDA,

$$I_1P + I_GG - I_2R = 0$$

- Applying Kirchhoff 's voltage rule to loop ABCDA,

$$I_1P + I_3Q - I_4S - I_2R = 0$$

- When the points B and D are at the same potential, the bridge is said to be balanced.
- As there is no potential difference between B and D, no current flows through galvanometer ($I_G = 0$). Substituting $I_G = 0$ in equations we get

$$I_1 = I_3$$

$$I_2 = I_4$$

$$I_1P = I_2R$$

$$I_1P + I_1Q - I_2S - I_2R = 0$$

$$I_1 (P + Q) = I_2 (R + S)$$

$$\frac{P+Q}{P} = \frac{R+S}{R}$$

$$1+\frac{Q}{P} = 1+\frac{S}{R}$$

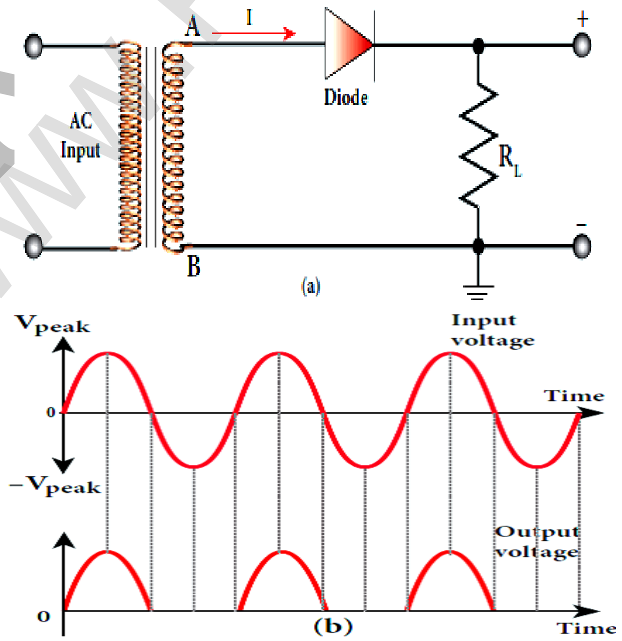
$$\frac{Q}{P} = \frac{S}{R}$$

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

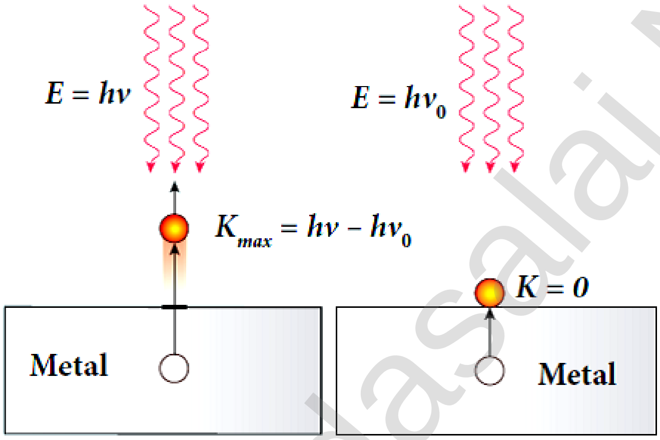
- Suppose we know the values of two adjacent resistances, the other two resistances can be compared.
- If three of the resistances are known, the value of unknown resistance (fourth one) can be determined.

(OR)

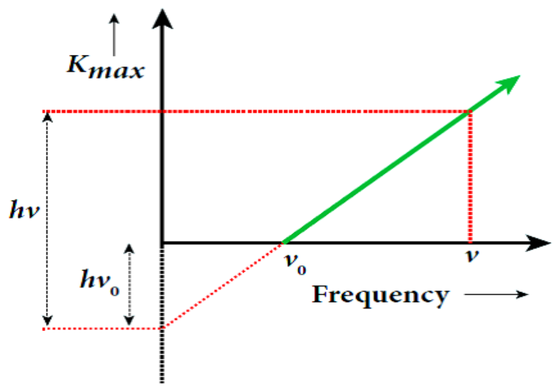
- The circuit consists of a transformer, a p-n junction diode and a resistor.
- In a half wave rectifier circuit, either a positive half or the negative half of the AC input is passed through while the other half is blocked.
- Only one half of the input wave reaches the output. Therefore, it is called half wave rectifier. Here, a p-n junction diode acts as a rectifying diode.
- **During the positive half cycle** When the positive half cycle of the ac input signal passes through the circuit, terminal A becomes positive with respect to terminal B.
- The diode is forward biased and hence it conducts. The current flows through the load resistor R_L and the AC voltage developed across R_L constitutes the output voltage V_0 and the waveform of the diode current is shown in Figure
- **During the negative half cycle** When the negative half cycle of the ac input signal passes through the circuit, terminal A is negative with respect to terminal B. Now the diode is reverse biased
  and does not conduct and hence no current passes through R_L. The reverse saturation current in a diode is negligible. Since there is no voltage drop across R_L, the negative half cycle of ac supply is suppressed at the output.



- Efficiency (η) is the ratio of the output dc power to the ac input power supplied to the circuit. Its value for half wave rectifier is 40.6 %

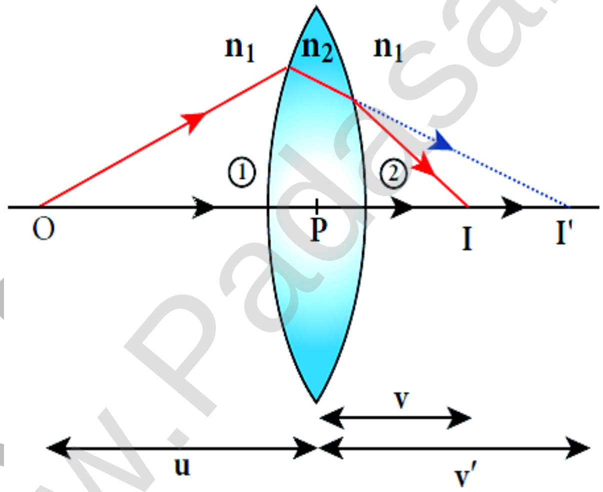
24	• When a photon of energy $h\nu$ is incident on a metal surface, it is completely absorbed by a single electron and the electron is ejected. • In this process, a part of the photon energy is used for the ejection of the electrons from the metal surface (photoelectric work function ϕ_0) and the remaining energy as the kinetic energy of the ejected electron. From the law of conservation of energy, $$h\nu = \phi_0 + \frac{1}{2}m\upsilon^2 \quad \text{.................. (1)}$$ where m is the mass of the electron and υ its velocity.  • If we reduce the frequency of the incident light, the speed or kinetic energy of photo electrons is also reduced. • At some frequency ν_0 of incident radiation, the photo electrons are ejected with almost zero kinetic energy $$h\nu_0 = \phi_0$$ where ν_0 is the threshold frequency. Byrewriting the equation $$h\nu = h\nu_0 + \frac{1}{2}m\upsilon^2 \quad \text{.................. (2)}$$ • The equation is known as **Einstein's photoelectric equation**. • If the electron does not lose energy by internal collisions, then it is emitted with maximum kinetic energy K_{max}. Then $$K_{max} = \frac{1}{2}m\upsilon_{max}^2$$ where υ_{max} is the maximum velocity of the electron ejected. Equation (1) becomes	5

$$K_{max} = h\nu - \phi_0 \quad \text{............ (3)}$$



- A graph between maximum kinetic energy K_{max} of the photoelectron and frequency ν of the incident light is a straight line. The slope of the line is h and its y-intercept is $-\phi_0$.
- The slope is independent of the metals.

(OR)



- Let us consider a thin lens made up of a medium of refractive index n_2 is placed in a medium of refractive index n_1. Let R_1 and R_2 be the radii of curvature of two sphericalsurfaces (1) and (2) respectively and P be the pole as shown in figure. Consider a point object O on the principal axis.
- The ray which falls very close to P, after refraction at the surface (1) forms image at I'. Before it does so, it is again refracted by the surface (2). Therefore the final image is formed at I.
- The general equation for the refraction at a spherical surface is given from Equation

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$$

- For the refracting surface (1), the light goes from n_1 to n_2.

$$\frac{n_2}{v'} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R_1}$$

- For the refracting surface (2), the light goes from medium n_2 to n_1.

$$\frac{n_1}{v} - \frac{n_2}{v'} = \frac{(n_1 - n_2)}{R_2}$$

- Adding the above two equations

$$\frac{n_1}{v} - \frac{n_1}{u} = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

- Further simplifying and rearranging,

$$\frac{1}{v} - \frac{1}{u} = \left(\frac{n_2 - n_1}{n_1}\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{v} - \frac{1}{u} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

- If the object is at infinity, the image is formed at the focus of the lens. Thus, for $u = \infty$, $v = f$. Then the equation becomes.

$$\frac{1}{f} - \frac{1}{\infty} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

- If the refractive index of the lens is n_2 and it is placed in air, then $n_2 = n$ and $n_1 = 1$. So the equation becomes,

$$\frac{1}{f} = (n - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

- The above equation is called the ***lens maker's formula***, because it tells the lens manufactures what curvature is needed to make a lens of desired focal length with a material of particular refractive index. This formula holds good also for a concave lens.

25	**(a) Lyman series** • Electron jumps from any outer orbit to first orbit • n = 1 and m = 2,3,4........ The wave number or wavelength of spectral lines of Lyman series which lies in ultra-violet region is $$\bar{\nu} = \frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{m^2}\right)$$ **(b) Balmer series** • Electron jumps from any outer orbit to second orbit • n = 2 and m = 3,4,5....... . The wave number or wavelength of spectral lines of Balmer series which lies in visible region is $$\bar{\nu} = \frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{m^2}\right)$$ **(c) Paschen series** • Electron jumps from any outer orbit to third orbit • n = 3 and m = 4,5,6....... . The wave number or wavelength of spectral lines of Paschen series which lies in infra-red region (near IR) is $$\bar{\nu} = \frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{m^2}\right)$$ **(d) Brackett series** • Electron jumps from any outer orbit to fourth orbit • n = 4 and m = 5,6,7......... The wave number or wavelength ofspectral lines of Brackett series which lies in infra-red region (middle IR) is $$\bar{\nu} = \frac{1}{\lambda} = R\left(\frac{1}{4^2} - \frac{1}{m^2}\right)$$ **(e) Pfund series** • Electron jumps from any outer orbit to fifth orbit • n = 5 and m = 6,7,8......... The wave number or wavelength of spectral lines of Pfund series which lies in infra-red region (far IR) is	5

$$\bar{v} = \frac{1}{\lambda} = R\left(\frac{1}{5^2} - \frac{1}{m^2}\right)$$

(OR)

INTRODUCTION

- Robert Van de Graaff designed a machine which produces a large amount of electrostatic potential difference, up to several million volts (10^7 V).

PRINCIPLE

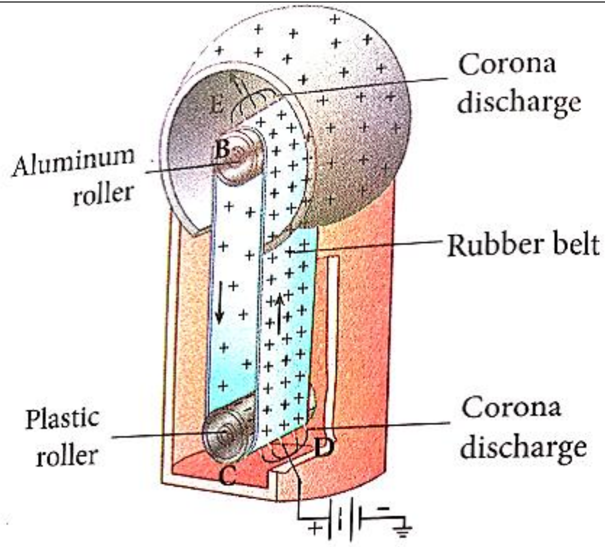
- This Van de Graff generator works on the principle of electrostatic induction and action at points.

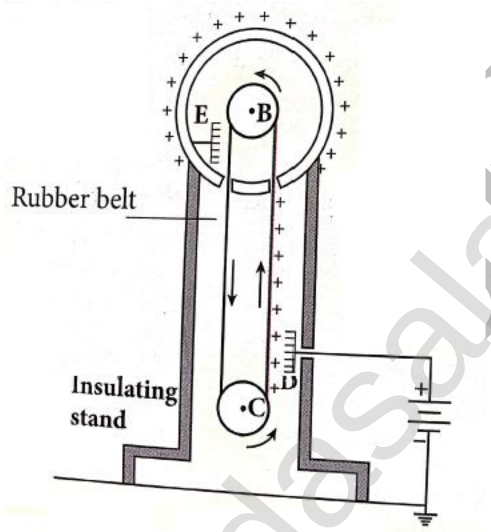
CONSTRUCITON

- A large hollow spherical conductor is fixed on the insulating stand as shown in Figure.
- A pulley B is mounted at the center of the hollow sphere and another pulley C is fixed at the bottom.
- A belt made up of insulating materials like silk or rubber runs over both pulleys. The pulley C is driven continuously by the electric motor.
- Two comb shaped metallic conductors E and D are fixed near the pulleys.
- The comb D is maintained at a positive potential of 10^4 V by a power supply.
- The upper comb E is connected to the inner side of the hollow metal sphere.

WORKING

- Due to the high electric field near comb D, air between the belt and comb D gets ionized.
- The positive charges are pushed towards the belt and negative charges are attracted towards the comb D.
- The positive charges stick to the belt and move up. When the positive charges reach the comb E,





- A large amount of negative and positive charges are induced on either side of comb E due to electrostatic induction.
- As a result, the positive charges are pushed away from the comb E and they reach the outer surface of the sphere.
- Since the sphere is a conductor, the positive charges are distributed uniformly on the outer surface of the hollow sphere.
- At the same time, the negative charges nullify the positive charges in the belt due to corona discharge before it passes over the pulley.
- When the belt descends, it has almost no net charge. At the bottom, it again gains a large positive charge.
- The belt goes up and delivers the positive charges to theouter surface of the sphere.
- This process continues until the outer surface produces the potential difference of the order of 10^7 which is the limiting value.

LIMITATIONS

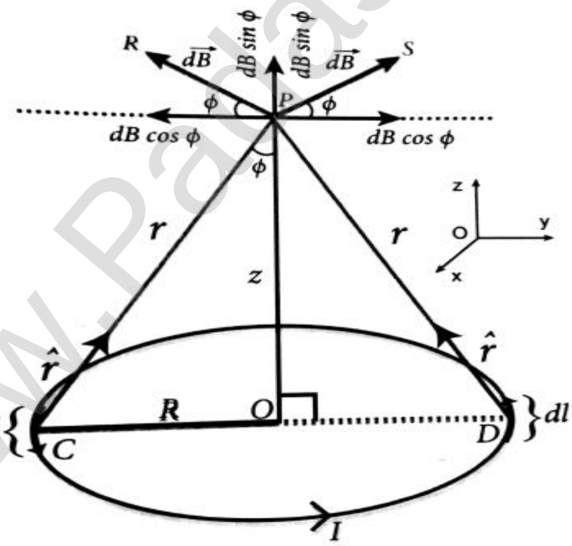
- We cannot store charges beyond this limit since the extra charge starts leaking to the surroundings due to ionization of air.
- The leakage of charges can be reduced by enclosing the machine in a gas filled steel chamber at very high pressure.

APPLICATIONS

- The high voltage produced in this Van de Graaff generator is used to accelerate positive ions (protons and deuterons) for nuclear disintegrations and other applications.

26 5

- Consider a current carrying circular loop of radius R and let I be the current flowing through the wire in the direction as shown in Figure.
- The magnetic field at a point P on the axis of the circular coil at a distance *z* from its center of the coil O.
- It is computed by taking two diametrically opposite line elements of the coil each of length $\vec{dl}$ at C and D. Let $\vec{r}$ be the vector joining the current element ($I\vec{dl}$) at C to the point P.



- According to Biot-Savart's law, the magnetic field at P due to the current element *C* is

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,d\vec{l}\times\hat{r}}{r^2}$$

- The magnitude of $\vec{dB}$ is

$$dB = \frac{\mu_0}{4\pi}\frac{I\,dl\sin\theta}{r^2} = \frac{\mu_0}{4\pi}\frac{I\,dl}{r^2}$$

- where θ is the angle between $I\vec{dl}$ and $\vec{r}$. Here $\theta = 90^0$.

- The direction of $\overrightarrow{dB}$ is perpendicular to the cuttent element I$\overrightarrow{dl}$ and CP. It is therefore along PR perpendicular to CP.
- The magnitude of magnetic field at P due to current element at D is the same as that for from the coil. But its direction is along PS
- The magnetic field $\overrightarrow{dB}$due to each current element is resolved into two components: dB cos Φ along y direction and dB sin Φ along z direction.
- The horizontal components cancel out while the vertical components along contribute to the net magnetic field $\vec{B}$ at the point P.

$$= \frac{\mu_0 I}{4\pi}\int \frac{dl}{r^2}\sin\phi\,\hat{k}$$

$$\vec{B} = \int d\vec{B} = \int dB\sin\phi\,\hat{k}$$

From ΔOCP,

$$\sin\phi = \frac{R}{\left(R^2+z^2\right)^{1/2}} \text{ and } r^2 = R^2+z^2$$

substituting these in the above equation

$$\vec{B} = \frac{\mu_0 I}{4\pi}\frac{R}{\left(R^2+z^2\right)^{3/2}}\hat{k}\left(\int dl\right)$$

$$\vec{B} = \frac{\mu_0 I}{2}\frac{R^2}{\left(R^2+z^2\right)^{3/2}}\hat{k}$$

If the circular coil contains N turns, then the magnetic field is

$$\vec{B} = \frac{\mu_0 NI}{2}\frac{R^2}{\left(R^2+z^2\right)^{3/2}}\hat{k}$$

The magnetic field at the centre of the coil is

$$\vec{B} = \frac{\mu_0 NI}{2R}\hat{k} \qquad \text{since } z = 0$$

(OR)

- At any instant *t*, the number of decays per unit time, called rate of decay is proportional to the number of nuclei (dN / dt) at the same instant.

$$\frac{dN}{dt} \propto N$$

$$\frac{dN}{dt} = -\lambda N$$

$$dN = -\lambda N dt$$

at time $t = 0$ s, the number of nuclei present in the radioactive sample is N_0

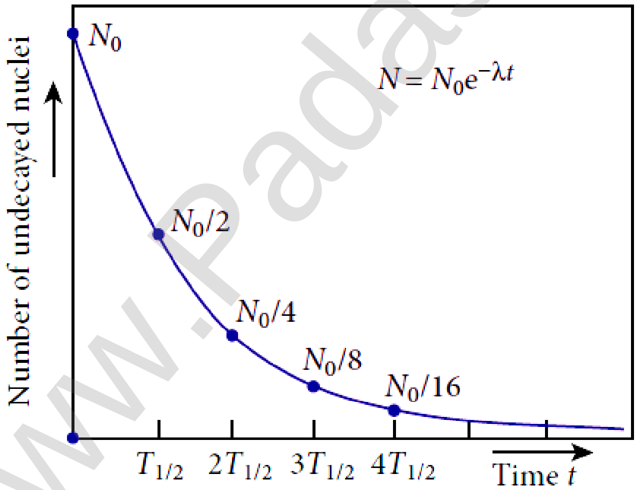
$$\frac{dN}{N} = -\lambda\, dt$$

$$\int_{N_0}^{N} \frac{dN}{N} = -\int_{0}^{t} \lambda\, dt$$

$$[\ln N]_{N_0}^{N} = -\lambda t$$

$$\ln\left[\frac{N}{N_0}\right] = -\lambda t$$

- Taking exponentials on both sides, we get $N = N_0 e^{-\lambda t}$
- This Equation is called the law of radioactive decay.
- Here N denotes the number of undecayed nuclei present at any time t and N_0 denotes the number of nuclei at initial time $t=0$. The number of atoms is decreasing exponentially over the time. Time taken for all the radioactive nuclei to decay will be infinite.



N

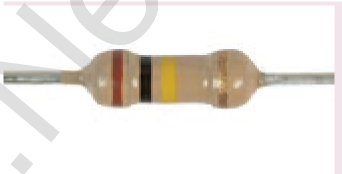
PREPARATORY TEST - 3

CLASS : 12 **MARKS: 50**
SUBJECT: PHYSICS **TIME : 2 Hrs.**

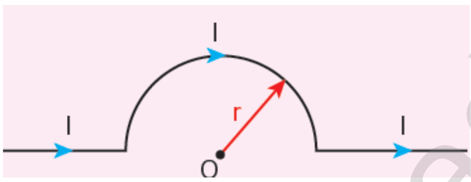
PART – A (ANSWER ALL) 20 X 1 = 20

1. Which charge configuration produces a uniform electric field?
(a) point charge (b) infinite uniform line charge
(c) uniformly charged infinite plane (d) uniformly charged spherical shell

2. If voltage applied on a capacitor is increased from *V* to 2*V*, choose the correct conclusion.
(a) *Q* remains the same, *C* is doubled (b) *Q* is doubled, *C* doubled
(c) *C* remains same, *Q* doubled (d) Both *Q* and *C* remain same

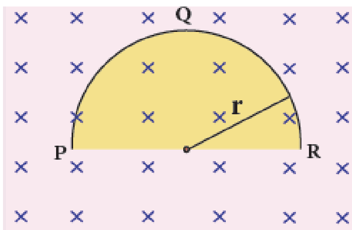
3. What is the value of resistance of the following resistor?

(a)100 k Ω (b)10 k Ω
(c) 1k Ω (d)1000 k Ω

4. A thin and a thick copper wires have the resistivities ρ_1 Ω m and ρ_2 Ω m respectively. Then
(a) $\rho_1 > \rho_2$ (b) $\rho_1 < \rho_2$ (c) $\rho_1 = \rho_2$ (d) $\frac{\rho 2}{\rho 1} = \alpha$

5. The magnetic field at the centre O of the following current loop is


(a) $\frac{\mu_0 I}{4r} \otimes$ (b) $\frac{\mu_0 I}{4r} \odot$
(c) $\frac{\mu_0 I}{2r} \otimes$ (d) $\frac{\mu_0 I}{2r} \odot$

6. The vertical component of Earth's magnetic field at a place is equal to the horizontal component. What is the value of angle of dip at this place?
(a) 45° (b) 30° (c) 90° (d) 60°

7. A thin semi-circular conducting ring (PQR) of radius r is falling with its plane vertical in a horizontal magnetic field B, as shown in the figure. The potential difference developed across the ring when its speed v, is


(a) Zero
(b) $\frac{Bv\pi r^2}{2}$ and P is at higher potential
(c) πrBv and R is at higher potential (d) 2rBv and R is at higher potential

8. Resonance occurs in an AC circuit when
(a) Z = R (b) $Z = wL - \frac{1}{wC}$ (c) L = R (d) None of the above

9. In an electromagnetic wave travelling in free space the rms value of the electric field is 3 V m^{-1}. The peak value of the magnetic field is
(a) 1.414×10^{-8} T (b) 1.0×10^{-8} T
(c) 2.828×10^{-8} T (d) 2.0×10^{-8} T

10. Green house effect is due to
(a) Ultra violet (b) Gamma rays (c) X-rays (d) Radio waves

11. For light incident from air on a slab of refractive index 2, the maximum possible angle of refraction is
(a) 30^o (b) 45^o (c) 60^o (d) 90^o

12. Light refracted through pile of plates is found to be
(a) partially polarised (b) unpolarised
(c) plane polarised (d) elliptically polarised

13. The wavelength λ_e of an electron and λ_p of a photon of same energy E are related by
(a) $\lambda_p \alpha \lambda_e$ (b) $\lambda_p \alpha \sqrt{\lambda_e}$ (c) $\lambda_p \alpha \frac{1}{\sqrt{\lambda e}}$ (d) $\lambda_p \alpha \lambda_e^2$

14. In a hydrogen atom, the electron revolving in the fourth orbit, has angular momentum equal to
(a) h (b) $\frac{h}{\pi}$ (c) $\frac{4h}{\pi}$ (d) $\frac{2h}{\pi}$

15. A radioactive nucleus (initial mass number A and atomic number Z) emits two α-particles and 2 positrons. The ratio of number of neutrons to that of proton in the final nucleus will be
(a) $\frac{A-Z-4}{Z-2}$ (b) $\frac{A-Z-2}{Z-6}$ (c) $\frac{A-Z-4}{Z-6}$ (d) $\frac{A-Z-12}{Z-4}$

16. If a positive half –wave rectified voltage is fed to a load resistor, for which part of a cycle there will be current flow through the load?
(a) 0^0–90^0 (b) 90^0–180^0 (c) 0^0–180^0 (d) 0^0–360^0

17. $\bar{A} + A = ?$
(a) 1 (b) 0 (c) A (d) $\bar{A}$

18. Doping a semiconductor results in
(a) The decrease in mobile charge carriers
(b) The change in chemical properties
(c) The change in the crystal structure
(d) The breaking of the covalent bond

19. The variation of amplitude of the carrier wave with respect to the amplitude of the modulating signal is called
(a) Amplitude modulation (b) Frequency modulation
9c) Phase modulation (d) Pulse width modulation

20. The method of making nanomaterial by assembling the atoms is called
(a) Top down approach (b) Bottom up approach
(c) Cross down approach (d) Diagonal approach

PART – D 6 X 5 = 30

Answer ALL the questions.

21. Calculate the electric field due to a dipole on its axial line plane.

(OR)

Explain the types of absorption spectrum.

22. Derive an expression for phase angle between the applied voltage and current in a series RLC circuit.

(OR)

Deduce the relation for the magnetic field at a point due to an infinitely long straight conductor carrying current.

23. Obtain the condition for bridge balance in Wheatstone's bridge.

(OR)

Draw the circuit diagram of a half wave rectifier and explain its working.

24. Obtain Einstein's photoelectric equation with necessary explanation.

(OR)

Obtain lens maker's formula and mention its significance.

25. Discuss the spectral series of hydrogen atom.

(OR)

Explain in detail the construction and working of a Van de Graaff generator.

26. Obtain a relation for the magnetic field at a point along the axis of a circular coil carrying current.

(OR)

Obtain the law of radioactivity.

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