SHRI VIDHYABHARATHI MATRIC HR.SEC.SCHOOL

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QUARTERLY - SEPTEMBER - 2019

STD: XII

SUBJECT: PHYSICS **TENTATIVE ANSWER KEY** **MARKS : 70**

Q.N	SECTION - I		MARKS
OPTION		ANSWER	
1	a)	Straight line	1
2	d)	9 / 16 F	1
3	d)	Energy density	1
4	b)	Resitance of wet hand is low	1
5	b)	0.03×10^{-3} ms^{-1}	1
6	b)	50 Hz	1
7	a)	π / 4	1
8	d)	60^0	1
9	d)	Infra red rays	1
10	b)	8 mC	1
11	a)	In phase and perpendicular to each other	1
12	c)	q / 2m	1
13	d)	4×10^{-7} T	1
14	d)	zero	1
15	d)	b < d < c < a	1

16

Coulomb force	Gravitational force
It acts between two charges	It acts between two masses
It can be attractive or repulsive	It is always attractive
It is always greater in magnitude	It is always lesser in magnitude
It depends on the nature of the medium	It is independent of the medium
If charges are in motion, another force called Lorentz force come in to play in addition to Coulomb force	Gravitional force is the same whether two masses are at rest or in motion

(Each point carries ½ marks)

2

17

$$C = \frac{\quad}{d} = \frac{\quad}{\quad}$$

1

$$= 221.2 \times 10^{-13} F$$

$$C = 22.12 \times 10^{-12} F$$

1

18

Electrical resistivity of a material is defined as the resistance offered to current flow by a conductor of unit length having unit area of cross section. 1 ½

Its unit is ohm - m ½

19

i) $\xi_{eq} = n\,\xi = 4 \times 5 = 20$ V ½

ii) $r_{eq} = 4 \times 0.5 = 2.0\ \Omega$ ½

iii) $I = \frac{n\,\xi}{R+nr} = \frac{4 \times 5}{8+2.0} = 2$ A ½

iv) V = IR = 2 x 8 = 16 V ½

20

The line integral of magnetic field over a closed loop is μ0 times net current enclosed by the loop. 2

$$\oint_C \vec{B}.\vec{dl} = \mu_0 I_{enclosed}$$

(equation only award 1 mark)

21

First law:

Whenever magnetic flux linked with a closed circuit changes, an emf is induced in the circuit. 1

	Second law The magnitude of induced emf in a closed circuit is equal to the time rate of change of magnetic flux linked with the circuit.	1
22	1) For a given dimension of the generator, three-phase machine produces higher power output than a single-phase machine. 2) For the same capacity, three-phase alternator is smaller in size when compared to single phase alternator. 3) Three-phase transmission system is cheaper. A relatively thinner wire is sufficient for transmission of three-phase power. (Any two points)	2
23	• X-rays are used extensively in studying structures of inner atomic electron shells and crystal structures. • It is used in detecting fractures, diseased organs, • Used to detect formation of bones and stones, observing the progress of healing bones. • Further, in a finished metal product, it is used to detect faults, cracks, flaws and holes.	2
24	$\frac{d\emptyset}{dt} = \frac{d}{dt}(BA)$ $\varepsilon = \frac{0.05\ x\ (101-100) x 10^{-4}}{dt}$ $= \frac{0.05\ x\ 10^{-4}}{dt}$	1
	$i = \frac{\epsilon}{R}$; $i = \frac{dq}{dt}$ $\frac{\epsilon}{R} = \frac{dq}{dt} \Longrightarrow \frac{0.05\ x\ 10^{-4}}{dt\ x\ 2} = \frac{dq}{dt}$ dq = 2.5 x 10^{-6} C	1

<table>
<tr><th>Q.N</th><th>SECTION - III</th><th>MARKS</th></tr>
<tr><td>25</td><td>Diagram

Rules each point carries ½ marks

(propertie of electric field lines)</td><td>1

2</td></tr>
<tr><td>26</td><td>B and C are parallel. so C = 6 + 2 = 8 μF

a, b , c and d are in series

$\frac{1}{C_s} = \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{3}{8}$

$C_s = \frac{8}{3}$ μF</td><td>1</td></tr>
<tr><td></td><td>Total charge on capacitor q = $C_sV = \frac{8}{3} \times 9 \times 10^{-6} = 24$ μC

Charge on Capacitor a, q_a = CV = 24 μC

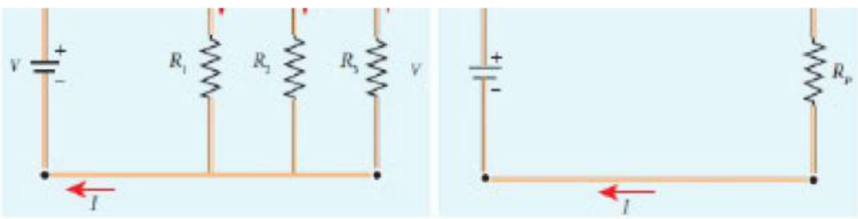
$q_a = q_d = 24$ μC

$q_b = 6$ μF x 3 = 18 μC

$q_c = 2$ μF x 3 = 6 μC</td><td>1</td></tr>
<tr><td></td><td>Potential difference across capacitor a, $V_a = q_a / C_a = \frac{24 \times 10^{-6}}{8 \times 10^{-6}} = 3$ V

Potential difference across capacitor b, $V_b = q_b / C_b = \frac{18 \times 10^{-6}}{6 \times 10^{-6}} = 3$ V

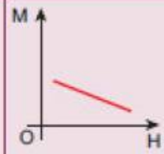
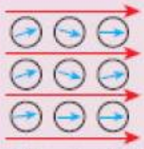
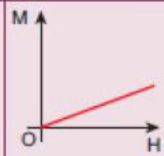
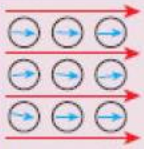
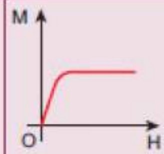
Potential difference across capacitor c, $V_c = q_c / C_c = \frac{6 \times 10^{-6}}{2 \times 10^{-6}} = 3$ V

Potential difference across capacitor d, $V_d = q_d / C_d = \frac{24 \times 10^{-6}}{8 \times 10^{-6}} = 3$ V</td><td>1</td></tr>
<tr><td>27</td><td>

• When two or more resistors are connected across the same potential difference, they are said to be</td><td>½</td></tr>
</table>

		
	• When two or more resistors are connected across the same potential difference, they are said to be in parallel. • Let R_1, R_2, R_3 be the resistances of three resistors connected in parallel. • Let 'V' be the potential difference applied across this combination. • In parallel connection, (i) Potential difference across each resistance will be the same (V) (ii) But current flows through different resistors will be different.	1
	• Let I_1, I_2, I_3 be the currents flow through R_1, R_2, R_3 respectively, then from Ohm's law $I_1 = \frac{V}{R_1}$; $I_2 = \frac{V}{R_2}$; $I_3 = \frac{V}{R_3}$ • Hence the total current will be, $I = I_1 + I_2 + I_3 = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$ $\boldsymbol{I = V\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]} \quad ----\ (1)$	½
	• Let $\boldsymbol{R_P}$ be the equivalent resistance in parallel connection, then, $\boldsymbol{I = \frac{V}{R_P}} \quad ----\ (2)$ • From equation (1) and (2), $\frac{V}{R_P} = V\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]$ $\therefore \quad \boldsymbol{\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$	½
	• When resistances are connected in parallel, the reciprocal of equivalent resistance is equal to the sum of the reciprocal of the values of resistance of the individual resistor. • The equivalent resistance in parallel connection will be lesser than each individual resistance.	½
28		½
		½
		1 ½
	▪ Here, $R_G <$ ▪ Thus an v and it alw element. ▪ An *ideal a*	½

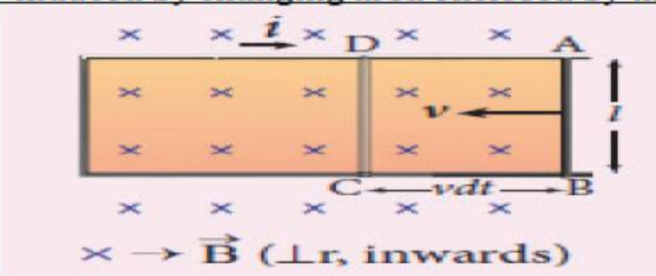
29

Type of magnetism	Magnetising field is absent (H = 0)	Magnetising field is present ($H \neq 0$)	Magnetisation of the material	Susceptibility	Relative permeability
Diamagnetism	 (Zero magnetic moment)	 (Aligned opposite to the field)		Negative	Less than unity
Paramagnetism	 (Net magnetic moment but random alignment)	 (Aligned with the field)		Positive and small	Greater than unity
Ferromagnetism	 (Net magnetic moment in a domain but random alignment of domains)	 (Aligned with the field)		Positive and large	Very large

Marks: 1, 1, 1

30

EMF induced by changing area enclosed by the coil



½

- Consider a conducting rod of length '*l*' moving with a velocity '*v*' towards left on a rectangular metallic frame work.
- The whole arangemetn is placed in a uniform magnetic field '$\vec{B}$' acting perpendicular to the plane of the coil inwards.

area enclos
flux throug

1

- The change
d
d
c

½

- This chang
emf and it i

1

- This emf is

31

Any six properties (each property carries ½ mark) — 3

32	$v = \frac{1}{\sqrt{\mu\varepsilon}}$ $v = \frac{1}{\sqrt{\mu_0\varepsilon_0}} \times \frac{1}{\sqrt{\mu_r\varepsilon_r}} = c \times \frac{1}{\sqrt{\mu_r\varepsilon_r}}$	1
	$v^2 = \frac{c^2}{\mu_r\varepsilon_r}$ $= \frac{3 \times 10^8 \times 3 \times 10^8}{1 \times 2.25}$ $= 4 \times 10^{16}\ ms^{-1}$	1
	$v = 2 \times 10^8\ ms^{-1}$	1
33	$V = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \frac{1}{r_4}\right)$	1
	$= 9 \times 10^9 \times 10/3 \times 10^{-9} \times \left(\frac{1}{4\sqrt{2} \times 10^{-2}} + \frac{1}{4\sqrt{2} \times 10^{-2}} + \frac{1}{4\sqrt{2} \times 10^{-2}} + \frac{1}{4\sqrt{2} \times 10^{-2}}\right)$	1
	$V = 2.1216 \times 10^3\ V$	1
Q.N	**SECTION - IV**	**MARKS**
34 (a)		1
	• It produce of about 1	½
	Principle : • Electro stat • Action of p **Construction :**	

Construction :

- It consists
fixed on the
- Pulley 'B' i
and anothe
- A belt mad
rubber run:
- The pulley
electric mo 1
- Two comb s
fixed near th
- The comb 'D
of $10^4\ V$ by
- The upper c
of the hollow

Working :

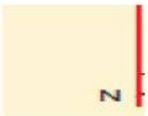
- Due to the
between th
- The positive charges are pushed towards the belt and negative charges are attracted towards the comb 'D'
- The positive charges stick to the belt and move up.
- When the positive charges reach the comb 'E' a large amount of negative and positive charges are induced on either side of comb 'E' due to electrostatic induction. 2
- As a result. the positive charges are pushed away from the comb 'E' and they reach the outer surface of the sphere.
- These positive charges are distributed uniformly on the outer surface of the hollow sphere.
- At the same time, the negative charges neutralize 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.
- This process continues until the outer surface produces the potential difference of the order of $10^7\ V$ which is the limiting value.
- Beyond this, the charges starts leaking to the surroundings due to ionization of air.
- It is prevented by enclosing the machine in a gas filled steel chamber at very high pressure.

Applications :

- The high voltage produced in this Van de Graff generator is used to accelerate positive ions (protons and deuterons) for nuclear disintegrations and other applications. ½

34 (b)

1



- Consider a long straight wire NM carrying a current I
- Let P be a point at a distance 'a' from 'O'
- Consider an element of length 'dl' of the wire at a distance 'l' from point 'O'
- Let $\vec{r}$ be the vector joining the element 'dl' with the point 'P' and 'θ' be the angle between $\vec{r}$ and $\vec{dl}$ ½
- Then the magnetic field at 'P' due to the element is,

$$\vec{dB} = \frac{\mu_o}{4\,\pi}\frac{I\,dl\sin\theta}{r^2}\,\hat{n} \qquad ----(1)$$ ½

- where, $\hat{n} \rightarrow$ unit vector normal to both $I\,\vec{dl}$ and $\hat{r}$
- In ΔPAO,

$$\tan(\pi - \theta) = \frac{a}{l}$$
$$(or) \qquad -\tan\theta = \frac{a}{l}$$
$$(or) \qquad l = -\frac{a}{\tan\theta} = -a\cot\theta$$

- Differentiate,

$$dl = -a\,(-\,cosec^2\theta)\,d\theta = a\,cosec^2\theta\,d\theta$$

- Also from ΔPAO,

$$\sin(\pi - \theta) = \frac{a}{r} \qquad (or) \qquad \sin\theta = \frac{a}{r}$$
$$(or) \qquad r = \frac{a}{\sin\theta} = a\,cosec\,\theta$$ 1

coordinate

$\vec{B} =$

$\vec{B} =$

$\vec{B} =$ 1

- For an infi
$\varphi_2 = \pi$ (18

$\vec{B} = \frac{\mu_o}{4\,\pi}$

$\vec{B} = \frac{\mu_o}{2}$ 1

35 (a)

DIAGRAM 1

EXPLANATION ½

	Potential due to $+q = \frac{1}{4\pi\varepsilon_0}\frac{q}{r_1}$ Potential due to $-q = -\frac{1}{4\pi\varepsilon_0}\frac{q}{r_2}$	½
	$V = \frac{1}{4\pi\varepsilon_0} q\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$	½
	$r_1^2 = r^2\left(1 - 2a\frac{\cos\theta}{r}\right)$ $r_1^2 = r^2 + a^2 - 2ra\cos\theta$ $r_1 = r\left(1 - \frac{2a}{r}\cos\theta\right)^{\frac{1}{2}}$ $r_1^2 = r^2\left(1 + \frac{a^2}{r^2} - \frac{2a}{r}\cos\theta\right)$ $\frac{1}{r_1} = \frac{1}{r}\left(1 - \frac{2a}{r}\cos\theta\right)^{-\frac{1}{2}}$ $\frac{1}{r_1} = \frac{1}{r}\left(1 + \frac{a}{r}\cos\theta\right)$ $r_2^2 = r^2\left(1 + \frac{2a\cos\theta}{r}\right)$ $r_2^2 = r^2 + a^2 - 2ra\cos(180 - \theta)$ $\cos(180-\theta) = -\cos\theta$ we get $r_2 = r\left(1 + \frac{2a\cos\theta}{r}\right)^{\frac{1}{2}}$ $r_2^2 = r^2 + a^2 + 2ra\cos\theta$	1
	$V = \frac{1}{4\pi\varepsilon_0} q\left(\frac{1}{r}\left(1 + a\frac{\cos\theta}{r}\right) - \frac{1}{r}\left(1 - \right.\right.$ $V = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r}\left(1 + a\frac{\cos\theta}{r} - 1 + a\frac{\cos}{r}\right.\right.$ $V = \frac{1}{4\pi\varepsilon_0}\frac{2aq}{r^2}\cos\theta$	1
	$V = \frac{1}{4\pi\varepsilon_0}\frac{\vec{p}\cdot\hat{r}}{r^2}$	½
35 (b)	DIAGRAM	½
	EXPLANATION	½
	$I_1 - I_G - I_3 = 0$ $I_2 + I_G - I_4 = 0$	1
	$I_1P + I_GG - I_2R = 0$ $I_1P + I_3Q - I_4S - I_2R = 0$	1
	$I_G = 0$	½
	$I_1 = I_3$ $I_2 = I_4$ $I_1P = I_2R$ $I_1P + I_1Q - I_2S - I_2R = 0$ $I_1(P + Q) = I_2(R + S)$	½

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

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

1

1

½

36 (a)

- Here $\vec{B}_1$ inwards
- Then Lorentz force acts on the length element dl in conductor 'B' carrying current I_2 due to this magnetic field $\vec{B}_1$

$$\overrightarrow{dF} = I_2\overrightarrow{dl} \; X \; \vec{B}_1 = -\, I_2 \, dl \, \hat{k} \; X \; \frac{\mu_o \, I_1}{2\,\pi\,r} \, \hat{\imath}$$

$$\overrightarrow{dF} = -\, \frac{\mu_o \, I_1 \, I_2 \, dl}{2\,\pi\,r} \, (\hat{k} \; X \; \hat{\imath})$$

$$\overrightarrow{dF} = -\, \frac{\mu_o \, I_1 \, I_2 \, dl}{2\,\pi\,r} \, \hat{\jmath}$$

- By Flemming's left hand rule, this force acts left wards. The force per unit length of the conductor B

$$\frac{\vec{F}}{l} = -\, \frac{\mu_o \, I_1 \, I_2}{2\,\pi\,r} \, \hat{\jmath} \qquad ------ \; (1)$$

1 ½

- Similarly, net magnetic field due to I_2 at a distance 'r' is

$$\vec{B}_2 = \frac{\mu_o \, I_2}{2\,\pi\,r} \; \hat{\imath}$$

- Here $\vec{B}_2$ acts perpendicular to plane of paper and outwards.
- Then Lorentz force acts on the length element dl in conductor 'A' carrying current I_1 due to this magnetic field $\vec{B}_2$

$$\overrightarrow{dF} = I_1\overrightarrow{dl} \; X \; \vec{B}_2 = I_1 \, dl \, \hat{k} \; X \; \frac{\mu_o \, I_2}{2\,\pi\,r} \, \hat{\imath}$$

$$\overrightarrow{dF} = \frac{\mu_o \, I_1 \, I_2 \, dl}{2\,\pi\,r} \, (\hat{k} \; X \; \hat{\imath})$$

$$\overrightarrow{dF} = \frac{\mu_o \, I_1 \, I_2 \, dl}{2\,\pi\,r} \, \hat{\jmath}$$

- By Flemming's left hand rule, this force acts right wards. The force per unit length of the conductor A

$$\frac{\vec{F}}{l} = \frac{\mu_o \, I_1 \, I_2}{2\,\pi\,r} \, \hat{\jmath} \qquad ----- \; (2)$$

1 ½

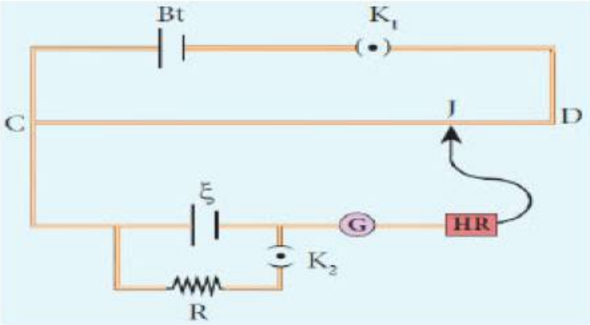
- Thus the force experienced by two parallel current carrying conductors is attractive if they carry current in same direction.
- On the other hand, the force experienced by two parallel current carrying conductors is repulsive if they carry current in opposite direction.

½

36 (b)

circuit.

- The cell ξ v
  measured is
- A resistance
  across the ce ½



1

- With key K_2 open, the balancing point J is found out and balancing length $CJ = l_1$ is measured.
- By the principle,

$$\xi \propto l_1 \qquad ----(1)$$

½

- A suitable resistance is included in R and key K_2 is closed.
- The current flows through R and cell is,

$$I = \frac{\xi}{R+r}$$

- Hence potential difference across R

$$V = I\,R = \frac{\xi}{R+r}\,R$$

1

- For this potential difference, again the balancing point J is found out and the balancing length $CJ = l_2$ is measured.
- By the principle,

$$\frac{\xi}{R+r}\,R \propto l_2 \qquad ----(2)$$

½

- Divide equation (1) by (2)

$$\frac{\xi}{\left(\frac{\xi}{R+r}\,R\right)} = \frac{l_1}{l_2}$$

½

$$\frac{R+r}{R} = \frac{l_1}{l_2}$$

$$1 + \frac{r}{R} = \frac{l_1}{l_2}$$

$$\frac{r}{R} = \frac{l_1}{l_2} - 1 = \frac{l_1 - l_2}{l_2}$$

$$\boldsymbol{r = R\left[\frac{l_1 - l_2}{l_2}\right]} \qquad ---(3)$$

1

- By substituting R, l_1, l_2 in equation (3) the internal resistance of the cell can be measured.
- Here the internal reistance is not constant, and it increased with increase of external resistance R.

37 (a)

1

½

- The rep
  (i.e.) ma

  $\overrightarrow{B_N} =$ → ½

- The attractive force experienced by unit north pole
  (i.e.) magnetic field at 'C' due to south pole

  $$\overrightarrow{B_S} = \frac{\overrightarrow{F_S}}{q_{m_C}} = -\frac{\mu_o}{4\pi}\frac{q_m}{(r+l)^2}\,\hat{\imath} \qquad ----(2)$$ → ½

- Then total magnetic field at 'C' is

$$\vec{B}_{axis} = \overrightarrow{B_N} + \overrightarrow{B_S}$$

$$= \frac{\mu_o}{4\pi}\frac{q_m}{(r-l)^2}\,\hat{\imath} + \left[-\frac{\mu_o}{4\pi}\frac{q_m}{(r+l)^2}\,\hat{\imath}\right]$$

$$= \frac{\mu_o}{4\pi}\,q_m\left[\frac{1}{(r-l)^2} - \frac{1}{(r+l)^2}\right]\hat{\imath}$$

$$= \frac{\mu_o}{4\pi}\,q_m\left[\frac{(r+l)^2 - (r-l)^2}{(r-l)^2\,(r+l)^2}\right]\hat{\imath}$$

$$= \frac{\mu_o}{4\pi}\,q_m\left[\frac{r^2 + l^2 + 2\,r\,l - r^2 - l^2 + 2\,r\,l}{\{(r-l)\,(r+l)\}^2}\right]\hat{\imath}$$

$$= \frac{\mu_o}{4\pi}\,q_m\,\frac{4\,r\,l}{(r^2 - l^2)^2}\,\hat{\imath}$$

$$= \frac{\mu_o}{4\pi}\,\frac{2\,r\,(q_m\,2\,l)}{(r^2 - l^2)^2}\,\hat{\imath}$$

$$\vec{B}_{axis} = \frac{\mu_o}{4\pi}\,\frac{2\,r\,p_m}{(r^2 - l^2)^2}\,\hat{\imath} \qquad ----(3)$$ 1

- where $q_m\,2\,l = p_m \rightarrow$ magnetic dipole moment
- If $r \gg l$, then $(r^2 - l^2)^2 \approx r^4$. So

$$\vec{B}_{axis} = \frac{\mu_o}{4\pi}\,\frac{2\,r\,p_m}{r^4}\,\hat{\imath}$$

$$\vec{B}_{axis} = \frac{\mu_o}{4\pi}\,\frac{2\,p_m}{r^3}\,\hat{\imath} \qquad [p_m\hat{\imath} = \vec{p}_m]$$ 1

$$\boldsymbol{\vec{B}_{axis} = \frac{\mu_o}{4\pi}\,\frac{2\,\overrightarrow{p_m}}{r^3}} \qquad ----(4)$$ → ½

37 (b)	conductors single circ alternating alternator.	½
	DIAGRAM	½

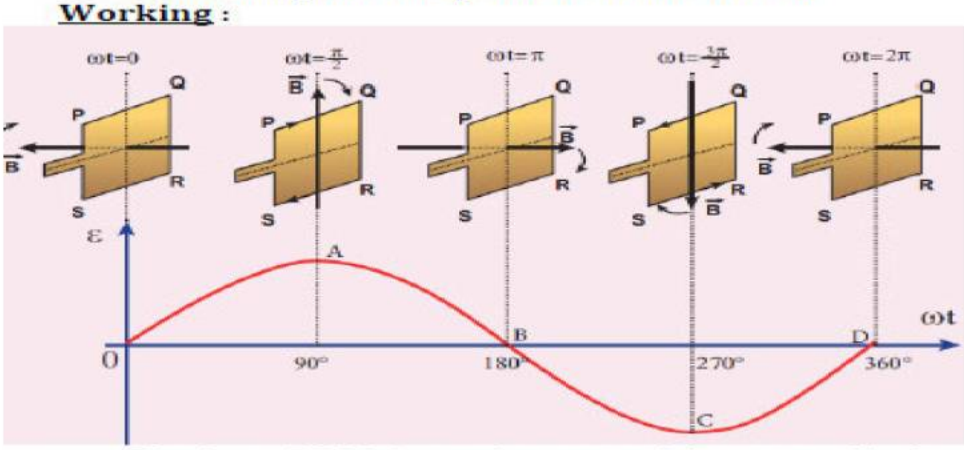
Principle :

- Electro magnetic induction ½

Construction :

- Consider a stator core consisting of 2 slots in which 2 armature conductor PQ and RS are mounted to form single - turn rectangular loop PQRS ½
- Rotor has 2 salient poles with field windings which can be magnetized by means of DC source.

Working :

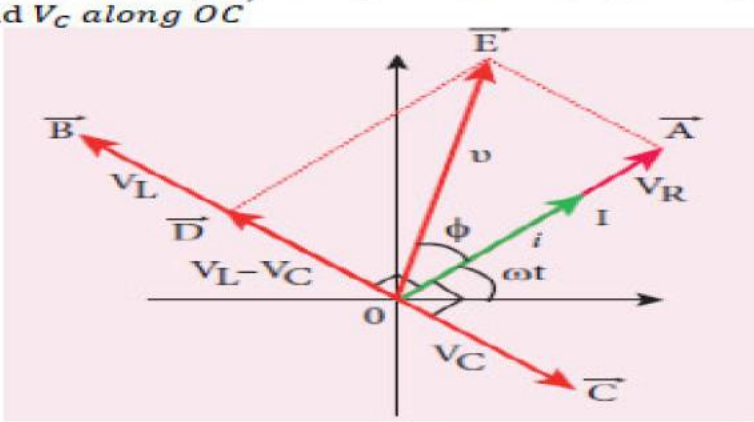


1

- The loop PQRS is stationary and is perpendicular to the plane of the paper.
- Assume the initial position of the field magnet is horizontal. At that instant, the direction of magnetic field is perpendicular to the plane of the loop PQRS. The induced emf is zero. It is represented by origin 'O' in the graph
- Let the magnetic field rotate in clock-wise direction.

2

downward
current flo
represent:
- When field
perpendic
becomes z
- When field
parallel to
the direct
along SRQ
- On compl
zero and it
- From the
completes
alternatin

38 (a)		
		½
	resistance capacitor alternatin ♠ The applie	½
	♠ Let 'i' be the current in the circuit at that instant. ♠ Hence the voltage developed across R, L and C $V_R = i\,R$ (V_R is in phase with i) $V_L = i\,X_L$ (V_L leads i by $\frac{\pi}{2}$) $V_C = i\,X_C$ (V_C lags i by $\frac{\pi}{2}$)	½
	♠ The phasor diagram is drawn by representing current along $\overrightarrow{OI}$, V_R along $\overrightarrow{OA}$, V_L along $\overrightarrow{OB}$ and V_C along $\overrightarrow{OC}$ 	1
	(or) (or)	1
	♠ Where, impedanc effective series RL ♠ From th between ' **tan φ**	½

	This circui (iii) When X_L = means that $(i.e.)$ v = This circui	1
38 (b)	(ii) <u>Line e</u> ♣ Li sp di ♣ The line spectr are sharp lines of definite wavelengths or frequencies. ♣ It is different for different elements (e.g.) spectra of atomic hydrogen, helium, etc (iii) <u>Band emission spectra</u> : ♣ The light from excited molecules gives band spectrum. ♣ It consists of several number of very closely spaced spectral lines which overlapped together forming specific coloured bands. ♣ This spectrum has a sharp edge at one end and fades out at the other end. ♣ Band spectrum is the characteristic of the molecule. (e.g.) spectra of hydrogen gas, ammonia gas in the discharge tube, etc	1 1 1 ½ 1 ½

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