SHRI KRISHNA ACADEMY

BOARD EXAM (10,+1,+2) ,NEET AND JEE COACHING CENTRE
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HALF YEARLY - DECEMBER - 2019

STD: XII

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

Q.N	SECTION - I		MARKS
	OPTION	ANSWER	
1	b)	V_a / V_w	1
2	b)	- 10 V	1
3	d)	$V_g = V_x = V_m$	1
4	a)	AND GATE	1
5	c)	uniformly charged infinite plane	1
6	b)	decrease by 3 times	1
7	d)	1 A	1
8	a)	eVr / 2	1
9	a)	1	1
10	c)	equal to 90^0	1
11	a)	30 kJ	1
12	b)	45^0	1
13	b)	3.6 F	1
14	a)	25 m	1
15	d)	voltage regulator	1

Q.N	SECTION - II	MARKS
16	The impact parameter (b) is defined as the perpendicular distance between the centre of the gold nucleus and the direction of velocity vector of alpha particle when it is at a large distance.	2
17	1) The gravitational force between two masses is always attractive but Coulomb force between two charges can be attractive or repulsive, depending on the nature of charges. 2) the electrostatic force is always greater in magnitude than gravitational force for smaller size objects. 3) The gravitational force between two masses is independent of the medium. But the electrostatic force between the two charges depends on nature of the medium in which the two charges are kept at rest. [OR ANY RELEVANT POINTS]	2
18	As the intensity of the unpolarised light falling on the first polaroid is I, the intensity of polarized light emerging will be, $I_0 = \left(\frac{I}{2}\right)$. Let I' be the intensity of light emerging from the second polaroid. Malus' law, $I' = I_0 \cos^2\theta$ Substituting, $I' = \left(\frac{I}{2}\right)\cos^2(30^\circ) = \left(\frac{I}{2}\right)\left(\frac{\sqrt{3}}{2}\right)^2 = I\frac{3}{8}$ $I' = \left(\frac{3}{8}\right)I$	2
19	The phenomenon of lagging of magnetic induction behind the magnetising field is called hysteresis. Hysteresis means 'lagging behind'.	2
20	$\alpha = \frac{I_C}{I_E}$ $I_C = \alpha I_E = 0.95 \times 1 = 0.95\ mA$ $I_E = I_B + I_C$ $\therefore I_B = I_C - I_E = 1 - 0.95 = 0.05\ mA$	2

<table>
<tr><td>21</td><td>

DRIFT VELOCITY	MOBILITY
• The drift velocity is the average velocity acquired by the electrons inside the conductor when it is subjected to an electric field. • $\vec{v}_d = -\mu\vec{E}$ • Its unit is ms^{-1}	• The mobility of the electron is defined as the magnitude of the drift velocity per unit electric field. • $\mu = \frac{\lvert\vec{v}_d\rvert}{\lvert\vec{E}\rvert}$ • Its unit is $m^2V^{-1}s^{-1}$

</td><td>2</td></tr>
<tr><td>22</td><td>The frequency range over which the baseband signals or the information signals such as voice, music, picture, etc. is transmitted is known as bandwidth.</td><td>2</td></tr>
<tr><td>23</td><td>The displacement current can be defined as the current which comes into play in the region in which the electric field and the electric flux are changing with time.</td><td>2</td></tr>
<tr><td>24</td><td>The stone will reach the earth's surface earlier than the metal ball. The reason is that when the metal ball falls through the magnetic field of earth, the eddy currents are produced in it which opposes its motion. But in the case of stone, no eddy currents are produced and it falls freely.</td><td>2</td></tr>
<tr><td>Q.N</td><td>SECTION - III</td><td>MARKS</td></tr>
<tr><td>25</td><td>Advantages of FM
i) Large decrease in noise. This leads to an increase in signal-noise ratio.
ii) The operating range is quite large.
iii) The transmission efficiency is very high as all the transmitted power is useful.
iv) FM bandwidth covers the entire frequency range which humans can hear. Due to this, FM radio has better quality compared to AM radio.

Limitations of FM
i) FM requires a much wider channel.
ii) FM transmitters and receivers are more complex and costly.
iii) In FM reception, less area is covered compared to AM.</td><td>3</td></tr>
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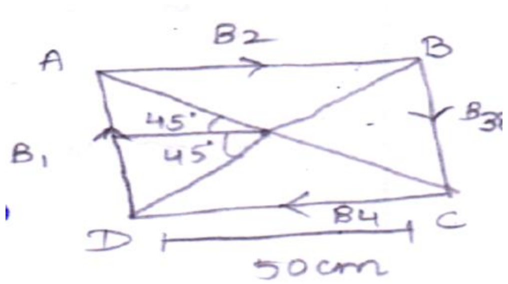
GIVEN

I = 1.5 A, L = 50 cm = 0.5 m



SOLUTION

B = $\frac{\mu_0}{4\pi a}$ [sin θ_1 + sin θ_2] $\hat{n}$

a = l / 2

$B_1 + B_2 + B_3 + B_4 = B$

$B_1 = \frac{\mu_0}{4\pi\, l/2}$ [sin 45^0 + sin 45^0]

$= \frac{4\pi \ x\ 10^{-7}}{4\pi \ x \ \frac{50\ x\ 10^{-2}}{2}}$ x $\left[\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right]$

$= \frac{2\ x\ 10^{-7} x\ 10^{-2}}{50}$ x $\frac{2}{\sqrt{2}}$

B = $4B_1$

$= \frac{4\ x\ 2\ x\ 10^{-5} x\ 2}{50\sqrt{2}}$

$$= \frac{8\ x\ 10^{-5} x\ \sqrt{2}\ x\ \sqrt{2}}{50\sqrt{2}} = \frac{8\ x\ 1.414\ x\ 10^{-5}}{50}$$

B = 3.4 x 10^{-6} T

3

27

A p-n junction diode which converts an optical signal into electric current is known as photodiode. Thus, the operation of photodiode is exactly opposite to that of an LED. Photo diode words in reverse bias. The direction of arrows indicates that the light is incident on the photo diode.

1

Applications

- Alarm system
- Count items on a conveyer belt
- Photoconductors
- Compact disc players, smoke detectors
- Medical applications such as detectors for computed tomography etc.

2

28

- Let C - centre of curvature of the mirror.
- Consider a light ray parallel to the principal axis is incident on the mirror at M and passes through the principal focus F after reflection. ½
- The line CM is the normal to the mirror at M.
- Let i be the angle of incidence and the same will be the angle of reflection.

The angles $\angle MCP = i$ and $\angle MFP = 2i$

From right angle triangles ΔMCP and ΔMFP,

$$\tan i = \frac{PM}{PC} \text{ and } \tan 2i = \frac{PM}{PF}$$

As the angles are small, $\tan i \approx i$,

$$i = \frac{PM}{PC} \text{ and } 2i = \frac{PM}{PF}$$

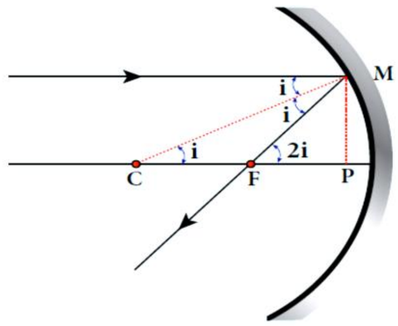
Simplifying further,

$$2\frac{PM}{PC} = \frac{PM}{PF};\ 2PF = PC$$

2

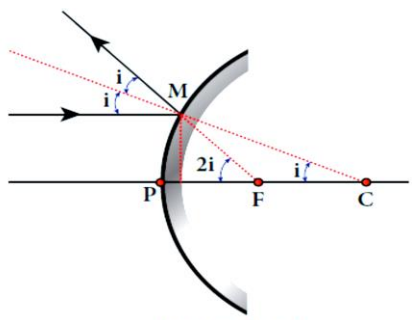
- PF is focal length f and PC is the radius of curvature R.

$$2f = R \qquad \text{(or)} \qquad f = \frac{R}{2}$$



(அ) குழி ஆடி

½



(ஆ) குவி ஆடி

[DIAGRAM ANY ONE IS SUFFICIENT]

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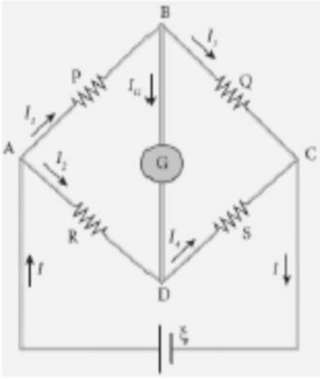
Wheatstone's bridge.

<u>Wheatstone's bridge</u> :



- An important application of Kirchoff's laws is the Wheatstone's bridge.
- It is used to compare resistances and also helps in determining the unknown resistance in the electrical network 1
- The bridge consists of four resistances P, Q, R, S connected as shown.
- A galvanometer 'G' is connected between B and D
- A battery 'ξ' is connected between A and C
- Let I_1, I_2, I_3, I_4 currents through various branches and I_G be the current through the galvanometer.
- Applying Kirchoff's current law at B and D,

$$I_1 - I_G - I_3 = 0 \qquad ---- (1)$$
$$I_2 + I_G - I_4 = 0 \qquad ---- (2)$$

- Applying Kirchoff's voltage law ABDA and ABCDA,

$$I_1 P + I_G G - I_2 R = 0 \qquad ---- (3)$$
$$I_1 P + I_3 Q - I_2 R - I_4 S = 0 \qquad ---- (4)$$

- At balanced condition, the potential at B and D are same, and hence the galvanometer shows zero deflection. So $\boldsymbol{I_G = 0}$
- Put this in equation (1), (2) and (3)

$$I_1 - I_3 = 0 \quad (or) \quad I_1 = I_3 \qquad ---- (5)$$
$$I_2 - I_4 = 0 \quad (or) \quad I_2 = I_4 \qquad ---- (6)$$
$$I_1 P - I_2 R = 0 \quad (or) \quad I_1 P = I_2 R \qquad ---- (7)$$

- Put equation (5) and (6) in (4)

$$I_1 P + I_1 Q - I_2 R - I_2 S = 0$$
$$I_1 (P + Q) - I_2 (R + S) = 0$$
$$\therefore \quad I_1 (P + Q) = I_2 (R + S) \qquad ---- (8)$$

- Divide equation (8) by (7)

$$\frac{I_1 (P + Q)}{I_1 P} = \frac{I_2 (R + S)}{I_2 R}$$
$$\frac{P + Q}{P} = \frac{R + S}{R}$$
$$1 + \frac{Q}{P} = 1 + \frac{S}{R}$$
$$\frac{Q}{P} = \frac{S}{R}$$
$$(or) \quad \boldsymbol{\frac{P}{Q} = \frac{R}{S}} \qquad ---- (\mathbf{9})$$

2

30	i) For a given frequency of incident light, the number of photoelectrons emitted is directly proportional to the intensity of the incident light. The saturation current is also directly proportional to the intensity of incident light. ii) Maximum kinetic energy of the photo electrons is independent of intensity of the incident light. iii) Maximum kinetic energy of the photo electrons from a given metal is directly proportional to the frequency of incident light. iv) For a given surface, the emission of photoelectrons takes place only if the frequency of incident light is greater than a certain minimum frequency called the threshold frequency. v) There is no time lag between incidence of light and ejection of photoelectrons.	3
31	**GIVEN** $T_{1/2A}$ = 20 min, $T_{1/2B}$ = 40 min, Both have same nuclei initially, Total time = 80 min, ratio of No. of decayed = $\frac{A}{B}$ = ? **SOLUTION** $N_A = \frac{1}{2}^n N_0$ $n = \frac{T}{T_{1/2}} = \frac{80}{20} = 4$ $N_A = \frac{1}{2^4} N_0$ $N_A = N_0 / 16$ $N_B = \frac{1}{2}^n N_0$ $n = \frac{T}{T_{1/2}} = \frac{80}{40} = 2$ $N_A = \frac{1}{2^2} N_0$ $N_A = N_0 / 4$ No. of decayed atoms in A = $N_0 - N_A = N_0 - (N_0 / 16) = 15N_0 / 16$ No. of decayed atoms in B = $N_0 - N_B = N_0 - (N_0 / 4) = 3N_0 / 4$ $\frac{A}{B} = (15N_0 / 16) / (3N_0 / 4) = 5/4$ Therefore the ratio of A: B is 5 : 4	3

32

<u>**Conservation of energy LC oscillations**</u> :

- ♠ During LC oscillations, the energy of the system oscillates between the electric field of the capacitor and the magnetic field of the inductor.
- ♠ Although these two energies vary with time, the total energy remains constant. (i.e)

$$U = U_E + U_B = \frac{q^2}{2C} + \frac{1}{2} L\, i^2 = constant$$ ½

<u>Case (i)</u> :

- ♠ When the charge of in the ccapacitor ; $q = Q_m$ and the current through the inducor ; $i = 0$

$$U = \frac{Q_m^2}{2C} + 0 = \frac{Q_m^2}{2C} \qquad ----(1)$$ ½

- ♠ The total energy is wholly electrical.

<u>Case (ii)</u> :

- ♠ When charge $q = 0$; Current □ $i = I_m$, the total energy,

$$U = 0 + \frac{1}{2} L\, I_m^2 = \frac{1}{2} L\, I_m^2$$

$$[\because i = -\frac{dq}{dt} = -\frac{d}{dt}(Q_m \cos \omega t) = Q_m \omega \sin \omega t = I_m \sin \omega t]$$

- ♠ Hence, $I_m = Q_m \omega = \frac{Q_m}{\sqrt{LC}}$

$$\therefore \quad U = \frac{1}{2} L \left[\frac{Q_m^2}{LC}\right] = \frac{Q_m^2}{2C} \qquad ----(2)$$ 1

- ♠ Here the total energy is wholly magnetic

<u>Case (iii)</u> :

- ♠ When charge $= q$, Current $= i$, then the total energy,

$$U = \frac{q^2}{2C} + \frac{1}{2} L\, i^2$$

- ♠ Here, $q = Q_m \cos \omega t$ & $i = Q_m \omega \sin \omega t$. So

$$U = \frac{Q_m^2 \cos^2 \omega t}{2\,C} + \frac{1}{2} L\, Q_m^2 \omega^2 \sin^2 \omega t$$

- ♠ Since, $\omega^2 = \frac{1}{L\,C}$

$$U = \frac{Q_m^2 \cos^2 \omega t}{2C} + \frac{L\, Q_m^2 \sin^2 \omega t}{2\,LC}$$ 1

$$U = \frac{Q_m^2}{2C}(\cos^2 \omega t + \sin^2 \omega t) = \frac{Q_m^2}{2C} \qquad ---(3)$$

- ♠ From equation (1), (2) and (3) it is clear that the total energy of the system remains constant

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33

GIVEN

q = 5 μC, E along axial line at 25 cm = ?, E along equatorial line at 20 cm = ?

SOLUTION

dipole moment p = q x 2d = 5 x 10^{-6} x 8 x 10^{-3} = 40 x 10^{-9} Cm

E along axial line at 25 cm

E = $\frac{1}{4\pi\varepsilon_0} \frac{2p}{r^3}$ = 9 x 10^9 x $\frac{2 \times 40 \times 10^{-9}}{(25 \times 10^{-2})^3}$ = 0.04608 x 10^6 = 4.6 x10^4 NC^{-1} 1 ½

E along equatorial line at 20 cm

E = $\frac{1}{4\pi\varepsilon_0} \frac{p}{r^3}$ = 9 x 10^9 x $\frac{40 \times 10^{-9}}{(20 \times 10^{-2})^3}$ = 0.045 x 10^6 = 4.5 x 10^4 NC^{-1} 1 ½

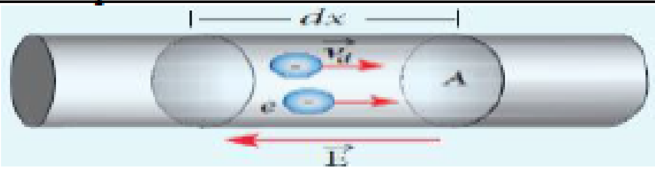
Q.N	SECTION - IV	MARKS
34 (a)	**Principle :** ▪ When a charged particle moves normal to the magnetic field, it experience magnetic Lorentz force. **Construction :** ▪ It consists two semi circular metal containers called *Dees*. ▪ The Dees are enclosed in an evacuated chamber and it is kept in a region of uniform magnetic field acts normal to the plane of the Dees. ▪ The two Dees are kept separated with a gap and the source 'S' of charged particles to be accelerated is placed at the centre in the gap between the Dees. ▪ Dees are connected to high frequency alternating potential difference. **Working :** ▪ Let the positive ions are ejected from source 'S' ▪ It is accelerated towards a Dee-1 which has negative potential at that instant. ▪ Since the magnetic field is normal to the plane of the Dees, the ion undergoes circular path. ▪ After one semi-circular path in Dee-1, the ion reaches the gap between Dees. ▪ At this time the polarities of the Dees are reversed, so that the ion is now accelerated towards Dee-2 with a greater velocity. ▪ For this circular motion, the centripetal force of the charged particle is provided by Lorentz force, then $$\frac{m\,v^2}{r} = B\,q\,v$$ $$r = \frac{m\,v}{B\,q}$$ $$\therefore \quad r \propto v$$ ▪ Thus the increase in velocity increases the radius of the circular path. Hence the particle undergoes spiral path of increasing radius. ▪ Once it reaches near the edge, it is taken out with help of deflector plate and allowed to hit the target T ▪ The important condition in cyclotron is the resonance condition. (i.e.) the frequency 'f' of the charged particle must be equal to the frequency of the electrical oscillator 'f_{osc}'. Hence $$f_{osc} = \frac{B\,q}{2\,\pi\,m}$$ ▪ The time period of oscillation is , $$T = \frac{2\,\pi\,m}{B\,q}$$ ▪ The kinetic energy of the charged particle is, $$KE = \frac{1}{2}\,m\,v^2 = \frac{B^2 q^2\,r^2}{2\,m}$$	1 1 3

34 (b)	DIAGRAM EXPLANATION Potential due to $+q = \frac{1}{4\pi\varepsilon_0}\frac{q}{r_1}$ Potential due to $-q = -\frac{1}{4\pi\varepsilon_0}\frac{q}{r_2}$ $V = \frac{1}{4\pi\varepsilon_0} q\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$ $r_1^2 = r^2\left(1 - 2a\frac{\cos\theta}{r}\right)$ $r_1^2 = r^2 + a^2 - 2ra\cos\theta$ $r_1 = r\left(1 - \frac{2a}{r}\cos\theta\right)^{\frac{1}{2}}$ $r_1^2 = r^2\left(1 + \frac{a^2}{r^2} - \frac{2a}{r}\cos\theta\right)$ $\frac{1}{r_1} = \frac{1}{r}\left(1 - \frac{2a}{r}\cos\theta\right)^{-\frac{1}{2}}$ $\frac{1}{r_1} = \frac{1}{r}\left(1 + \frac{a}{r}\cos\theta\right)$ $r_2^2 = r^2\left(1 + \frac{2a\cos\theta}{r}\right)$ $r_2^2 = r^2 + a^2 - 2ra\cos(180 - \theta)$ $\cos(180 - \theta) = -\cos\theta$ we get $r_2 = r\left(1 + \frac{2a\cos\theta}{r}\right)^{\frac{1}{2}}$ $r_2^2 = r^2 + a^2 + 2ra\cos\theta$ $V = \frac{1}{4\pi\varepsilon_0} q\left(\frac{1}{r}\left(1 + a\frac{\cos\theta}{r}\right) - \frac{1}{r}\left(1 - a\frac{\cos\theta}{r}\right)\right)$ $V = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r}\left(1 + a\frac{\cos\theta}{r} - 1 + a\frac{\cos\theta}{r}\right)\right)$ $V = \frac{1}{4\pi\varepsilon_0}\frac{2aq}{r^2}\cos\theta$ s $V = \frac{1}{4\pi\varepsilon_0}\frac{\vec{p}\cdot\hat{r}}{r^2}$ SPECIAL CASES	4 1
35 (a)	Diagram Principle construction working	½ 1 1 2 ½

35 (b)	when light entering the water from outside is seen from inside the water, the view is restricted to a particular angle equal to the critical angle ic. The restricted illuminated circular area is called Snell's window	1
	Diagram	1
	$n_1 \sin i_c = n_2 \sin 90^0$	
	$n_1 \sin i_c = n_2 \qquad \because \sin 90^0 = 1$	
	$\sin i_c = \dfrac{n_2}{n_1}$	
	$\sin i_c = \dfrac{CB}{AB} = \dfrac{R}{\sqrt{d^2 + R^2}}$	
	$\dfrac{R}{\sqrt{d^2 + R^2}} = \dfrac{n_2}{n_1}$	
	$\dfrac{R^2}{R^2 + d^2} = \left(\dfrac{n_2}{n_1}\right)^2$	
	$\dfrac{R^2 + d^2}{R^2} = \left(\dfrac{n_1}{n_2}\right)^2$	
	$1 + \dfrac{d^2}{R^2} = \left(\dfrac{n_1}{n_2}\right)^2; \qquad \dfrac{d^2}{R^2} = \left(\dfrac{n_1}{n_2}\right)^2 - 1;$	
	$\dfrac{d^2}{R^2} = \dfrac{n_1^2}{n_2^2} - 1 = \dfrac{n_1^2 - n_2^2}{n_2^2}$	
	$\dfrac{R^2}{d^2} = \dfrac{n_2^2}{n_1^2 - n_2^2}; \qquad R^2 = d^2\left(\dfrac{n_2^2}{n_1^2 - n_2^2}\right)$	
	$R = d\sqrt{\dfrac{n_2^2}{(n_1^2 - n_2^2)}}$	
	$n_2 = 1,\ n_1 = n$	
	$R = d\left(\dfrac{1}{\sqrt{n^2 - 1}}\right)$ (or) $R = \dfrac{d}{\sqrt{n^2 - 1}}$	3

36 (a)

<u>Microscopic model of current and Ohm' law</u> :



- Area of cross section of the conductor $= A$
  Number of electrons per unit volume $= n$
  Applied electric field along leftwads $= \vec{E}$
  Drift velocity of the electrons $= \boldsymbol{v_d}$
  Charge of the electron $= \boldsymbol{e}$
- If 'dx'be the distance travelled by the electron in time 'dt', then

$$v_d = \frac{dx}{dt} \quad (or) \quad dx = v_d\, dt$$

- The number of electrons available in the volume of length 'dx' is $= A\ dx\ X\ n = A\ v_d\, dt\ X\ n$
- Then the total charge in this volume element is,

$$dQ = A\, v_d\, dt\ n\, e$$

- By definition, the current is given by

$$I = \frac{dQ}{dt} = \frac{A\, v_d\, dt\ n\, e}{dt}$$

- $\boldsymbol{I = n\, e\, A\, v_d}$ — 3

<u>Current density</u> ($\vec{J}$) :

- Current density (J) is defined as the current per unit area of cross section of the conductor.

$$J = \frac{I}{A} = \frac{n\, e\, A\, v_d}{A}$$

$$\boldsymbol{J = n\, e\ v_d}$$

- Its unit is $\boldsymbol{A\, m^{-2}}$
- In vector notation,

$$\vec{J} = n\, e\ \vec{v_d}$$

$$\vec{J} = n\, e\left[-\frac{e\,\tau}{m}\vec{E}\right] = -\frac{n\, e^2\,\tau}{m}\vec{E}$$

- where, $\frac{n\, e^2\,\tau}{m} = \sigma \rightarrow$ conductivity

$$\therefore \quad \vec{J} = -\sigma\,\vec{E}$$

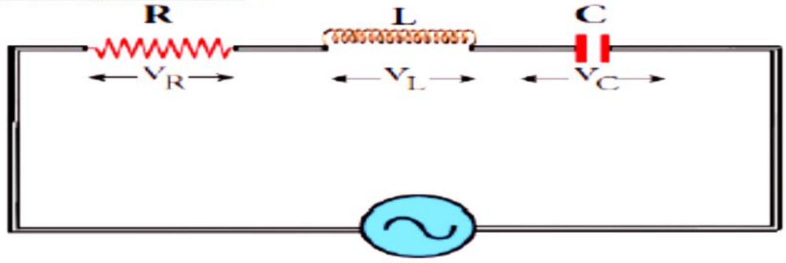
- But conventionally, we take the dirction of current density as the direction of electric field. So the above equation becomes,

$$\vec{J} = \sigma\,\vec{E}$$

- This is called microscopic form of Ohm's law. — 2

36 (b)

Series RLC circuit :



$\upsilon = V_m \sin \omega t$ ½

- 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, ½

$$v = V_m \sin \omega t \qquad ------ \quad (1)$$

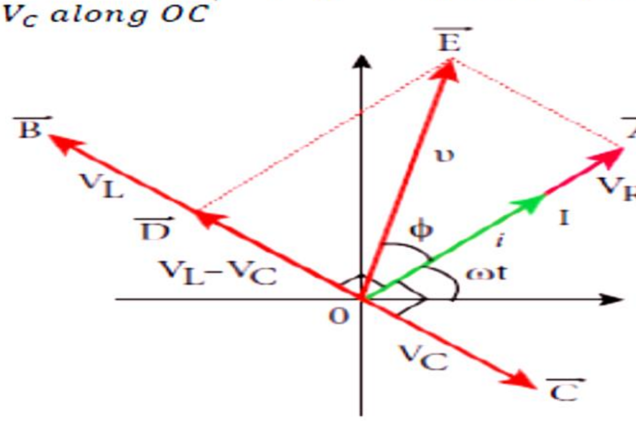
- Let 'i' be the current in the circuit at that instant.
- Hence the voltage developed across R, L and C

$$V_R = i\,R \qquad (\,V_R \text{ is in phase with } i)$$

$$V_L = i\,X_L \qquad (V_L \text{ leads } i \text{ by } \tfrac{\pi}{2})$$

$$V_C = i\,X_C \qquad (V_C \text{ lags } i \text{ by } \tfrac{\pi}{2})$$ 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

- If $V_L > V_C$, then the net voltage drop across LC combination is $(V_L - V_C)$ which is represented by $\overrightarrow{AD}$
- By parallogram law, the diagonal $\overrightarrow{OE}$ gives the resultant voltage 'v'

$$\therefore \qquad v = \sqrt{V_R^{\,2} + (V_L - V_C)^{\,2}}$$

$$v = \sqrt{i^2 R^2 + (i\,X_L - i\,X_C)^{\,2}}$$

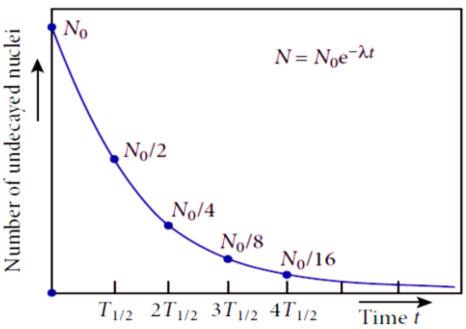
$$v = i\sqrt{R^2 + (X_L - X_C)^{\,2}}$$

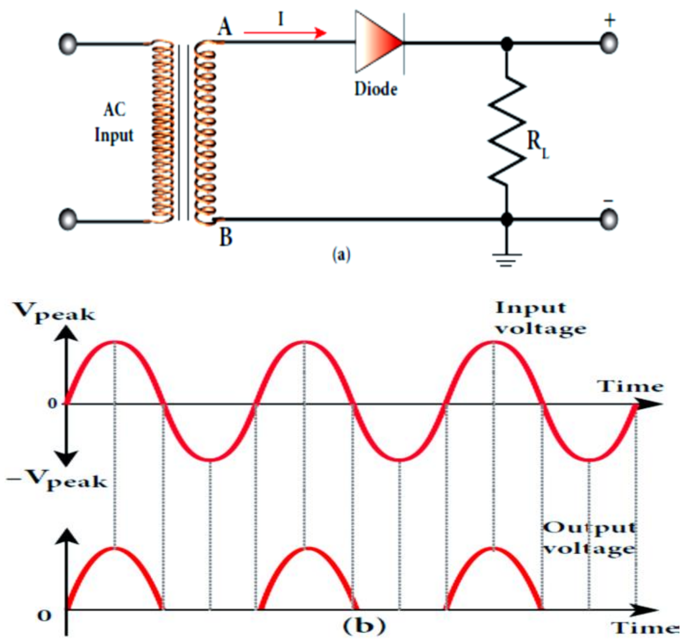
$$(or) \qquad i = \frac{v}{\sqrt{R^2 + (X_L - X_C)^{\,2}}} \qquad --- (4)$$

$$(or) \qquad i = \frac{v}{Z} \qquad --- (5)$$ 1

- Where, $Z = \sqrt{R^2 + (X_L - X_C)^{\,2}}$ is called impedance of the circuit, which refers to the effective opposition to the circuit current by the series RLC circuit.
- From the phasor diagram, the phase angle between 'v' and 'i' is found out by

$$\tan\phi = \frac{V_L - V_C}{V_R} = \frac{X_L - X_C}{R} \qquad --- (6)$$ ½

	Special cases : (i) When $X_L > X_C$, the phase angle ϕ *is positive.* It means that v leads i by ϕ. $(i.e.)$ $v = V_m \sin \omega t$ & $i = I_m \sin(\omega t - \phi)$ This circuit is inductive. (ii) When $X_L < X_C$, the phase angle ϕ *is negative.* It means that v lags behind i by ϕ. $(i.e.)$ $v = V_m \sin \omega t$ & $i = I_m \sin(\omega t + \phi)$ This circuit is capacitive (iii) When $X_L = X_C$, the phase angle ϕ *is zero.* It means that v inphase with i $(i.e.)$ $v = V_m \sin \omega t$ & $i = I_m \sin \omega t$ This circuit is resistive	1
37 (a)	• 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.  	1 3 1

37 (b)	• 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.	½
	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	1 ½
	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.	1 ½
		1
	• 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 %	½

38 (a)	Explanation	1
	Diagram	1
	Equation for magnification $m_o = \frac{h'}{h}$ $\tan\beta = \frac{h}{f_o} = \frac{h'}{L}$ $\frac{h'}{h} = \frac{L}{f_0}$ $m_o = \frac{L}{f_o}$ $m_e = 1 + \frac{D}{f_e}$ $m = m_o m_e = \left(\frac{L}{f_o}\right)\left(1 + \frac{D}{f_e}\right)$ $m_e = \frac{D}{f_e}$ $m = m_o m_e = \left(\frac{L}{f_o}\right)\left(\frac{D}{f_e}\right)$	3
38 (b)	Suppose we allow a beam of white light to pass through the prism, it is split into its seven constituent colours which can be viewed on the screen as continuous spectrum. This phenomenon is known as dispersion of light and the definite pattern of colours obtained on the screen after dispersion is called as spectrum.	1

	Emission spectra : ♣ The lighe from self luminous source gives emission spectrum. ♣ Each source has its own characteristic emission spectrum. ♣ The emission spectrum can be divided in to three types ; (i) **Continuous emission spectra** : ♣ Incandescent solids, liquids gives continuous spectra. ♣ It consists of wavelengths containing all the visible colours ranging from violet to red. (e.g.) Spectrum obtained from carbon arc, incandescent filament lamp, etc	1
	(ii) **Line emission spectra** : ♣ Light from excited atoms gives line spectrum. They are also known as discontinuous spectra. ♣ 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	1 ½
	(iii) **Band emission spectra** : ♣ 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 ½