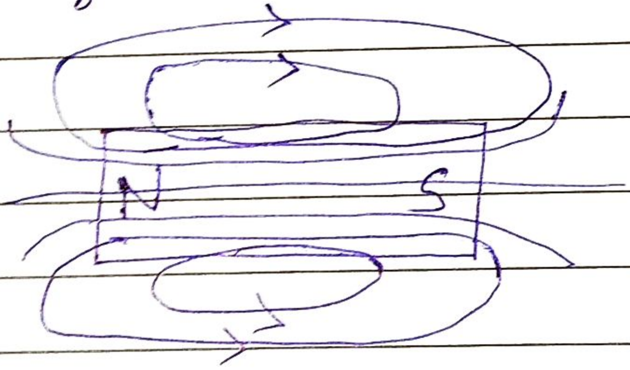
Moodlakatte Institute of Technology

Kundapura

PHYSICS

Part-A:

1. Electric charge
2. Quantity of charge per unit ~~length~~ length, $\frac{\Delta Q}{\Delta l} = \lambda$.
   $\lambda \rightarrow$ linear charge density
   $\Delta Q \rightarrow$ charge, $\Delta l \rightarrow$ small length of wire.
3. increase with increase in temperature.
4. 10%.
5. The total force on a charge q moving with velocity $\vec{v}$ in the presence of magnetic and electric fields $\vec{B}$ and $\vec{E}$, respectively is called the Lorentz force.
   $\vec{F} = q(\vec{v} \times \vec{B} + \vec{E})$
6. The net magnetic flux through any closed surface is zero.
7. 

8. In purely inductive or capacitive circuit, $\cos\phi = 0$ and no power is dissipated even through a current is flowing in the circuit. In such cases, current is referred as a Wattless current

(9) 90°

(10) Infrared waves.

2.34. Distinguish between non – polar and non – polar molecules with examples.

In a non – polar molecule, the centers of positive and negative charges coincide they have no permanent dipole moment. Ex: O_2, H_2.

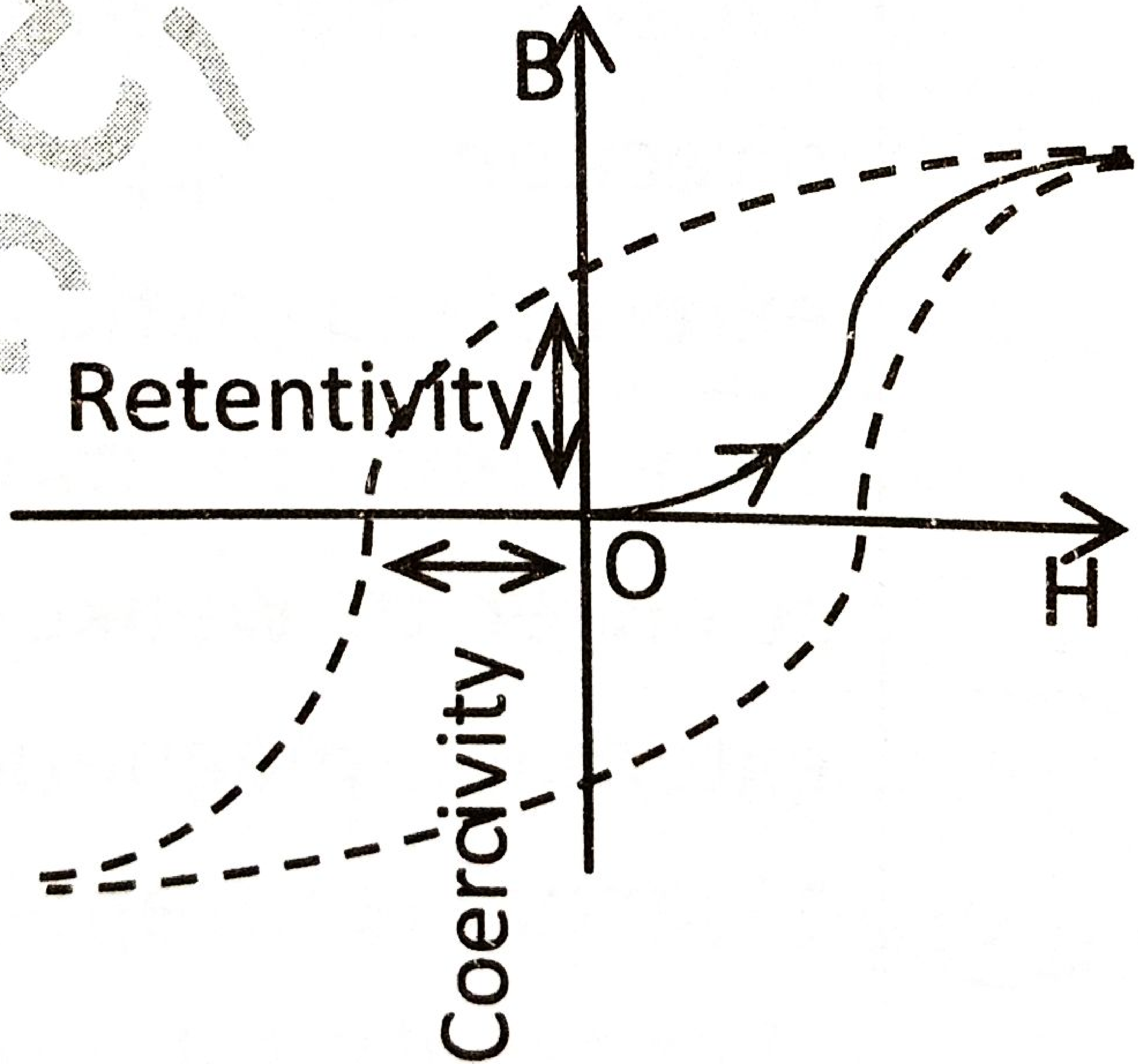
A polar molecule is one in which the centers of positive and negative charges are separated even when there is no external field. They have a permanent dipole moment. Ex: H_2O, HCl.

5.18. What is magnetic declination (D)?

Declination (D) at the place is the angle between true geographic north direction and the north shown by the magnetic compass needle.

5.19. What is magnetic dip or inclination (I)?

Magnetic dip (I) at a place is the angle between the earth's total magnetic field at a place and horizontal drawn in magnetic meridian.


B
Retentivity
O
H
Coercivity

parallel to each other)

10.73. What are the applications of polaroids?

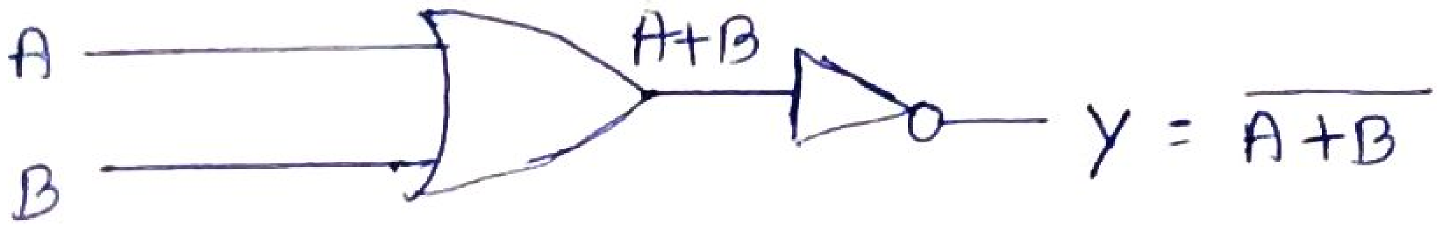
i. To control intensity in sunglasses.

ii. Control intensity in window panes.

iii. Used in photographic camera.

iv. Used in 3D movie cameras.

10.74. Is sunlight coming through the...



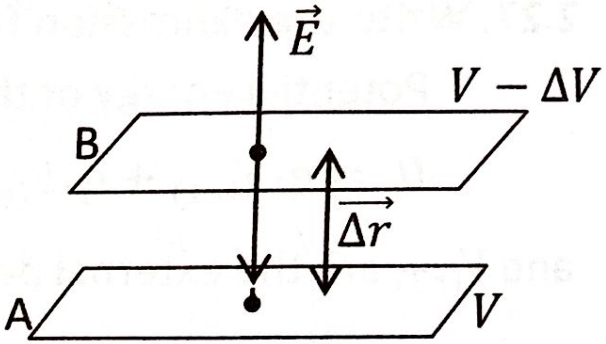
$Y = \overline{A+B}$

Given that $A = 1$ and $B = 1$

$\therefore Y = \overline{A+B} = \overline{1+1} = \overline{1} = 0$

This circuit represents NOR Gate

2.20. Establish the relation between electric field and potential.



Consider two closely spaced equipotential surfaces, A and B with potential values V and $V - \Delta V$ separated by a small distance Δr. $\vec{E}$ be the electric field over the distance Δr.

Work done in moving 1 C charge from the surface B to A through the distance Δr is given by,

$$\Delta W = E\Delta r \cos\theta = E\Delta r \cos 180° = -E\Delta r \text{ ------ (1)}$$

But work done ΔW in moving 1 C charge from surface B to A is the potential difference between them.

$$\therefore \Delta W = V_A - V_B = V - (V - \Delta V) = \Delta V \text{ ------ (2)}$$

From (1) and (2), $-E\Delta r = \Delta V$ OR $E = -\frac{\Delta V}{\Delta r}$.

The electric field at a point is the negative potential gradient at that point.

. Distinguish between dia, para

Diamagnetic
Weakly magnetised in a direction opposite to external magnetic field.
They tend to move from stronger to weaker part of external magnetic field. Magnet repels a diamagnetic substance.
Resultant magnetic moment in an atom is zero.
Susceptibility, $-1 \leq \chi < 0$.
Relative permeability, $0 \leq \mu_r < 1$.
Susceptibility does not change with temperature.
Permeability, $\mu < \mu_0$

7.35. What are the sources of power loss and how are they minimised in transformer?

i. Resistance of the windings – can be minimised by selecting thick wire.

ii. Flux leakage – can be minimised by properly winding secondary over the primary.

iii. Eddy currents – can be minimised by using laminated core.

iv. Hysteresis – can be minimised by selecting ferromagnetic substance which has a low hysteresis loss.

12.29. Give de – Broglie Explanation of Bohr's second postulate of quantisation.

According to de – Broglie the electron in its circular orbit must be seen as a particle wave. The particle wave forms standing waves when distance travelled by the electron in the orbit is equal to integral multiple of wavelength of the particle wave.

For an electron moving in n^{th} circular of radius r_n, the total distance is the circumference of the orbit, $2\pi r_n$.

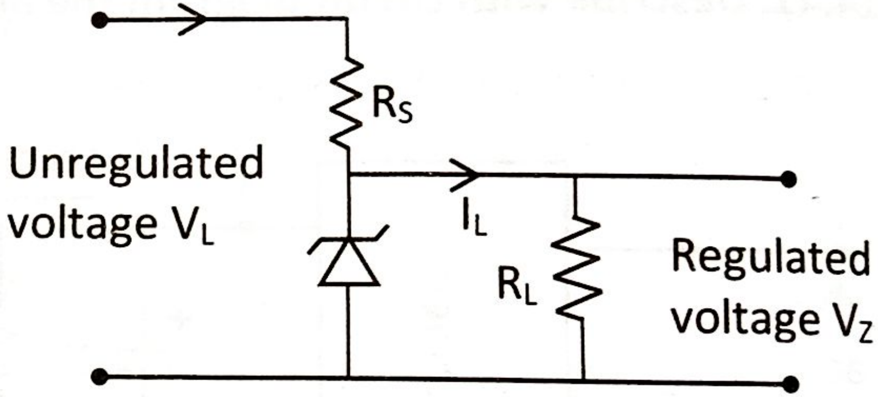
Thus, $2\pi r_n = n\lambda, n = 1, 2, 3, \ldots$

But $\lambda = \frac{h}{p} = \frac{h}{m v_n}$ OR $m v_n r_n = n\left(\frac{h}{2\pi}\right)$ OR angular momentum, $L = n\left(\frac{h}{2\pi}\right)$. This is Bohr's second postulate.

14.46. Explain the working of zener diode as a voltage regulator.

The unregulated dc filtered voltage is connected to zener diode through a series resistance R_S such that the zener diode is reverse biased.

If the input voltage increases,. the current through R_S and zener diode also increases. This increase in the voltage drop across R_S without any change in the voltage across the zener diode. This is because in the breakdown region, zener voltage remains constant even though the current through it changes.

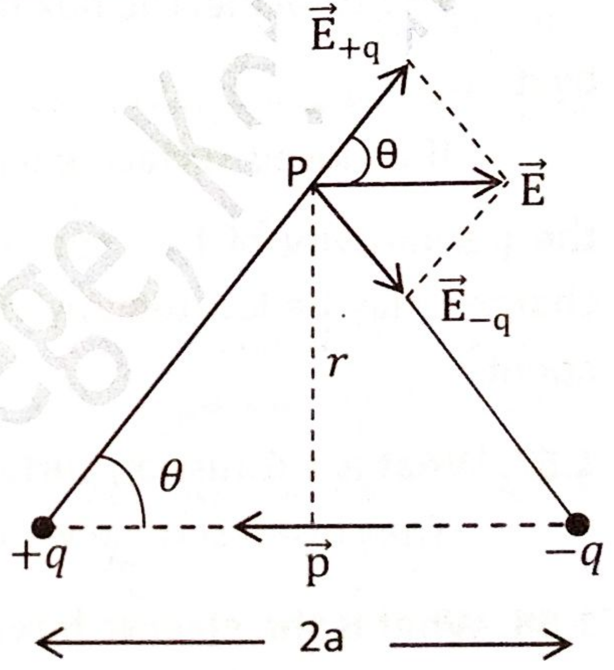


Similarly if the input voltage decreases, the current through R_S and zener diode also decreases. The voltage drop across R_S decreases without any change in the voltage across zener diode.

Thus any increase / decrease in the input voltage results in increase / decrease of the voltage drop across R_s without any change in voltage across the zener diode. Thus the zener diode acts as a voltage regulator.

1.52. Derive an expression for electric field at a distance along the equatorial line of a dipole.

Let P be a point at a distance r from the center of electric dipole along the equatorial line of electric dipole.



Magnitude of electric field at P due to charge $+q$ and $-q$ are

$E_{+q} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r^2+a^2)}$ and $E_{-q} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r^2+a^2)}$ respectively.

The field at P due to charges is resolved. The components along equatorial line cancel each other. The components along dipole axis added up.

Therefore, $\vec{E} = -(E_{+q} + E_{-q})\cos\theta\,\hat{p}$ (negative sign indicates that both components are opposite to $\vec{p}$)

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

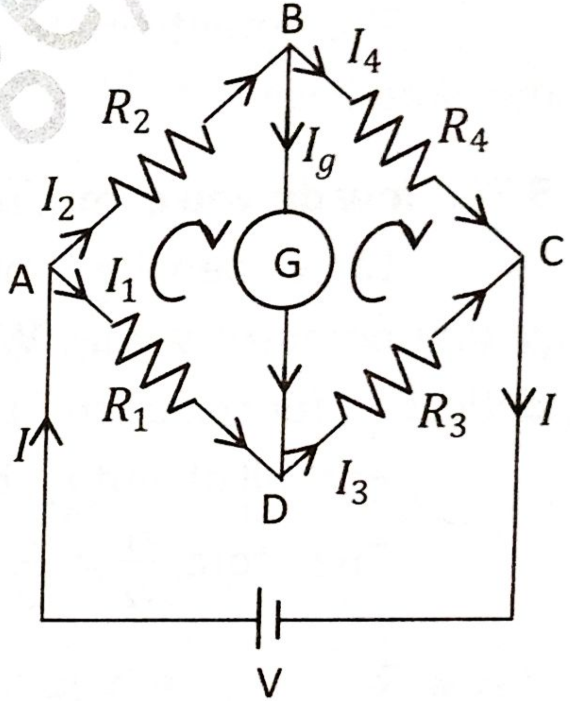
From the figure, $\cos\theta = \frac{a}{\sqrt{r^2+a^2}}$.

Therefore, $\vec{E} = -\frac{2qa}{4\pi\varepsilon_0(r^2+a^2)^{3/2}}\hat{p}$

OR $\vec{E} = -\frac{\vec{p}}{4\pi\varepsilon_0(r^2+a^2)^{3/2}}$. Since $\vec{p} = q2a\,\hat{p}$

3.67. Arrive at the balance condition of Wheatstone's bridge by applying Kirchhoff's rules. 5M

Four resistors of resistances R_1, R_2, R_3 and R_4 are connected to form a bridge ABCD. A pair of opposite terminals A and C is connected to a cell. A galvanometer of resistance G is connected between B and D.



Considering balanced bridge, current through the galvanometer is zero. i. e. $I_g = 0$.

Applying Kirchhoff's junction rule to the junctions B and D,

$I_2 = I_g + I_4 \Rightarrow I_2 = I_4$ ----- (1) and $I_1 + I_g = I_3 \Rightarrow I_1 = I_3$ ----- (2)

Since $I_g = 0$.

Applying Kirchhoff's loop rule to the closed loops ABDA and BCDB and also using (1) and (2).

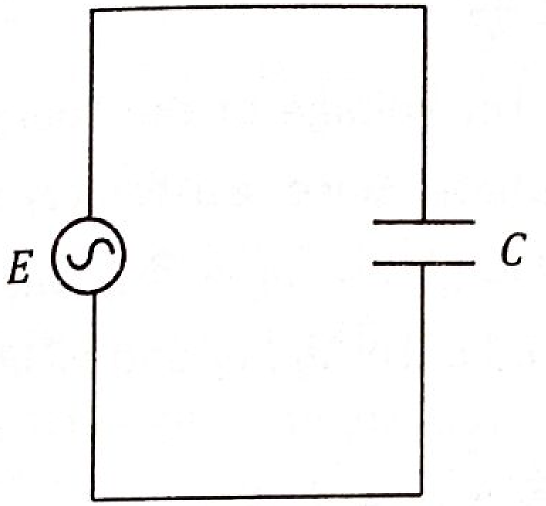
$-I_2R_2 - I_gG + I_1R_1 = 0$ or $I_2R_2 = I_1R_1$ ----- (3)

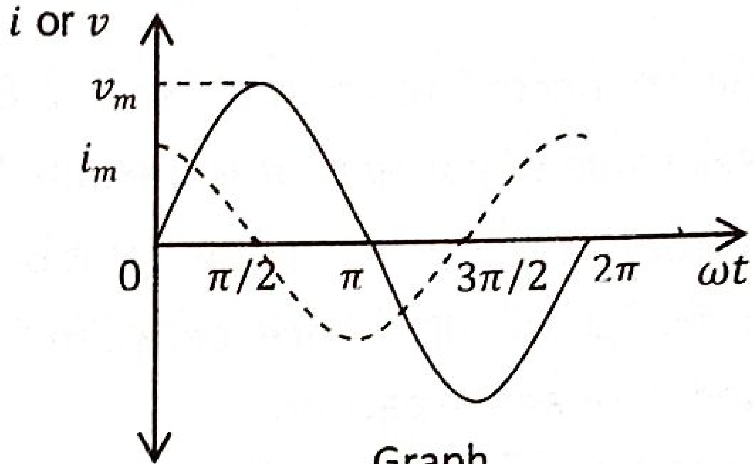
$-I_4R_4 + I_3R_3 + I_gG = 0$ or $I_4R_4 = I_3R_3$ OR $I_2R_4 = I_1R_3$ ----- (4) Since $I_g = 0$ and using (1) and (2).

(3) ÷ (4), $\frac{I_2R_2}{I_2R_4} = \frac{I_1R_1}{I_1R_3} \Rightarrow \frac{R_2}{R_4} = \frac{R_1}{R_3}$ OR $\frac{R_1}{R_2} = \frac{R_3}{R_4}$. This is the condition for balance.

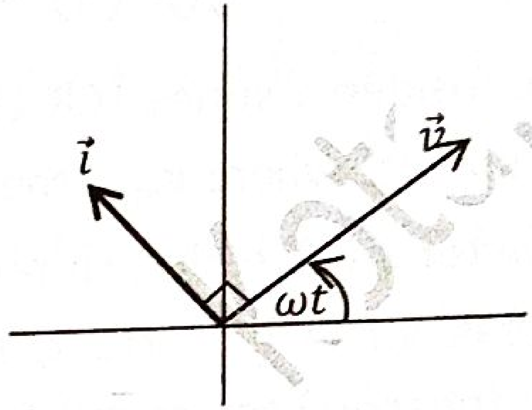
7.11. Derive an expression for current in A. C. circuit containing pure capacitor. Draw graph of v and i verses ωt. Draw phasor diagram. Mention phase relation between voltage and current.

5m





Graph



Phasor Diagram

Consider a capacitor of capacitance C, connected across an A. C. source. Let the voltage across the source be $v = v_m \sin \omega t$. Let q be the charge on the capacitor at any time t.

Instantaneous voltage across the capacitor is $q/_C$.

Form Kirchhoff's loop rule, $v_m \sin \omega t - q/_C = 0$ OR $v_m \sin \omega t = q/_C$.

Current, $i = \frac{dq}{dt} = \frac{d}{dt}(Cv_m \sin \omega t) = \omega C v_m \cos \omega t.$

Using the relation $\cos \omega t = \sin(\omega t + \pi/_2)$

We have $i = i_m \sin(\omega t + \pi/_2)$ where $i_m = \omega C v_m$ is the amplitude of the current.

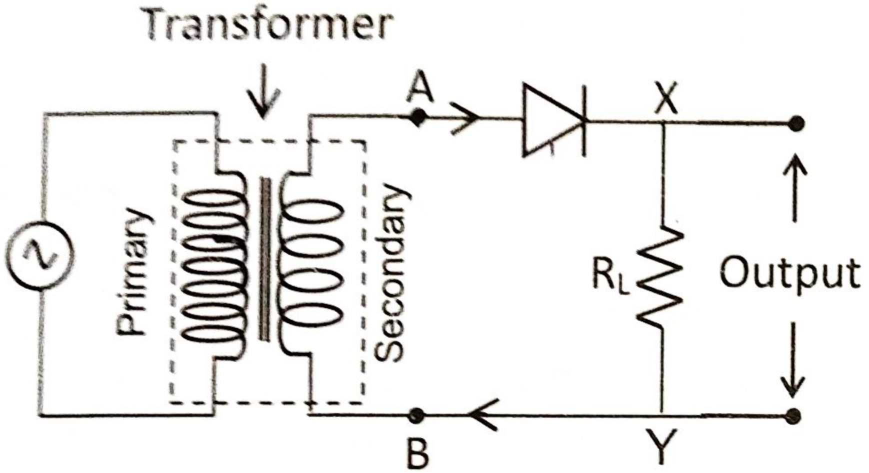
$i_m = \frac{v_m}{1/_{\omega C}}$. But $1/_{\omega C} = X_C$ is the capacitive reactance. Therefore, $i_m = \frac{v_m}{X_C}$.

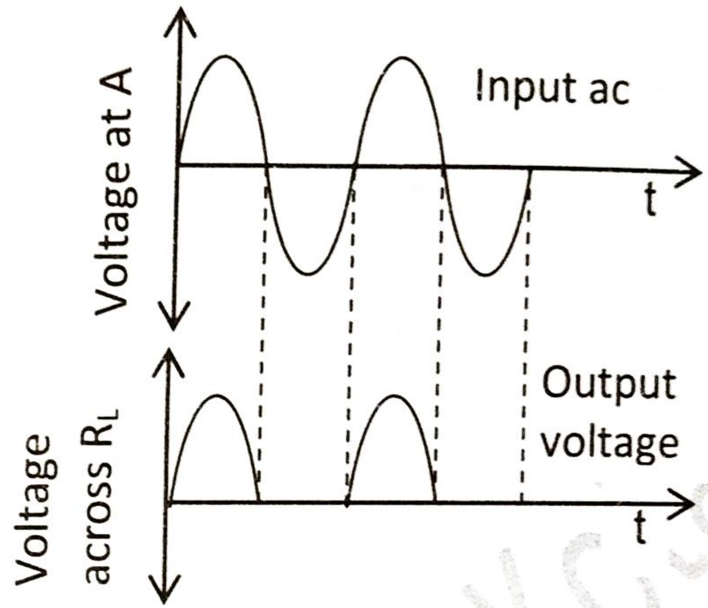
The current through the capacitor leads the voltage by $\pi/_2$.

14.36. What is rectification?

Process of conversion of AC into DC is called recification.

14.38. Describe with circuit diagram the working of half wave rectifier.





The secondary of a transformer supplies the desired ac voltage across terminals A and B. When the voltage at A is positive, the diode is forward biased and it conducts. When A is negative, the diode is reverse biased and it does not conduct. Thus the current flows through the circuit during positive half cycles. The current through R_L is from X to Y, unidirectional. Thus output voltage is unidirectional as shown in the graph.

(44). $q_1 = 2\mu C$ $q_2 = 8\mu C$ $r = 4cm = 0.04m$

Initial force is

$$F_1 = \frac{k q_1 q_2}{r^2}$$

$$= \frac{9\times10^9 \times 2\times8\times10^{-12}}{(0.04)^2}$$

$$F = 90N$$

In 2nd case:-

$$F_2 = \frac{k q_1 q_2}{K \times r^2}$$

$$= \frac{9\times10^9 \times 2\times8\times10^{-12}}{2\times(0.02)^2}$$

$$F_2 = 180N$$

∴ Change in force is $\Delta F = 180 - 90 = 90N$

(48). $u = -10cm$ $R = -15cm \Rightarrow f = -15/2 cm$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$\frac{1}{v} = -\frac{2}{15} + \frac{1}{10} = \frac{-4+3}{30} = \frac{-1}{30}$$

$$\Rightarrow v = -30cm$$

$$m = \frac{-v}{u} = \frac{-30}{10} = -3$$

Inverted image, Real and magnified image.

50. We know that

$$t_{1/2} = \frac{0.693}{K}$$

$$\therefore K = \frac{0.693}{t_{1/2}}$$ K → decay constant

$$K = \frac{0.693}{3.8} = 0.182 / \text{days}$$

Now we can find for 5% of sample using

$$t = \frac{2.303}{K} \log \frac{N_0}{N}$$

where N_0 is initial concentration

$$\therefore N = \frac{N_0 \times 5}{100} = \frac{N_0}{20}$$

$$\therefore t = \frac{2.303}{0.182} \log \frac{N_0}{N_0/20}$$

$$t = \frac{2.303}{0.182} \log 20$$

$$t = \frac{2.303}{0.182} \times 1.3010$$

$$t = 16.46 \text{ days}$$

∴ After 16.46 days will 5% of sample will be left over.