MARKING SCHEME CLASS 12Th PHYSICS (SET-1)		
Section-A		
1.	(d)	1
2.	(b)0.3 MB	1
3.	(c)mg/lB	1
4.	(d)	1
5.	(d)	1
6.	(a)is decreased	1
7.	(b)	1
8.	(d)	1
9.	Gamma rays	1
10.	(d)	1
11.	(b)	1
12.	(c)4En	1
13.	(c)Assertion is true but reason is false	1
14.	(a)	1
15.	(a)	1
16.	(a)	1
Section-B		
17.	Junction rule: In an electric circuit, the algebraic sum of currents at any junction is zero. At any junction, the sum of the currents entering the junction is equal to the sum of currents leaving the junction. Sigma*I = 0 Justification: This rule is based on the law of conservation of charge. Loop rule:The algebraic sum of emf's in any loop of a circuit is equal to the sum of products of currents and resistances in it. Sigma*Delta*E = Sigma*IR Justification: This rule is based on the law of conservation of energy.	1 1

18.

$$\mu = \frac{\sin\left[\frac{(A+D_m)}{2}\right]}{\sin\left(\frac{A}{2}\right)}$$ ½

$\therefore$ Given $D_m = A$

$$\therefore \quad \mu = \frac{\sin A}{\sin\frac{A}{2}} = \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{\sin\frac{A}{2}} = 2\cos\frac{A}{2}$$ 1

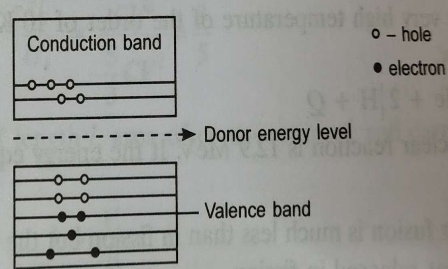
$$\therefore \quad \cos\frac{A}{2} = \frac{\sqrt{3}}{2} \text{ or } \frac{A}{2} = 30^\circ \quad \therefore \ A = 60^\circ$$ ½

19.

22. An n-type semiconductor is formed by doping a pure semiconductor with pentavalent impurity. 1

Electrons are the majority charge carriers in n-type semiconductor.

Energy level diagram at $T > 0°K$



1

Or

Ans. Arsenic is n-type impurity and indium is p-type impurity.

Number of electrons, $n_e = n_D - n_A$ ½

$$= 5 \times 10^{22} - 5 \times 10^{20}$$

$$= 4.95 \times 10^{22} \text{ m}^{-3}$$

Also, $n_i^2 = n_e n_h$ ½

Given, $n_i = 1.5 \times 10^{16} \text{ m}^{-3}$

Number of holes, $n_h = \frac{n_i^2}{n_e} = \frac{(1.5 \times 10^{16})^2}{4.95 \times 10^{22}}$

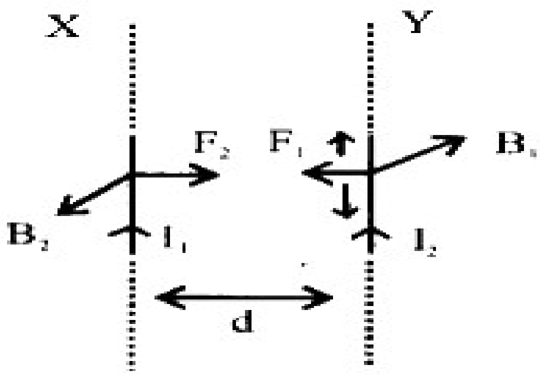
$\Rightarrow \quad n_h = 4.54 \times 10^{9} \text{ m}^{-3}$

As $n_e > n_h$; so the material is an n-type semiconductor. ½

1/2

20.	**Sol.** Given, $d = 0.28\,\text{mm} = 0.28 \times 10^{-3}\,\text{m}$, $D = 1.4\ \text{m}$ Position of nth bright fringe from central fringe is $y_n = \frac{nD\lambda}{d}$ Here $n = 4$, $y_4 = 1.2\ \text{cm} = 1.2 \times 10^{-2}\ \text{m}$ $\Rightarrow$ Wavelength $\lambda = \frac{y_4 . d}{4D}$ $= \frac{(1.2 \times 10^{-2}\ \text{m}) \times (0.28 \times 10^{-3}\ \text{m})}{4 \times 1.4}$ $= 6 \times 10^{-7}\ \text{m}$ $= 600\ \text{nm}$	½ ½ ½ ½
21.	(Any two) i) The number of photo-electrons emitted per second is directly proportional to the intensity of incident radiation. (ii) For a given frequency of the incident radiation, the stopping potential (or the maximum kinetic energy) is independent of its intensity. (iii) The maximum kinetic energy of the photo-electrons varies linearly with the frequency of incident radiation, but is independent of its intensity. (iv) for a frequency □ of incident radiation, lower than the cut-off frequency □□ , no photoelectric emission is possible even if the intensity is large.	1 1
	Section -C	
22.	a. Mutual inductance (M) decreases because the quantity of flux linking to a coil due to the other one will decrease. b. M increases because as the number of turns increase, the overall flux density also increases and hence the mutual inductance will also increase. c.M increases because iron is ferromagnetic in nature hence, it will increase the flux density.	1 1 1
23.	a. X-rays are used to take the photographs of the bones. b. X-rays are produced by bombarding a metal target with high energy electrons. c. Wavelength range of X-rays is from 10 nm to 10-3 nm.	1 1 1

24.



Consider two infinitely long straight parallel conductors x & y carrying a current I1 & I2 respectively. Let d is the ⊥r distance between them.

Let I_1 is the current flowing through x conductor, it produces a M.F. (B_1)

$$\therefore B_1 = \frac{\mu_0}{2\pi} \cdot \frac{I_1}{d}$$

Now the conductor Y carrying current I_2 in the M.F.B, it experiences a mechanical force of length 1 is

$$F_1 = I_2\, l\, B_1$$

$$F_1 = l.\frac{\mu_0}{2\pi} \cdot \frac{I_1 I_2}{d}$$

$$\therefore \frac{F_1}{l} = \frac{\mu_0}{2\pi} \cdot \frac{I_1 I_2}{d}$$

Force per unit length i.e., $l = 1\,m$

$$\frac{F_1}{1} = \frac{\mu_0}{2\pi} \cdot \frac{I_1 I_2}{d}$$

Parallelly F_2

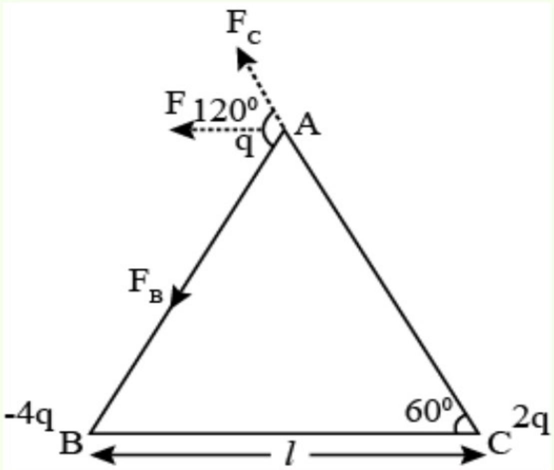
The direction of force can be obtained using ampere's left-hand rule.

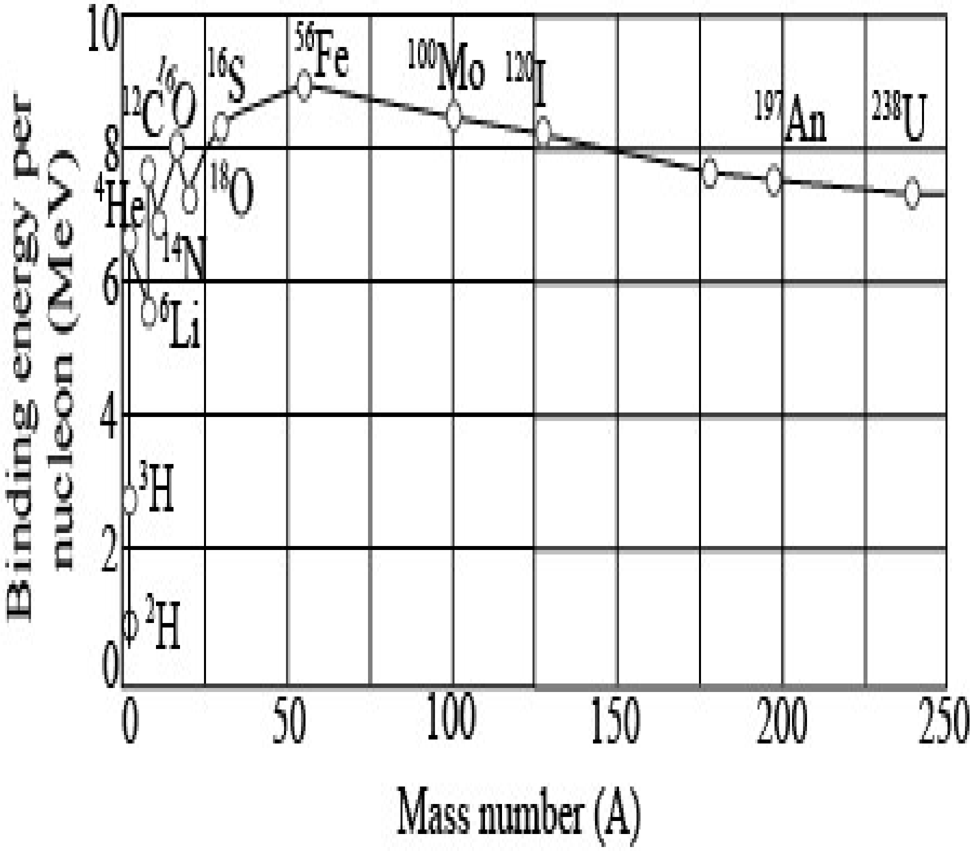
∴ The force between two parallel conductors carrying currents in the same direction is attractive. parallelly the force between two parallel conductors carrying current in opposite direction is repulsive.

One Ampere is the steady current which when flowing through each of 2 infinitely long straight parallel conductors placed in the air at a distance of 1m produces a force of 2 × 10-7 N/m.

Or

	Torque, $\tau = iAB\sin\theta$, $i = 0.1\,\text{A}$, $\theta = 90^\circ$ $A = \frac{1}{2} \times \text{Base} \times \text{Height}$ or $A = \frac{1}{2} a \times \frac{a\sqrt{3}}{2}$ $= \frac{\sqrt{3}\,a^2}{4} = \frac{\sqrt{3} \times (0.02)^2}{4}$ $= \sqrt{3} \times 10^{-4}\,\text{m}^2$, $\theta = 90^\circ$ $\tau = 0.1 \times \sqrt{3} \times 10^{-4} \times 5 \times 10^{-2} \sin 90^\circ$ $= 5\sqrt{3} \times 10^{-7}\,\text{N-m}$	

25.	 Now we can write Resultant force, $F = \sqrt{F_B^2 + F_C^2 + 2F_BF_C \cos 120^\circ}$ Or, $F = \frac{1}{4\pi\epsilon}\frac{q^2}{d^2}\sqrt{(4)^2 + (2)^2 + 2(4)(2)(-\frac{1}{2})}$ Therefore, $F = \frac{1}{4\pi\epsilon_0}\frac{\sqrt{12}q^2}{l^2}$ **(b)** Work done to seperate the charges to infinity is given as change in the potential Initial potential energy, $U_i = \frac{1}{4\pi\epsilon_0}[\frac{(-4q)q}{l} + \frac{(-4q)(2q)}{l} + \frac{(q)(2q)}{l}]$ $= \frac{1}{4\pi\epsilon_0 l}q^2[-4 - 8 + 2] = \frac{1}{4\pi\epsilon_0}(\frac{-10q^2}{l})$ Final potential energy, $U_f = 0$ Thus, work done $= U_f - U_i = 0 - (\frac{-10q^2}{4\pi\epsilon_0 l}) = \frac{10q^2}{4\pi\epsilon_0 l}$	
26.	Plot of binding energy per nucleon as the function of mass number A is given as below :	1



1

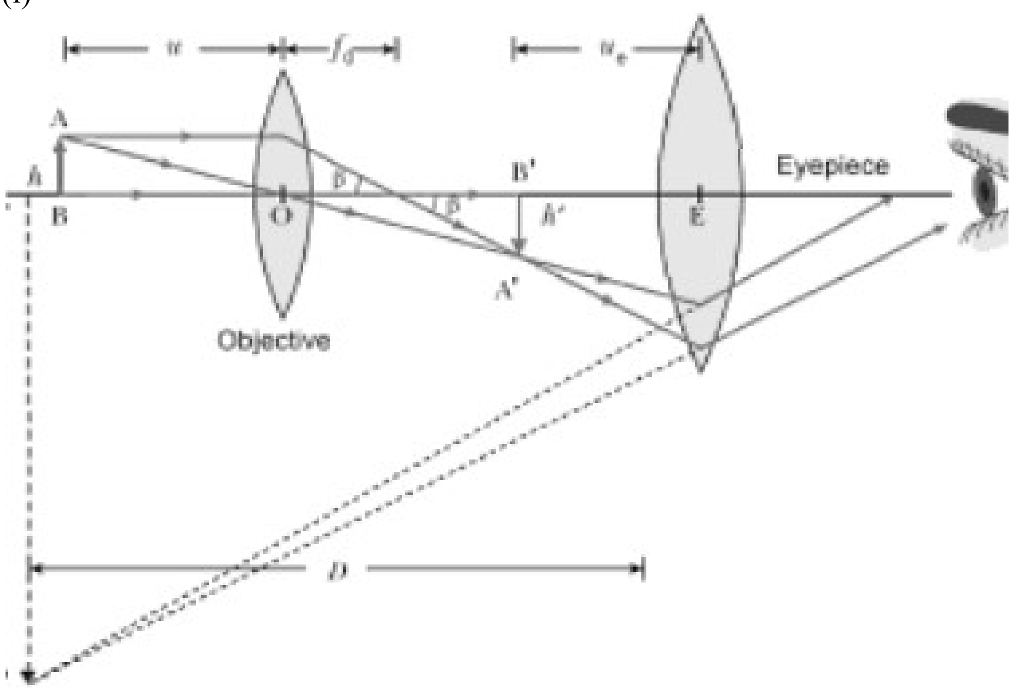
½

½

Following are the two conclusion that can be drawn regarding the nature of the nuclear force :

(i) The force is attractive and strong enough to produce a binding energy of few MeV per nucleon.
(ii) The constancy of the binding energy in the range 30 $<A<170$ is a consequence of the fact that the nuclear force is short range force.
Nuclear fission : A very heavy nucleus (say, $A = 240$) has lower binding energy per nucleon as compared to the nucleus with $A = 120$. Thus, if the heavier nucleus breaks to the lighter nucleus with high binding energy per nucleon, nucleons are tightly bound. This implies that energy will be released in the process which justifies the energy release in fission reaction.
Nuclear fusion : When two light nuclei ($A<10$) are combined to form a heavier nuclei, the binding energy of the fused heavier nuclei is more than the binding energy per nucleon of the lighter nuclei. Thus the final system is more tightly bound than the initial system. Again the energy will be released in fusion reaction.

27.	As per Rutherford model of the atom, an electron revolves around the nucleus of hydrogen atom such that the requisite centripetal force is provided by the coulombian attraction force acting on it due to nucleus. Thus $\frac{mv^2}{r} = \frac{1}{4\pi \in_0} \cdot \frac{e^2}{r^2} \Rightarrow mv^2 = \frac{1}{4\pi \in_0} \cdot \frac{e^2}{r}$ $\therefore$ Kinetic energy of orbiting electron $k = \frac{1}{2}mv^2 = \frac{1}{2} \times \frac{1}{4\pi \in_0} \cdot \frac{e^2}{r} = \frac{e^2}{8\pi \in_0 r}$ and potential energy of orbiting electron $U = \frac{q_1 q_2}{4\pi \in_0 r} = \frac{e^2}{4\pi \in_0 r}$ $\therefore$ Total energy of electron in hydrgoen atom $E = K + U = \frac{e^2}{8\pi \in_0 r} - \frac{e^2}{4\pi \in_0 r} = -\frac{e^2}{8\pi \in_0 r}$ The negative sign of energy signifies that the electron is bound to the nucleus and cannot escape from its orbit at its own.	
28.	Given that current in the circuit = 0.25A $\therefore$ Current through 4Ω resistor = 0.25A (a) Potential difference across 4Ω resistor = R × I = 4 × 0.25 = 1 V (b) Potential difference across 3Ω (internal resistance of the cell) = R × I = 3 × 0.25 = 0.75 V (c) the potential difference accross the RΩ or 2Ω resistors = 2 – 0.75 – 1 = 0.25V (d) Current through the 2Ω resistance = $\frac{0.25}{2}$ = 0.125 A Now ,V = IR $\Rightarrow$ R = $\frac{V}{I}$ On substituting the values we get: R = $\frac{0.25}{0.125}$ = 2Ω	

	Section-D	
29.	(i)(d) (ii)(a) (iii)(d) (iv)(a) (v)(b)	1 1 1 1 1
30.	(i)b (ii)d (iii)b (iv)b (v)d	1 1 1 1 1
	Section -E	
31.	(i)  (ii)The focal length of the objective and its aperture should be short, to have high magnifying power and high resolution. m=mo*me (iii)To calculate the magnifying power of a compound microscope. We have given, uo=-6. fo=4. fe=10	

$$\frac{1}{\nu_0} = \frac{1}{4} + \frac{1}{-6}$$

$$\frac{1}{\nu_0} = \frac{1}{4} + \frac{1}{-6}$$

$$\frac{1}{\nu_0} = \frac{1}{4} + \frac{1}{-6}$$

$$\nu_0 = 12\ cm$$

Since for eyepiece $(\nu_0) = -d = -25\ cm$

$$\frac{1}{u_e} = \frac{1}{v_e} - \frac{1}{f_e}$$

$$u_e = -7.14\ cm$$

Hence,

$$m = \frac{\vartheta_0}{u_0}\left(1 + \frac{D}{f_e}\right)$$ (formula of magnifying power)

$$m = \frac{12}{6}\left(1 + \frac{25}{10}\right) = 7$$

$m = 7$ it is the magnifying power of the compound microscope.

(ii) The length of the microscope can be determined as;-

$$L = |\nu_0| + |u_e|$$

$$L = 12 + 7.14$$

$$L = 19.14\ cm$$

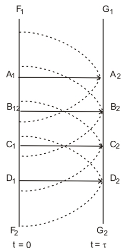
Or

(a)A source sends waves in all possible directions. The locus of particles of a medium vibrating in the same phase is called a wavefront. For a point source, the wavefront is spherical; while for a line source the wavefront is cylindrical. The distant wavefront is plane.

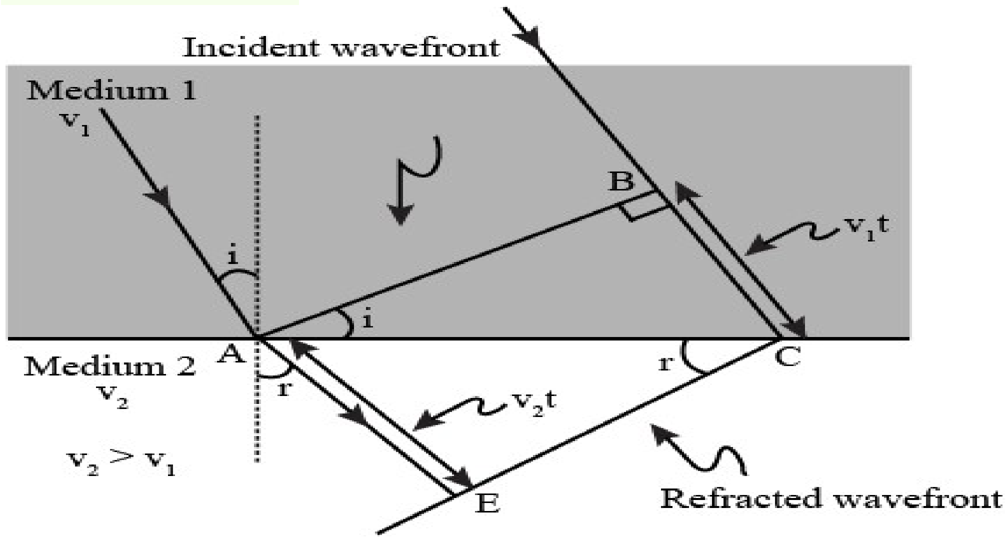
Each point of a wavefront acts as a source of secondary wavelets. The envelope of all wavelets at a given instant gives the position of a new wavefront.

The ratio of sine of angle of incidence and the sine of angle of refraction is a constant and is equal to the ratio of velocities of waves in the two media. This is the second law of refraction, and is called the Snell’s law.

When a light wave travels from rarer to denser medium, the speed decreases. It does not imply reduction its energy. This is because energy of wave depends on its frequency and not on its speed.



(b)Consider the diagram given below of a plane wavefront propagating from a denser to rarer medium



In $\triangle ABC$,

$\sin i = \frac{BC}{AC} = \frac{v_1 t}{AC}$

In $\triangle CEA$,

$\sin r = \frac{AE}{AC} = \frac{v_2 t}{AC}$

$\therefore \quad \frac{\sin i}{\sin r} = \frac{BC}{AE} = \frac{v_1 t}{v_2 t} = \frac{v_1}{v_2}$

$\therefore \quad \mu_1 = \frac{c}{v_1}$

$\mu_2 = \frac{c}{v_2}$

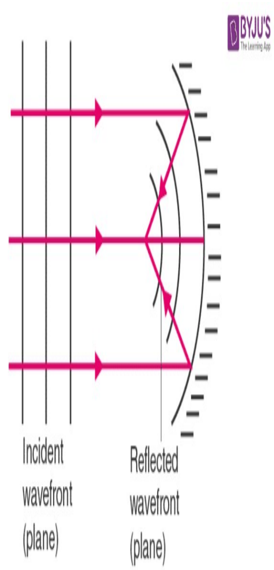
$\therefore \quad \frac{\mu_2}{\mu_1} = \frac{v_1}{v_2}$

$\therefore \quad \frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$

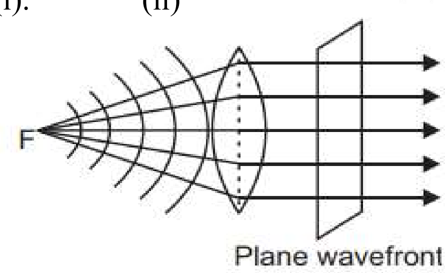
or $\mu_2 \sin r = \mu_1 \sin i$.

It is Snell's law.

©

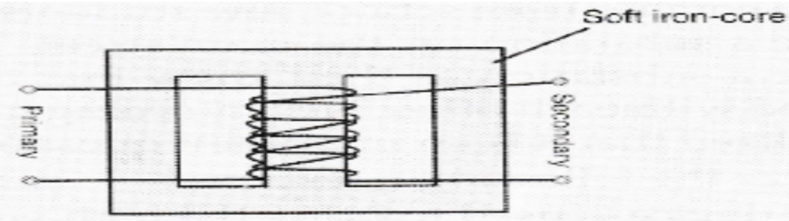


(i). (ii)



<table>
<tr><td></td><td></td><td></td></tr>
<tr><td>32.</td><td>

(a)



(b) Principle of a transformer : When an alternating current flows through the primary coil, an emf is induced in the neighbouring (secondary) coil.

(i) Let $\frac{d\phi}{dt}$ be the rate of change of flux through each turn of the primary and the secondary coil

$$\frac{\varepsilon_1}{\varepsilon_2} = -N_1\frac{d\phi}{dt} / -N_2\frac{d\phi}{dt} = \frac{N_1}{N_2}$$

or $$\frac{V_1}{V_2} = \frac{N_1}{N_2} \quad ...(i)$$

(ii) But for an ideal transformer, $V_1I_1 = V_2I_2$

$$\frac{V_1}{V_2} = \frac{I_2}{I_1} \quad ...(ii)$$

From equation (1) and (2)

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

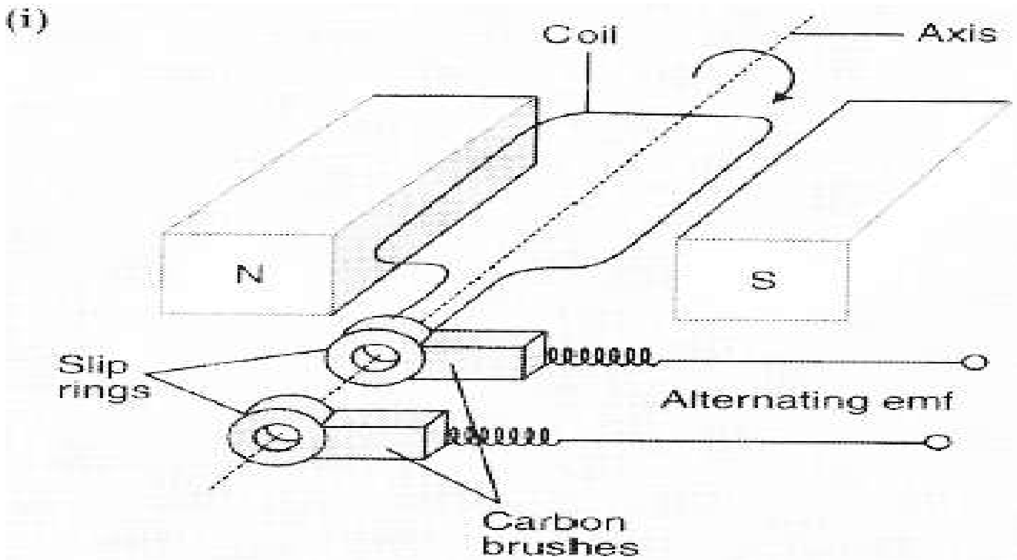
Reason due to which energy loses may occur : Flux leakage/Resistance of the coils/ Eddy currents/ HysteresiRead more on Sarthaks.com - https://www.sarthaks.com/179660/draw-schematic-arrangement-winding-primary-secondary-transformer-when-coils-wound-other

</td><td></td></tr>
<tr><td></td><td>

Or

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

(i)



It works on the principle of electromagnetic induction, i.e. when a coil continuously rotates in a magnetic field, the magnetic flux associated with it keeps on changing; thus an emf is induced in it. (ii) When the coil rotates in a magnetic field, its effective area, i.e. A cos θ, (i.e. area normal to the magnetic field) keeps on changing. Hence magnetic flux ϕ = NBA cos θ, keeps on changing.

Let the call be rotating with angular velocity at any instant .t. when the normal to the plane of the coil makes an angle θ with the magnetic field. Hence magnetic flux,

$\phi = NBA\cos\omega t$, There for induced emf (ε)

$$\varepsilon = -\frac{d\phi}{dt}$$

$$\Rightarrow \varepsilon = NBA\omega\sin\omega t$$

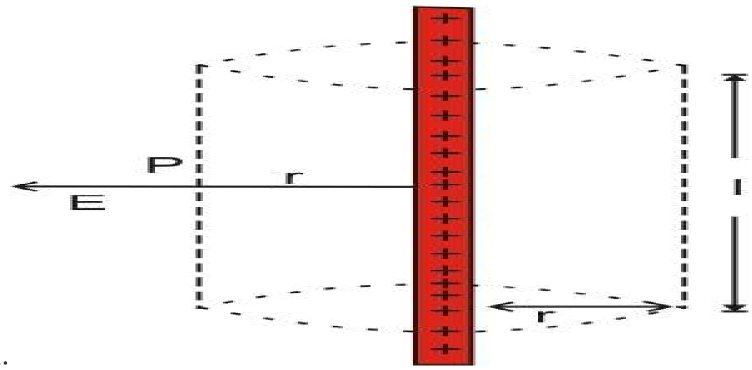
Induced emf will be maximum when

$\omega t = 90^\circ$

Hence, $\varepsilon_{\max} = NBA\omega$

Direction of induced emf can be determined using Flemming.s right hand rule.

33. (a)Consider infinitely long straight charged wire of linear charge density $\lambda C/m$
For calculating electric field consider an imaginary cylindrical Gaussian Surface

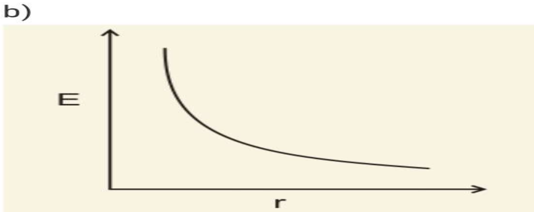


of radius r and length l.
Here the field is radial everywhere, so flux through the two ends of cylinder is Zero.
At the Gaussian cylindrical surface, the electric field E is normal to the surface at every point.

to the surface at every point. The magnitude of E depends only on radius 'r', so it is constant.
Therefore flux through Gaussian surface
$$= E \times 2\pi r l \; --- \; (1)$$
According to Gauss's law , flux
$$\phi = \frac{charge\ enclosed}{\varepsilon_0}$$
Here, total charge enclosed = linear charge density $\times$ length
$$= \lambda l$$
Therefore flux $\phi = \dfrac{\lambda l}{\varepsilon_0} \; --- \; (2)$

Using equation (1) and (2) $E \times 2\pi r l = \dfrac{\lambda l}{\varepsilon_0}$

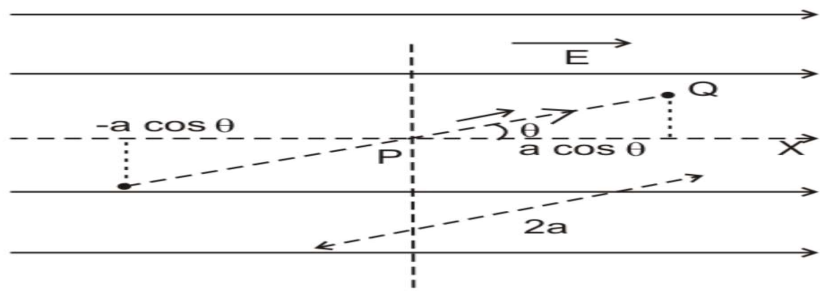
That is ,
$$E = \frac{\lambda}{2\pi\varepsilon_0 r}$$
The vector notation is
$$\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\hat{n}$$
where $\hat{n}$ is the radial unit vector normal to the line charge
b)
b)



$$E \alpha \frac{1}{r}$$
c) work done to move the charge 'q' through a small displacement 'dr'
$$dW = F \cdot dr$$
We know , $F = qE$
where E = electric field
Therefore $dW = qEdr\cos\theta = qEdr\ (\theta = 0°)$
Substitute the value of E
$$dW = q \times \frac{\lambda}{2\pi\varepsilon_0 r} dr$$
work done in moving the charge from r_1 to r_2 $(r_2 > r_1)$ is
$$W = \int_{r_1}^{r_2} dW = \int_{r_1}^{r_2} q\frac{\lambda}{2\pi\varepsilon_0 r} dr$$
$$W = q\frac{\lambda}{2\pi\varepsilon_0}[l_n r_2 - l_n r_1]$$
$$W = q\frac{\lambda}{2\pi\varepsilon_0} ln\frac{r_2}{r_1}$$

Or

(a) Deriving an expression of the potential energy of an electric dipole;



$\vec{\varsigma} = \vec{P} \times \vec{E}$
$\vec{\varsigma} = pE \sin\theta$
where, $\vec{\varsigma} = torque$
$p = momentum$
Now
work done $dw = \varsigma \cdot d\theta$
$dw = PE \sin\theta d\theta$
on integrating both side,we have
$w = \int_{\theta 1}^{\theta 2} dw = \int_{\theta 1}^{\theta 2} PE \sin\theta d\theta$
$w = pE\left[\cos\theta_1 - \cos\theta_2\right]$
if $\theta_1 = 0 \; and \; \theta_2 = \theta$
then,$w = pE\left(1 - \cos\theta\right)$

when the electric dipole is parallel to electric field the dipole is in the stable equilibrium
when the electric dipole is antiparallel to the electric field, the dipole is in unstable equilibrium.
(b) The electrostatic potential isn't necessarily Zero at a point where the electric field is Zero.
i.e Such as inside the equipotential surface