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XII CBSE - BOARD - MARCH - 2017

CODE (55/1) SET -1

Date: 15.03.2017

PHYSICS - SOLUTIONS

SECTION - A

1. Nichrome, since its resistance is high. **[1 M]**

Topic:Current Electricity; Sub-Topic:Resistance_ L-1_ Target-2017_ XII-CBSE Board Exam__Physics

2. Yes **[1 M]**

Topic:Electromagnetic waves; Sub-Topic:Properties_ L-1_Target-2017_ XII-CBSE Board Exam__Physics

3. $$\mu = \frac{\sin\left(\frac{\delta m + A}{2}\right)}{\sin\frac{A}{2}}$$

for red light $\mu =$ least; $\delta_m \rightarrow$ will reduce **[1 M]**

Topic:Ray optics; Sub-Topic:Refractive through prism_ L-3_ _Target-2017_ XII-CBSE Board Exam__Physics

4. Photo electric effect. **[1 M]**

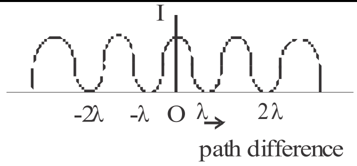
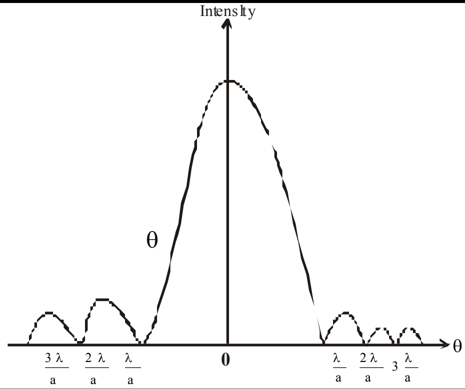
Topic:Dual nature of radiation & matters; Sub-Topic:Properties_ L-1_ _Target-2017_ XII-CBSE Board Exam__Physics

5. The polarity of plate 'A' will be positive with respect to plate 'B' in the capacitor. **[1 M]**

Topic:EMI; Sub-Topic:Lenz's law_L-2_Target-2017_ XII-CBSE Board Exam__Physics

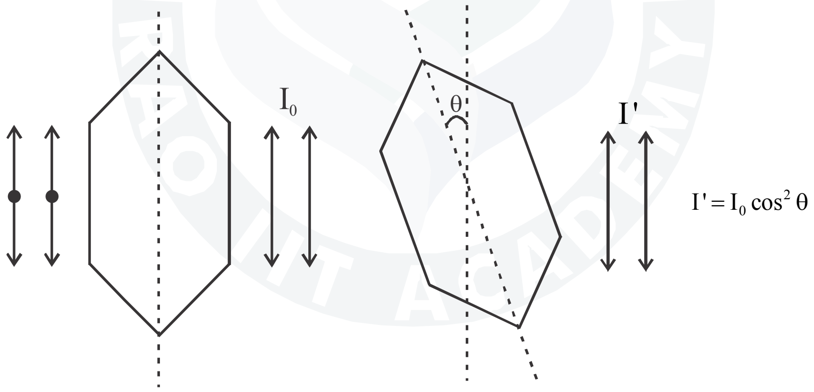
SECTION - B

6.

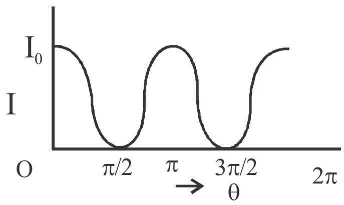
Interference	Diffraction
	 [1 M]
Fringe widths are same	Fringe widths are different
Generally fringe pattern is hyperbolic e.g. in YDSE or Biprism	Generally fringe pattern is circular. [1 M]

Topic:Wave optics; Sub-Topic:Difference between interference & diffraction_L-1_Target-2017_ XII-CBSE Board Exam__Physics

(OR)



[1 M]



[1 M]

Topic:Wave optics; Sub-Topic:Polarization_L-2_Target-2017_ XII-CBSE Board Exam__Physics

7. (a) X - rays

Uses - Use to study atomic structure. **[1 M]**

(b) Microwaves

Uses : Used in radar application. **[1 M]**

Topic:Electromagnetic waves; Sub-Topic:Spectrum _ L-1__Target-2017_ XII-CBSE Board Exam__Physics

8. Magnetic force = Electrostatic force

$qvB = qE$ **[1 M]**

$\Rightarrow v = \frac{E}{B}$ **[1 M]**

Topic:Moving charges & Magnetism; Sub-Topic:Velocity selector _ L-1_Target-2017_ XII-CBSE Board Exam__Physics

9. $P = \sqrt{2mE}$ **[1 M]**

$P = \sqrt{2\times 9.1\times 10^{-31}\times 12.5\times 1.6\times 10^{-19}}$

$\frac{h}{\lambda} = \sqrt{2\times 9.1\times 12.5\times 1.6\times 10^{-50}}$

$\lambda = \frac{h}{\sqrt{364\times 10^{-50}}} = \frac{6.6\times 10^{-34}}{19.07\times 10^{-25}} = 0.34\times 10^{-9}\, m$

$3.4\times 10^{-10}\, m$ ultraviolet. **[1 M]**

Topic:Atoms_; Sub-Topic:Debroglie wave length _ L-3__Target-2017_ XII-CBSE Board Exam__Physics

10. For permanant magnet

a - Magnetically hard

b - Retentivity & coercivity should be large **[1 M]**

For electromagnet

a – Magnetically soft

b – coercivity should be low. **[1 M]**

Topic:Magnetism & matter; Sub-Topic:__Hysteresis loop _ L-3_Target-2017_ XII-CBSE Board Exam__Physics

SECTION - C

11. (a) Heat increased 9 factor, so current increased by 3 factor, so potential increased by 3 factor.

also $H = \frac{V^2}{R}t$

$H \propto V^2$

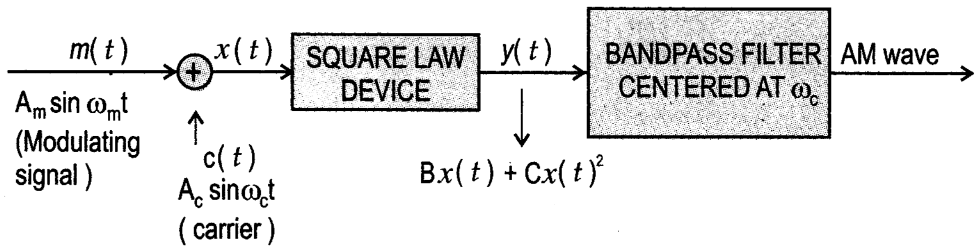
H increased by factor 9, so V increased by factor 3 **[2 M]**

(b) $I = \frac{12}{6} = 2A$

$V = E - ir = 12 - 2\times 2 = 8V$ **[1 M]**

Topic:_Current Electricity_; Sub-Topic:_Potential difference _ L-3__Target-2017_ XII-CBSE Board Exam__Physics

12 (a) Production and Direction of Amplitude Modulated Wave



Block diagram of a simple modulator for obtaining AM signal.

[1 M]

Here modulatign signal $A_m \sin \omega_c t$ is added to carrier signal $A_c \sin \omega_c t$ to produce the signal x(t).

$x(t) = A_c \sin \omega_c t + A_m \sin \omega_m t$

After, passing through square low devices

$y(t) = Bx(t) + Cx^2(t)$

$$y(t) = BA_m \sin \omega_m t + BA_c \sin \omega_c t + C A_m^2 \sin^2 \omega_m t + C A_c^2 \sin \omega_c t + C.2 A_m A_c \sin \omega_m t . \sin \omega_c t$$

$$y(t) = BA_m \sin \omega_m t + BA_c \sin \omega_c t + \frac{C}{2}(A_m^2 + A_c^2) + C A_m . A_c \cos(\omega_c - \omega_m)t - C A_m A_c \cos(\omega_c + \omega_m)t$$

Where, $\frac{C}{2}\left(A_m^2 + A_c^2\right)$ is a D.C. term.

The bandpass filter rejects D.C. term and allows sinusoidal functions. **[1 M]**

(b) $W_c + W_m = 660....(i)$

$W_c - W_m = 640....(ii)$

On solving (i) and (ii)

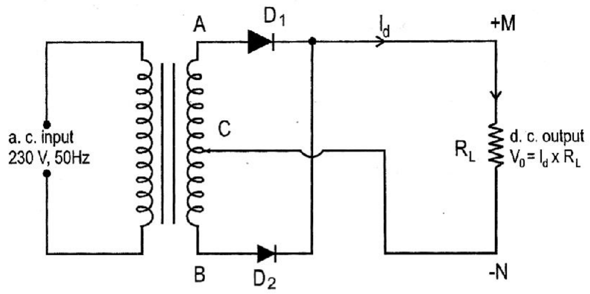
$W_c = 650\,KHz$

$W_m = 10\,KHz$ **[1 M]**

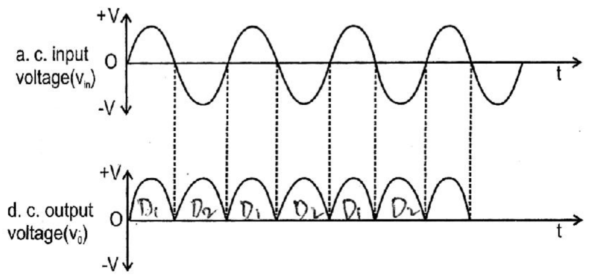
Topic:Communication system; Sub-Topic:Amplitude modulation_ L-2_ _Target-2017_ XII-CBSE Board Exam__Physics

13. (a) Reverse Bias **[1 M]**

(b)



Circuit diagram for full wave rectifiter



Input and output waveforms for full wave rectifier

[1 M]

During positive half cycle of the A.C. input point A is + ve w.r.t. point C, (and point B is – ve w.r.t. point C), therefore the diode D_1 is forward biased and D_2 is reverse biased.

The current flows through diode D_1, R_L and upper half winding (AC).

During every negative half cycle of A.C. input, point B is + ve w.r.t point C (and point A is – ve w.r.t. point C), therefore diode D_2 is forward biased and diode D_1 is reverse biased.

Current flows through R_L, from point M to point N (unidirectional). **[1 M]**

Topic:_Semiconductors Electronics materials devices and simple circuit_; Sub-Topic:_Diode applicaiton_ _ L-3_ _Target-2017_ XII-CBSE Board Exam__Physics

14. According to photon picture of light, in photoelectric effect, electron absorbs a quantum of energy ($h\nu$) of radiation. If this quantum of energy absorbed exceeds the minimum energy needed for the electron to escape from the metal surface, the electron is emitted with some kinetic energy, the maximum value of which can be given by **[1 M]**

$K_{max} = h\nu - \phi_0$

This is know as Einstein's photoelectric equation. ϕ_0 is the work function of metal, which is the minimum energy needed by a surface electron to come out. **[1 M]**

The two features of photoelectric effect which cannot be explained by wave theory, are

(i) Instantaneous emission (ii) Existance of threshold frequency **[1 M]**

Topic:Dual natrure of radition & matter; Sub-Topic:Einstein's photoelectric equation_L-1_Target-2017_ XII-CBSE Board Exam__Physics

15. (a) **Given:** **[0.5 M]**

wavelength in air, $\lambda_a = 589\ nm = 5.89 \times 10^{-7} m$

refractive index of water, $\mu_w = 1.33$

$\because$ speed of light in vacuum, $c = 3 \times 10^8 m/s$

$\therefore$ frequency, $v = \dfrac{c}{\lambda_a}$

$$(\because \text{speed in air} \approx c) = \frac{3 \times 10^8 m/s}{5.89 \times 10^{-7} m} = 5.093 \times 10^{14} Hz$$

Now, speed of light in water, $v = \dfrac{c}{u_w}$

$$= \frac{3 \times 10^8 m/s}{1.33} \approx 2.2605 \times 10^8 m/s$$ **[0.5 M]**

$\therefore$ wavelength in water, $\lambda_w = \dfrac{\text{v}}{v}$

($\because$ frequency remains the same in all media)

$$= \frac{c/\mu_w}{c/\lambda_a} = \frac{\lambda_a}{\mu_w} = \frac{5.89 \times 10^{-7} m}{1.33}$$

$\approx 4.43 \times 10^{-7} m$

Thus, for the refracted light,

wavelength $\lambda_w \approx 4.43 \times 10^{-7} m$

frequency $v \approx 5.09 \times 10^{14} Hz$ and

speed $v \approx 2.26 \times 10^8 m/s.$ **[0.5 M]**

Topic:_Ray optics_; Sub-Topic:_Refraction_L-1_Target-2017_ XII-CBSE Board Exam__Physics

(b) **Given:** $\mu = 1.55, f = 20 cm$ **[0.5 M]**

$|R_1| = |R_2| = R \quad (let)$

$\because$ for double convex lens as $R_1 > 0$ and $R_2 < 0$

So, $R_1 = R \ and \ R_2 = -R$

Using Lens Maker's Equation

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right), \ we \ get$$ **[0.5 M]**

$$\frac{1}{20} = (1.55 - 1) \cdot \left(\frac{1}{R} + \frac{1}{R}\right)$$

$\Rightarrow \frac{1}{20} = 0.55 \times \frac{2}{R}$

$\Rightarrow R = 0.55 \times 2 \times 20\,cm = 22\,cm$

$\therefore$ The radius of curvature is 22 cm. **[0.5 M]**

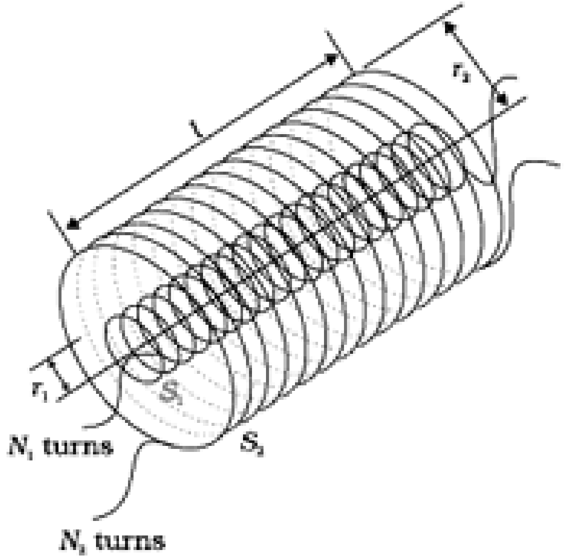
Topic:Ray optics; Sub-Topic:lens maker's equation_ L-2 _Target-2017_ XII-CBSE Board Exam__Physics

16. If we consider two coaxial coils s_1 and s_2, when a current I_2 is set up through S_2, it in turn sets up a magnetic flux through S_1. Let us denote it by ϕ_1. The corresponding flux linkage with solenoid S_1 is

$N_1\phi_1 = M_{12}I_2$ ....(1) **[0.5 M]**

M_{12} is called the mutual inductance of solenoid S_1 with respect to solenoid S_2.

The magnetic field due to the current I_2 in S_2 is $\mu_0 n_2 I_2$. the resulting flux linkage with coil S_1 is,



[0.5 M]

$N_1\phi_1 = (n_1 l)(\pi r_1^2)(\mu_0 n_2 I_2)$

$= \mu_0 n_1 n_2 \pi r_1^2 l I_2$ ....(2)

where $n_1 l$ is the total number of turns in solenoid S_1. Thus, from equation (1) and equation (2).

$M_{12} = \mu_0 n_1 n_2 \pi r_1^2 l$ ....(3)

We now consider the reverse case. A current I_1 is passed through the solenoid S_1 and the flux linkage with coil S_2 is,

$N_2\phi_2 = M_{21}I_1$ ....(4) **[1 M]**

M_{21} is called the mutual inductance of solenoid S_2 with respect to solenoid S_1.

The flux due to the current I_1 in S_1 can be assumed to be confined solely inside S_1 since the solenoids are very long. Thus, flux linkage with solenoid S_2 is

$N_2\phi_2 = (n_2 l)(\pi r_1^2)(\mu_0 n_1 I_1)$

where $n_2 l$ is the total number of turns of S_2. From equation (4).

$M_{21} = \mu_0 n_1 n_2 \pi r_1^2 l$ ....(5)

Using Equation (3) and Equation (5), we get

$M_{12} = M_{21} = M\,(say)$

$\therefore M = \mu_r \mu_0 n_1 n_2 \pi r_1^2 l$ **[1 M]**

Topic:_EMI; Sub-Topic:_Mutual induction_ L-1_Target-2017_ XII-CBSE Board Exam__Physics

(OR)

The flux linkage through a coil of N turns is proportional to the current through the coil and is expressed as

$N \cdot \phi_B \propto I$

or $N \cdot \phi_B = LI$

where the constant of proportionality L is called self inductance of the coil. **[1 M]**

Energy stored in an inductor:

For the current I at an instant in a circuit containing an inductor, the rate of work done is

$\frac{dW}{dt} = |\varepsilon| \cdot I$, where ε is self induced emf.

If we ignore the resistive losses and consider only the inductive effect, then using

$\varepsilon = -L\frac{dI}{dt}$, we get

$\frac{dW}{dt} = LI \cdot \frac{dI}{dt}$

or, $dW = LI.dI$

$\therefore$ Total amount of work done in establishing the current I is

$W = \int dW = \int_0^I LIdI = \frac{1}{2}LI^2$

Thus, the energy required to build up the current I is

$W = \frac{1}{2}LI^2$

This energy is stored as magnetic potential energy in the Inductor.

Thus, energy stored, $U = \frac{1}{2}LI^2$ **[2 M]**

Topic:_EMI; Sub-Topic:_Self induction_ L-1_Target-2017_ XII-CBSE Board Exam__Physics

17. (a) The metre bridge works on the principle of balanced condition of wheatstone bridge. **[1 M]**

(B) According to the problem; $\frac{R}{S} = \frac{l_1}{100 - l_1}......(i)$ **[0.5 M]**

Now, when X is connected in parallel with S, the effective resistance of this pair becomes $\frac{S.X}{S+X}$

$\therefore$ we get $\frac{R}{\left(\frac{S.X}{S+X}\right)} = \frac{l_2}{100 - l_2}.....(ii)$ **[0.5 M]**

$\therefore$ Dividing eg. (i) by (ii) we, get

$$\frac{X}{S+X} = \frac{l_1}{l_2}\left(\frac{100 - l_2}{100 - l_1}\right)$$

or $l_2(100 - l_1)X = l_1(100 - l_2)(S + X)$

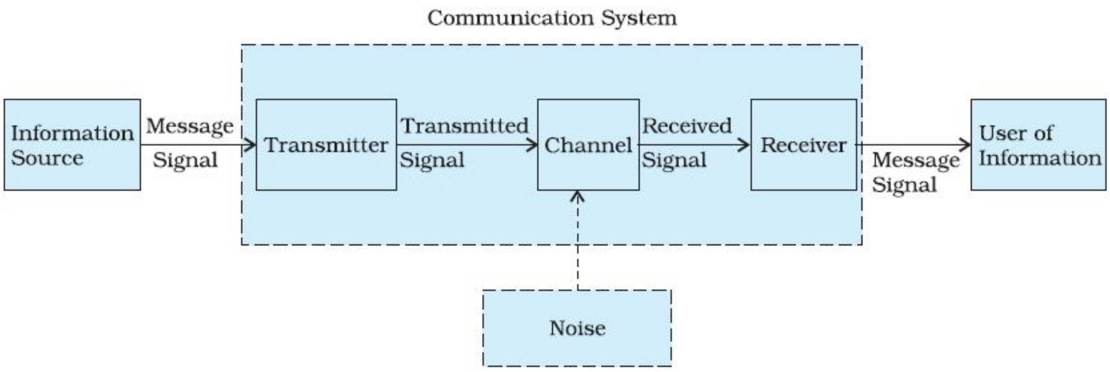
or $\{l_2(100 - l_1) - l_1(100 - l_2)\}X = l_1(100 - l_2)S$ **[0.5 M]**

or $(l_2 - l_1) \times (100X) = l_1(100 - l_2)S$

or $X = \frac{l_1(100 - l_2)}{100(l_2 - l_1)}S$

where l_1 and l_2 are in centemetres **[0.5 M]**

Topic:Current electricity; Sub-Topic:Meter bredge_ L-2 _Target-2017_ XII-CBSE Board Exam__Physics

18. 

[1 M]

(a) **Transmitter :** A transmitter processes the incoming message signal so as to make it suitable for transmission through a channel and subsequent reception.

(b) **Channel :** The function of channel is to provide a physical medium for the transmitted signal to move from transmitter to receiver. Thus, a channel connects the transmitter to a receiver.

(c) **Receiver:** A receiver extracts the desired message signals from the recived signals at the channel output. **[2 M]**

Topic:Communication system; Sub-Topic:Basic communication system_L-1_Target-2017_ XII-CBSE Board Exam_Physics

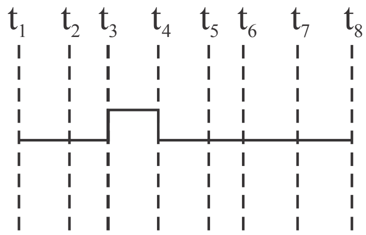
19. (a) **Emitter :** It supplies a large number of majority carriers for the current flow through the transistor.

Base : The thin base allows most of the majority charge carriers coming from emitter to appear in the base-collector junction.

Collector : This segment collects major portion of the majority carriers supplied by the emitter.

[1 M]

(b) Output waveform will be as follows :



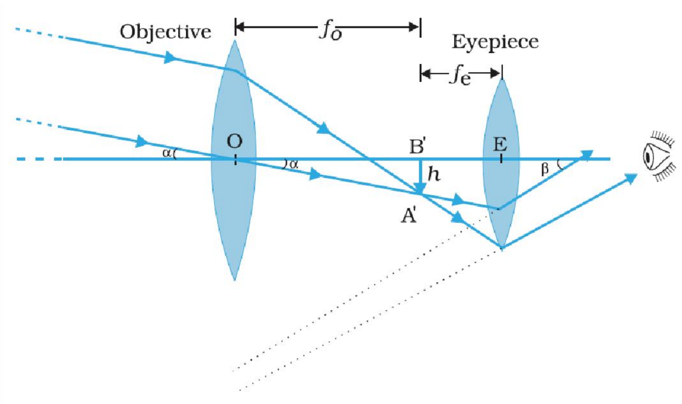
[1 M]

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

Truth table of AND gate **[1 M]**

Topic:Semi conductor electronics; Sub-Topic:Logic gates_L-1_Target-2017_ XII-CBSE Board Exam__Physics

20. (a)



[1 M]

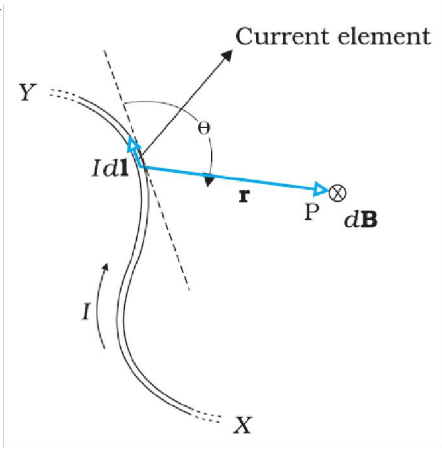
Topic:Ray optics_; Sub-Topic:Telescope_L-1_Target-2017_ XII-CBSE Board Exam__Physics

(b) For a telescope, lens L_1 is chosen as objective, as its aperture and focal length are largest.**[1 M]**

The lens L_3 is chosen as eyepiece as its focal length is smallest. **[1 M]**

Topic:Ray optics_; Sub-Topic:Telescope_L-2_Target-2017_ XII-CBSE Board Exam__Physics

21. (a) According to Biot-Savart's law, the magnitude of the magnetic field $d\vec{B}$ due to a small element of length 'dl' of a current carrying wire at a point P, is proportional to the current I, the element length dl and is inversly proportional to the square of the distance r. It is also proportional to $\sin\theta$ where θ is angle between $\vec{dl}$ and $\vec{r}$



Its direction is perpendicular to the plane containing $\vec{dl}$ and $\vec{r}$.
In vector form

$$\vec{dB} \propto \frac{I\vec{dl} \times \vec{r}}{r^3}$$

or, $$\vec{dB} = \frac{\mu_0}{4\pi} \cdot \frac{I\vec{dl} \times \vec{r}}{r^3}$$

($\vec{dl}$ is directed along the length of the wire in the direction of current and $\vec{r}$ is the vector joining the centre of current element to the point P) **[1 M]**

Topic:Moving charges and magnetism; Sub-Topic:Biot-Savart law _L-1_Target-2017_ XII-CBSE Board Exam__Physics

(b) Field due to current in coil P, is

$$\vec{B_2} = \frac{\mu_0 I_1}{2R} \cdot \hat{k}$$

(Assuming current to be anticlockwise as seen form + ve z-axis)
and that due to current in coil Q is

$$\vec{B_2} = \frac{\mu_0 I_2}{2R}\,\hat{i}$$

(Assuming current to be anticlockwise as seen from positive $x-axis$.)

$$\therefore \text{ net field } \vec{B} = \vec{B_1} + \vec{B_2}$$

$$\therefore \vec{B} = \left(\frac{\mu_0 I_1}{2R}\right)\hat{k} + \left(\frac{\mu_0 I_2}{2R}\right)\hat{i}$$

$$\because I_1 = 1A \text{ and } I_2 = \sqrt{3}\,A$$

$$= \left(\frac{\mu_0}{2R}\right)\hat{k} + \left(\frac{\sqrt{3}\,\mu_0}{2R}\right)\hat{i}$$ **[1 M]**

{all units are in S.I.}

$$\therefore |\vec{B}| = \sqrt{\left(\frac{\mu_0}{2R}\right)^2 + \left(\frac{\sqrt{3}\,\mu_0}{2R}\right)^2}$$

$$= \frac{\mu_0}{2R}\sqrt{1+3}$$

$$= \frac{\mu_0}{2R} \times 2$$

$$\therefore |\vec{B}| = \frac{\mu_0}{R}$$ **[0.5 M]**

The field is directed in XZ plane. Let θ be the angle of $\vec{B}$ with positive x-axis.

than $\tan\theta = \left(\frac{\mu_0}{2R}\right) / \left(\sqrt{3}\frac{\mu_0}{2R}\right)$

or, $\tan\theta = \frac{1}{\sqrt{3}}$

$\Rightarrow \theta = 30°$

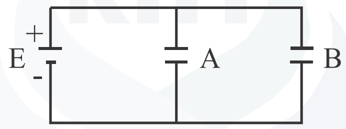
Thus $\vec{B}$ is directed in XZ -plane making an angle of 30° with x-axis. **[0.5 M]**

Topic:Moving charges and magnetism; Sub-Topic:Application of Biot-Savart law _L-2_Target-2017_ XII-CBSE Board Exam__Physics

22. Let C be the capacitance of each capacitor.
With switch S closed, the two capacitors are in parallel.
$\therefore$ equivalent capacitance is 2C.

$\therefore$ Energy stored $= \frac{1}{2}(2C)V^2$

or $U_1 = CV^2 .....(i)$ **[0.5 M]**



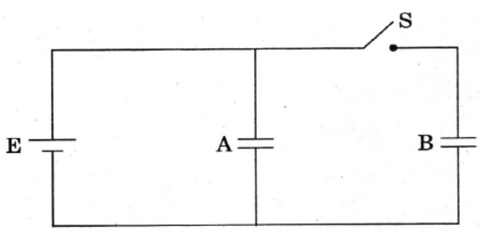
Now, when switch is opened and then free space of capacitors are filled with dielctric, the capacitance of each capacitor will be KC. For capacitor B, the charge will remain same as before and for A, the potential difference will remain same.
Charge on each capacitor in the previous case will be CV

$\therefore$ Energy stored in capacitor A in current case is $U_A = \frac{1}{2}(KC)V^2 = \frac{1}{2}KCV^2$ and that in capacitor B, is

$U_B = \frac{Q^2}{2KC} = \frac{(CV)^2}{2KC} = \frac{1}{2K}CV^2$ **[1 M]**

$\therefore$ Total energy stored,

$U_2 = U_A + U_B$



or, $U_2 = \frac{1}{2}KCV^2 + \frac{1}{2K}CV^2$

or, $U_2 = \frac{1}{2}\left(K + \frac{1}{K}\right)CV^2$

or, $U_2 = \left(\frac{K^2+1}{2K}\right)CV^2 ....(ii)$ **[1 M]**

$\therefore \frac{U_1}{U_2} - \frac{CV^2}{\left(\frac{K^2+1}{2K}\right)CV^2}$ { Using eq. (i) and (ii) }

or, $\frac{U_1}{U_2} = \frac{2K}{K^2+1}$ **[0.5 M]**

Topic:Electrostatic potential & capacitance ; Sub-Topic:Energy stored in capacitors_L-2_Target-2017_ XII-CBSE Board Exam__Physics

SECTION - D

23. (a) It was a nuclear reactor. The cause of disaster was human error which bypassed the safety procedure. **[1 M]**

(b) Energy released due to uncontrolled chain reaction which led to production of exessive heat due to which water converted into pressurised steam and blast occurred. **[1.5 M]**

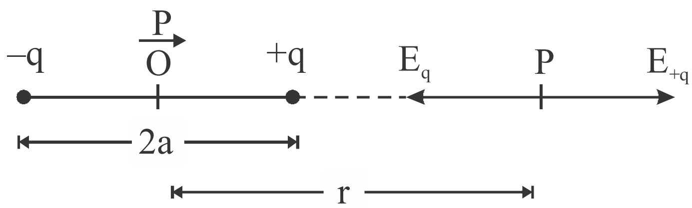
(c) Asha had in depth knowledge of nuclear reaction. She was aware about the accident her mom was very compossanate and caring lady. **[1.5 M]**

Topic:Nuclei; Sub-Topic:Nuclear reactor_L-1_Target-2017_ XII-CBSE Board Exam__Physics

SECTION - E

24. (a) Electric field at an axial point of an electric dipole.

As shown in figure, consider an electric dipole consisting of charges +q and –q, seperated by distance 2a and placed in vacuum. Let P be a point on the axial line at distance r from the centre O of the dipole on eh side of the charge +q.



Electric Field at an axial point of dipole **[1 M]**

Electric filed at an axial point of dipole

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

where $\hat{p}$ is a unit vector along the dipole axis from – q to +q.

Electric field due to charge +q at point P is

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

Hence the resultant electric field at point P is

$$\vec{E}_{axial} = \vec{E}_{+q} + \vec{E}_{-q}$$

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

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

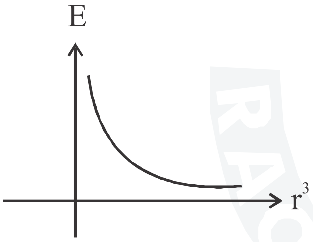
or $\vec{E}_{axial} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{2ar}{(r^2-a^2)^2}\hat{p}$

Here p = q × 2a = dipole moment

For r > > a, a^2 can be neglected compared to r^2.

$\vec{E}_{axial} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{2p}{r^3}\hat{p}$ (towards right) **[1 M]**

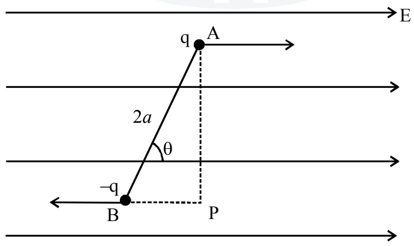
Topic:Electrostatic charges; Sub-Topic:Dipole_ L-1_Target-2017_ XII-CBSE Board Exam_Physics

(b) 

[1 M]

Topic:Electrostatic charges; Sub-Topic:Dipole_ L-1_Target-2017_ XII-CBSE Board Exam_Physics

(c) Expression for Torque for a Dipole Placed in a Uniform Electric Field:



[1 M]

Consider a dipole AB placed in a uniform electric field of intensity E.

∴ The force on A is $+q\vec{E}$ and on B is $-q\vec{E}$. These two forces are separated by distance $2a \sin\theta$. This constitute a couple,

According to definition of torque of a couple,

$\tau = qE \times 2a \sin\theta$

∴ $\boxed{\tau = pE\sin\theta}$ In vector form $\vec{\tau} = \vec{p} \times \vec{E}$

Case - I: For stable equilibrium θ should be = 0^0 in that case τ is zero

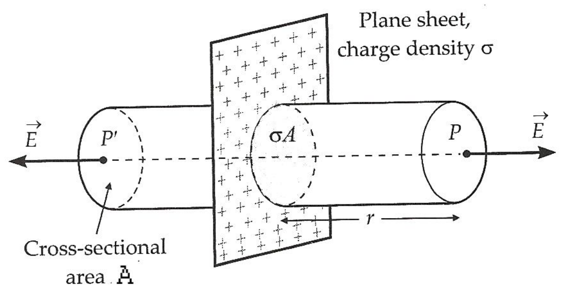
Case - II: For unstable equilibrium θ should be = 180^0 in that case τ is – pE **[1 M]**

Topic:Electrostatic charges; Sub-Topic:Torque acting on dipole_L-1_Target-2017_ XII-CBSE Board Exam_Physics

(OR)

(a) **Electric field due to uniformly charged infinite plane sheet**

Apply Gayss's theorem to calculate electric field due to an infinite plane sheet of charge.
Electric field due to a uniformly charged infinite plane sheet. A shown in figure, consider a thin, infinite plane sheet of charge with uniform surface charge density σ . We wish to calculate its electric field at a point P at distance r from it. **[1 M]**



[0.5 M]

Gaussian surface for a uniformly charged infinite plane sheet.

By symmetry, electric field E points outwards normal tot he sheet. Also, it must have same magnetude and opposite direction at two points P and P' equidistant from the sheet and on oppo site sides. We choose cylindrical gaussian surface of cross-sectional area A and length 2r with its axis perpendicular to the sheet.
As the lines of force are parallel to the curved surface of the cylinder, the flux through the curved surface is zero. the flux through the plane-end faces of the cylinder is

$$\phi_E = EA + EA = 2\,EA$$

Charge enclosed by the gaussian surface,

$$q = \sigma A$$

According to gauss's theorem,

$$\phi_E = \frac{q}{\varepsilon_0}$$

$$\therefore\ 2\,EA = \frac{\sigma A}{\varepsilon_0} \text{ or } E = \frac{\sigma}{2\varepsilon_0}$$ **[1.5 M]**

Topic:Electrostatic charges; Sub-Topic:Application of Gauss's theorem_L-2_Target-2017_ XII-CBSE Board Exam_Physics

(b) Let P be a point at distance r from the sheet.
The required work done to bring point charge 'q' from infinity to P, is

$$W = q\cdot\left(V_P - V_\infty\right) \qquad ......(i)$$

Now, $V_P - V_\infty = -\int_\infty^r \vec{E}\cdot\vec{dr} = -\int_\infty^r E\,dr = -\int_\infty^r \left(\frac{\sigma}{2\varepsilon_0}\right)\cdot dr$ **[1.5 M]**

$$\left\{\begin{matrix}\because \text{ Field in front of an infinitely large plane sheet} \\ \text{of charge is uniform and is given by } \dfrac{\sigma}{2\varepsilon_0}\end{matrix}\right\}$$

$$-\frac{\sigma}{2\varepsilon_0}\int_{\infty}^{r} dr = -\frac{\sigma}{2\varepsilon_0}\cdot[r]_{\infty}^{r}$$

$$-\frac{\sigma}{2\varepsilon_0}(r-\infty) = \infty$$

$$or,\ V_P - V_\infty = \infty$$

$\therefore$ from eq. (i), W = ∞ **[1 M]**

Topic:Electrostatic potential & capacitance; Sub-Topic:Electric potential_L-3_Target-2017_ XII-CBSE Board Exam_Physics

25. (a) Device is capacitor **[0.5 M]**

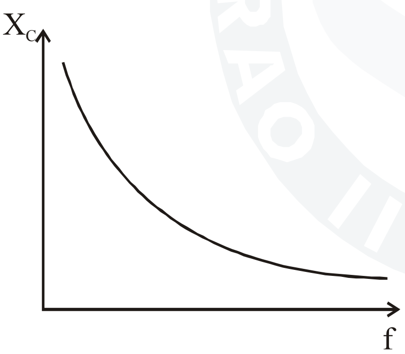
(b) $B \rightarrow$ Voltage (Because it is sine wave)

$C \rightarrow$ Current (Because current leads voltage by $\pi/2$)

$A \rightarrow$ Power (Average power over one cycle is zero) **[1 M]**

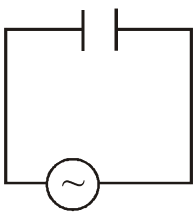
(c) $X_C = \frac{1}{\omega C}$

$X_C = \frac{1}{2\pi fC}$ **[1 M]**



[1 M]

(d)



[1 M]

$V = v_0 \sin\omega t$

$$C = \frac{q}{v}$$

$$q = Cv_0 \sin\omega t$$

$$i = \frac{dq}{dt} = \frac{d}{dt}(Cv_0 \sin\omega t)$$

$$= \omega Cv_0 \sin\omega t$$

$$= \frac{v_0}{\frac{1}{\omega C}} \cos \omega t$$

$$i = \frac{v_0}{X_C} \sin\left(\omega t + \frac{\pi}{2}\right)$$

$$i = i_0 \sin\left(\omega t + \frac{\pi}{2}\right)$$

In pure capacitive circuit current leads voltage by $\frac{\pi}{2}$ **[1.5 M]**

Topic:AC; Sub-Topic:AC applied to capacitor_L-2_Target-2017_ XII-CBSE Board Exam__Physics

(OR)

(a) An ac generator converts mechanical energy into electrical energy.It consists of a coil mounted on a rotar shaft. The axis of rotation of coil is perpendicular to magnetic field and the coil (armature) is mechanically rotated in magnetic field. Rotation causes magnetic flux hence an emf is induced in coil. Let ω be angular velocity and θ be the angle between magnetic field and area vector, then $\theta = \omega t$, hence flux is,

$\Phi_B = BA\cos\theta$ **[1 M]**

$$= -NAB\frac{d}{dt}(\cos\omega t)$$

Thus instantaneous emf is,

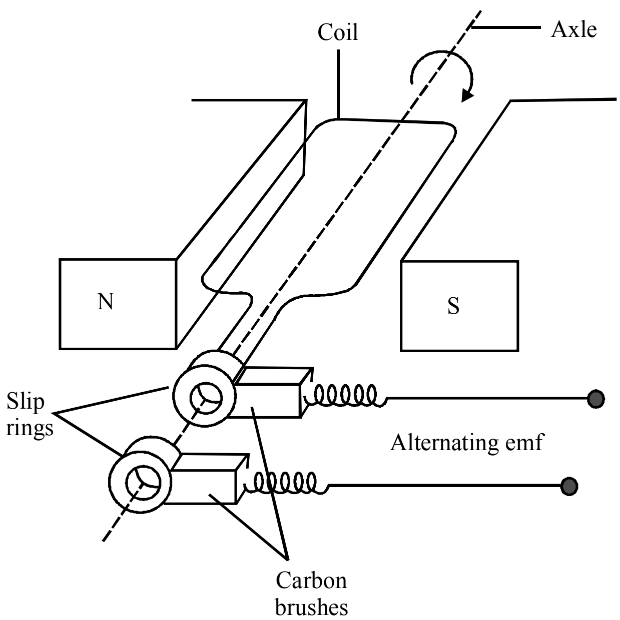
$\varepsilon = NBA\omega \sin\omega t$

If $NAB\omega = \varepsilon_0$ then

$\varepsilon = \varepsilon_0 \sin\omega t$

Sine function varies between ± 1 and emf for $\theta = 0° \; to \; \theta = 270°$

The direction of current changes periodically hence called alternating current.



[1.5 M]

Topic:EMI; Sub-Topic:AC Generator_L-2_Target-2017_ XII-CBSE Board Exam_Physics

(b) $e = Blv\sin\theta$

Given: $B = 0.3\ 510^{-4} wb/m^2$ **[0.5 M]**

$v = 5m/s.$

$l = 10m$

$\theta = 90°$

$e = Blv\sin\theta$

$= 0.3\times10^{-4}\times10\times5\times\sin 90°$ **[1.5 M]**

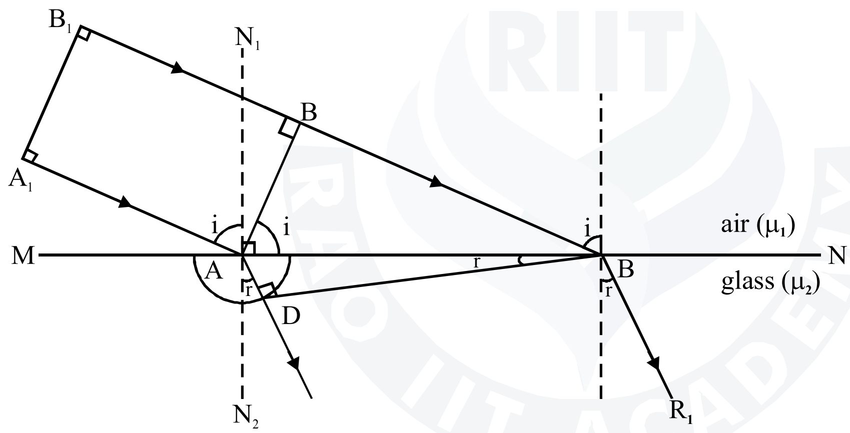
$e = 15\times10^{-4}V$

$e = 1.5\times10^{-3}v = 1.5mV$ **[0.5 M]**

Topic:EMI; Sub-Topic:Faraday's law of emi_L-2_Target-2017_ XII-CBSE Board Exam_Physics

26. (a)

Wave front:- Wave front is locus of all the points where reaches at same time in same phase. **[0.5 M]**



[1.5 M]

Suppose that a plane wavefront of light is incident at a plane refracting surface MN separating two media Let A_1B_1 and AB be the successive postitions of the incident wavefront A_1A and B_1B the corresponding rays. When the wavefornt reaches the point A, it becomes a secondary source and emits secondary waves in the second medium. Let V_1 and V_2 be the speed of light in the medium one (say a rarer medium of R.I. m_1) and the medium two (a denser medium of R.I. m_2) respectively. If t is the time taken by the incident ray to cover the distance BC, then BC = V_1t. During this time, the secondary waves originating at A cover a distance V_2 t in the denser medium. Therefore, the secondary spherical wavelet has radius V_2t in the denser medium two (a denser medium) respectively. If t is the time taken by the incident ray to cover the distance BC, then BC = V_1 t. During this time, the secondary waves originating at A cover a distance V_2 t in the denser medium. Therefore, the secondary spherical wavelet has a radius V_2t. With A as the centre, draw a hemisphere of radius V_2 t in the denser medium. It represents the secondary wavelet According to Huygens's principle locus of tangent to all secondary wavelets represent new wave front. Draw a tangent CD to the secondary wavelet. As the points C&D are in the same phase of wave motion, CD represents the refracted wavefront in denser medium. It moves parallel to itself taking successive posititions C_1D_1, C_2D_2, etc. AD_2 and CC_2 represents the corresponding refracted rays. Draw PAQ normal to MN.

Now, $\angle A_1AP = i$ = angle of incidence & $\angle QAD = r$ = angle of refraction

Also, from the figure, $\angle BAC$ & i and $\angle ACD = r$

From the traingles ΔBAC & ΔACD

$\sin i = \frac{BC}{AC}$ & $\sin r = \frac{AD}{AC}$, Let $\mu = \frac{\mu_2}{\mu_1}$ $\therefore$ Refractive index $\mu = \frac{\sin i}{\sin r} = \frac{BC/AC}{AD/AC} = \frac{BC}{AD}$ ....(1)

$\therefore$ Refractive index $\mu = \frac{V_1 t}{V_2 t}$

$\therefore \mu = \frac{V_1}{V_2}$ ....(2)

$\therefore$ Refractive index of medium 2 w.r.t.1 $= \frac{\text{speed of light in medium1}}{\text{speed of light in medium2}}$

= constant for given pair of media & given frequency.

From equation (1) and (2)

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

Thus Snell's law can be proved using Huygens' principle. **[2 M]**

Topic:Wave optics; Sub-Topic:Refraction of plane wave fromt_L-1_Target-2017_ XII-CBSE Board Exam__Physics

(b) According to Brewster's Law

$\tan i_p = \mu$

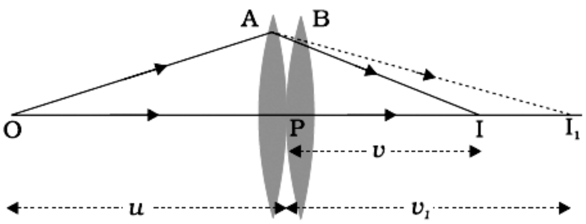
$i_p = \tan^{-1}(\mu)$

$i_p = \tan^{-1}(1.5)$

$\boxed{i_p = 56.30°}$ **[1 M]**

Topic:Wave optics; Sub-Topic:Polarisation_L-1_Target-2017_ XII-CBSE Board Exam__Physics

(OR)

(a)


[1 M]

Consider two lenses placed close to each other. The focal lengths of lens 1 and 2 is f_1 and f_2 respectively.

For Lens 1

$$\frac{1}{v'} - \frac{1}{u} = \frac{1}{f_1} \quad ...(i)$$

For Lens 2

$$\frac{1}{v} - \frac{1}{v'} = \frac{1}{f_2} \qquad ...(ii)$$

Adding (i) and (ii)

$$\frac{1}{v'} - \frac{1}{u} + \frac{1}{v} - \frac{1}{v'} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2}$$

Since, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ **[1 M]**

then, $\frac{1}{f_T} = \frac{1}{f_1} + \frac{1}{f_2}$

$P = P_1 + P_2 + P_3 + ...$ total power

$f_T \rightarrow$ Total new focal length of the combination.

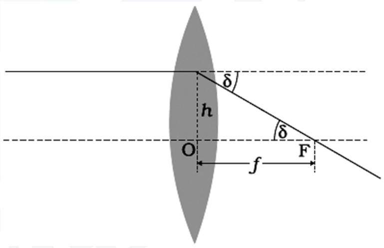
Power of Lens

Power of lens is defined as the total tangent of the angle by which it converges or diverges a beam of light falling at unit distance from the optical centre.

$$\tan\delta = \frac{h}{f}$$

If, $h = 1$, then

$$\tan\delta = \frac{1}{f} \quad \text{(or)} \quad P = \frac{1}{f}$$



[1 M]

SI unit of power is Dioptre.

Topic:Ray optics; Sub-Topic:Combination of lens_ L-1 _Target-2017_ XII-CBSE Board Exam__Physics

(b) For equilateral prism $A = 60°$

for minimum angle of deviation

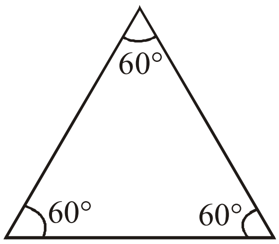
$$i + e = A + \delta_m$$

$$2i = A + \delta_m$$

$$\frac{2 \times 3A}{4} = A + \delta_m$$

$$\delta_m = \frac{3A}{2} - A$$

$$\delta_m = \frac{A}{2}$$



$$\mu = \frac{\sin\left(\frac{A+\frac{A}{2}}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$ **[1 M]**

$$\mu = \frac{\sin\frac{3A}{4}}{\sin\frac{A}{2}} = \frac{\sin 45°}{\sin 30°} = \frac{0.7071}{0.5}$$

$$= 1.414$$

$$\boxed{\mu = 1.414}$$

$$V = \frac{c}{\mu}$$

$$= \frac{3\times10^8}{1.414} = 2.1216\times10^8 \, m/s$$ **[1 M]**

Topic:Ray optics; Sub-Topic:Prism_L-2_Target-2017_ XII-CBSE Board Exam__Physics