CLASS - XII
PHYSICS (042)
SAMPLE QUESTION PAPER (2019-20)

Time allowed: 3 hours | Max. Marks: 70

General Instructions:

1. All questions are compulsory. There are 37 questions in all.
2. This question paper has four sections: Section A, Section B, Section C and Section D.
3. Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each, and Section D contains three questions of five marks each.
4. There is no overall choice. However, internal choices have been provided in two questions of one mark each, two questions of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. You may use the following values of physical constants where ever necessary.

$c = 3 \times 10^{8}$ m/s

$h = 6.63 \times 10^{-34}$ Js

$e = 1.6 \times 10^{-19}$ C

$\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2 N^{-1} m^{-2}$

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}$ N $m^2 C^{-2}$

$m_e = 9.1 \times 10^{-31}$ kg

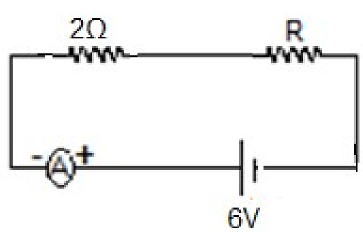
mass of neutron = 1.675×10^{-27} kg

mass of proton = 1.673×10^{-27} kg

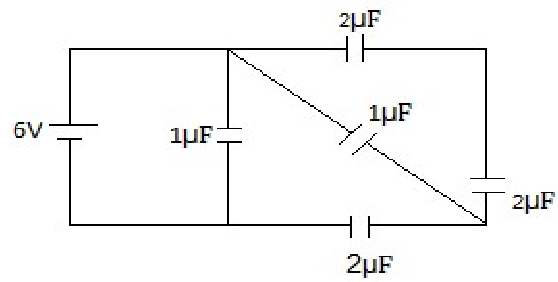
Avogadro's number = 6.023×10^{23} per gram mole

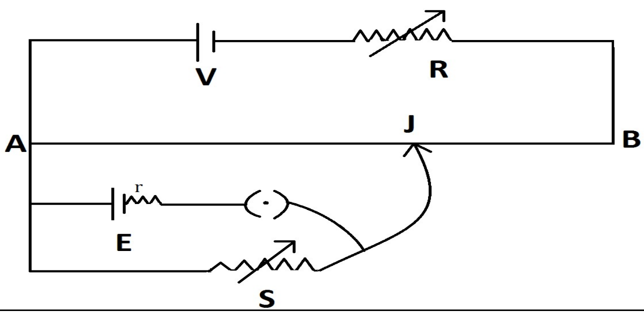
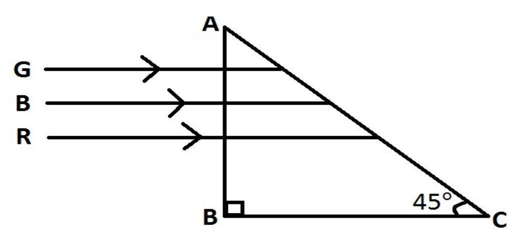
Boltzmann constant = 1.38×10^{-23} JK^{-1}

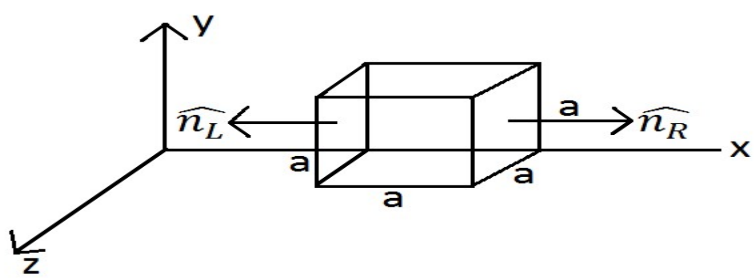
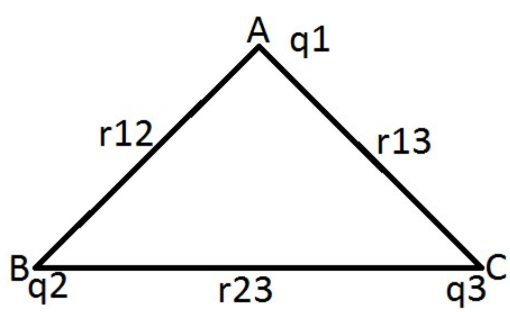
Section – A

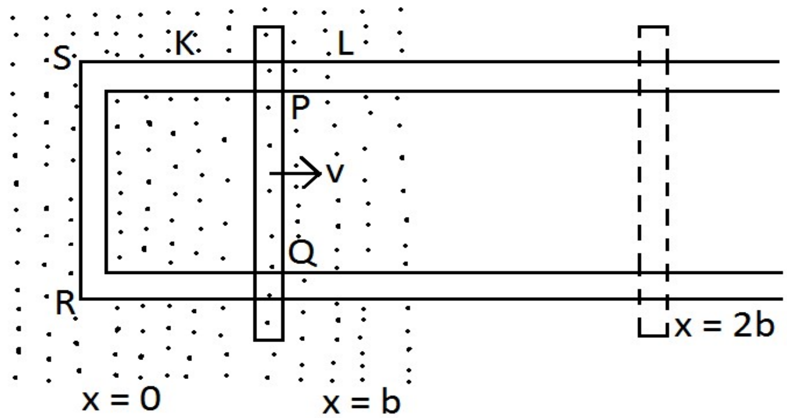
Directions (Q1-Q10) Select the most appropriate option from those given below each question		
1.	A charge q is placed at the point of intersection of body diagonals of a cube. The electric flux passing through any one of its face is (a) $\frac{q}{6\epsilon 0}$ (b) $\frac{3q}{\epsilon 0}$ (c) $\frac{6q}{\epsilon 0}$ (d) $\frac{q}{3\epsilon 0}$	1
2.	The electric potential of earth is taken to be zero because earth is a good (a) Insulator (b) conductor (c) semiconductor (d) dielectric	1
3.	If the ammeter in the given circuit shown in the diagram reads 2A, the resistance R is (a) 1Ω (b) 2Ω (c) 3Ω (d) 4Ω 	1
4.	The heat produced by 100W heater in 2 minutes is equal to (a) 10.5kJ (b) 16.3kJ (c) 12.0kJ (d) 14.2kJ	1
5.	Time period of a charged particle undergoing a circular motion in a uniform magnetic field is independent of (a) speed of the particle (b) mass of the particle (c) charge of the particle (d) magnetic field	1
6.	The final image formed in an astronomical refracting telescope with respect to the object is (a) Real inverted (b) Real erect (c) Virtual erect (d) Virtual inverted	1
7.	The shape of the interference fringes in Young's double slit experiment when D (distance between slit and screen) is very large as compared to fringe width is nearly (a) straight line (b) parabolic (c) circular (d) hyperbolic	1

8.	Unpolarized light is incident on a plane glass surface having refractive index $\sqrt{3}$. The angle of incidence at which reflected and refracted rays would become perpendicular to each other is : (a) 15° (b) 30° (c) 45° (d) 60°	1
9.	Photoelectric emission from a given surface of metal can take place when the value of a 'physical quantity' is less than the energy of incident photon. The physical quantity is : (a) Threshold frequency (b) Work function of surface (c) Threshold wave length (d) Stopping Potential	1
10.	A photon beam of energy 12.1eV is incident on a hydrogen atom. The orbit to which electron of H-atom be excited is (a) 2^{nd} (b) 3^{rd} (c) 4^{th} (d) 5^{th}	1
Directions (Q11 –Q15) Fill in the blanks with appropriate answer.		
11	Horizontal and vertical components of earth's magnetic field at a place are equal. The angle of dip at that place is ________. **OR** A free floating magnetic needle at North pole is __________to the surface of earth.	1
12	The magnetic flux linked with a coil changes by 2×10^{-2}Wb when the current changes by 0.01A. The self inductance of the coil is_______.	1
13	If the angular speed of the armature of a dynamo is doubled then the amplitude of the induced e.m.f will become_______.	1
14	An electron is accelerated through a potential difference of 100 V , then de-Broglie wavelength associated with it is approximately ____________A°	1
15	An equilateral prism is made up of material of refractive index $\sqrt{3}$. The angle of minimum deviation of light passing through the prism is_________.	1
Directions (Q16 –Q20) Answer the following		
16.	Which physical quantity in a nuclear reaction is considered equivalent to the Q-value of the reaction?	1
17.	Zener diode is used in reverse bias. When its reverse bias is increased, how does the thickness of the depletion layer change?	1
18	The initial concentration of a radioactive substance is N_o and its half life is 12 hours. What will be its concentration after 36 hours?	1
19.	Work function of Sodium is 2.75eV. What will be KE of emitted electron when photon of energy 3.54eV is incident on the surface of sodium?	1

20.	From the information of energy band gaps of diodes, how do you decide which can be light emitting diodes? **OR** Give any one advantage of LEDs over conventional incandescent low power lamps	1
21	Derive the expression for drift velocity of free electron in terms of relaxation time and electric field applied across a conductor.	2
22	Find total energy stored in capacitors given in the circuit  	2
23	An α - particle and a proton are accelerated through same potential difference. Find the ratio (v_α/ v_p)of velocities acquired by two particles.	2
24	What is Brewster's angle? Derive relation between Brewster angle and refractive index of medium which produces Plane Polarized light.	2
25	The work function of Cs is 2.14eV.Find (a) threshold frequency for Cs (b) Wavelength of incident light if the photo current is brought to zero by stopping potential of 0.6 V.	2
26	Derive an expression for the radius of n^{th} Bohr's orbit in Hydrogen atom. **OR** Energy of electron in first excited state in Hydrogen atom is -3.4eV. Find KE and PE of electron in the ground state.	2
27	Draw energy band diagram of p & n type semiconductors. Also write two differences between p and n type semiconductors. **OR** Energy gap in a p – n photodiode is 2.8 eV. Can it detect a wavelength of 6000 nm? Justify your answer.	2

Section – C		
28	State working principle of potentiometer. Explain how the balance point shifts when value of resistor R increases in the circuit of potentiometer, given below. 	3
29	Using Biot-Savart's law, derive an expression for magnetic field at any point on axial line of a current carrying circular loop. Hence, find magnitude of magnetic field intensity at the centre of circular coil.	3
30	Obtain the resonant frequency and Q – factor of a series LCR circuit with L = 3H, C = 27μF, R = 7.4Ω. It is desired to improve the sharpness of resonance of circuit by reducing its full width at half maximum by a factor of 2. Suggest a suitable way.	3
31	State the conditions of total internal reflection. Refractive indices of the given prism material for Red, Blue and Green colors are respectively 1.39, 1.48 and 1.42 respectively. Trace the path of rays through the prism. 	3
32	Define resolving power of an astronomical refracting telescope and write expression for it in normal adjustment.Assume that light of wave length 6000Å is coming from a star, what is the limit of resolution of a telescope whose objective has a diameter of 2.54m? **OR** Write the basic assumptions used in the derivation of lens – maker's formula and hence derive this expression.	3 3

33	Show that $^{238}_{92}U$ can not spontaneously emit a proton. Given: $^{238}_{92}U$ = 238.05079u, $^{237}_{91}Pa$ = 237.05121u $^{1}_{1}H$ = 1.00783u	3
34	Suggest an idea to convert a full wave bridge rectifier to a half wave rectifier by changing the connecting wire/s. Draw the diagram and explain your answer.	3
	<u>Section – D</u>	
35	**(a)** Using Gauss's law, derive expression for intensity of electric field at any point near the infinitely long straight uniformly charged wire. **(b)**The electric field components in the following figure are $E_x = \alpha x$, $E_y = 0$, $E_z = 0$; in which α = 400 N/C m. Calculate (i) the electric flux through the cube, and (ii) the charge within the cube assume that a = 0.1m.  **OR** **a)** Define electrostatic potential at a point. Write its SI unit. Three charges q_1 , q_2 and q_3 are kept respectively at points A, B and C as shown in figures. Write the expression for electrostatic potential energy of the system.  **b)** Depict the equipotential surfaces due to (i) an electric dipole (ii) two identical negative charges separated by a small distance.	5 5
36	In the following diagram, the arm PQ of the rectangular conductor is moved from x = 0; outwards.	5

	 The uniform magnetic field is perpendicular to the plane and extends from x = 0 to x = b and is zero for x >b. Only the arm PQ possesses substantial resistance ‘r’. consider the situation when the arm PQ is pulled outwards from x = 0 to x = 2b, and is then moved back to x = 0 with constant speed ‘v’. Obtain expressions for the (i) electric flux, (ii) the induced emf,(iii)the force necessary to pull the arm and (iv) the power dissipated as Joule heat. Sketch the variation of these quantities with distance. **OR** Write working principle of cyclotron and with a suitable diagram explain its working. Give any two applications of cyclotron.	5
37	Derive mirror equation for a convex mirror. Using it, show that a convex mirror always produces a virtual image, independent of the location of object. **OR** **(a)** Draw a ray diagram for final image formed at distance of distinct vision (D) by a compound microscope and write expression for its magnifying power. **(b)** An angular magnification (magnifying power) of 30x is desired for a compound microscope using as objective of focal length 1.25cm and eye piece of focal length 5cm. How will you set up the compound microscope?	5 5

Class -XII

PHYSICS

SQP Marking Scheme

2019-20

	Section – A	
1.	a , $\phi = \frac{q}{6\epsilon_0}$ (for one face)	1
2.	b , Conductor	1
3.	a , 1Ω.	1
4.	c ,12.0kJ	1
5.	a , speed	1
6.	d, virtual and inverted	1
7.	a, straight line	1
8.	d, 60^0	1
9.	b, work function	1
10.	b, third orbit	1
11.	45^0 or vertical	1
12.	2 H	1
13.	double	1
14.	1.227 A^o	1
15.	60°	1
16.	Difference in initial mass energy and energy associated with mass of products Or Total Kinetic energy gained in the process	1
17.	Increases	1
18.	$N_o/8$	1
19.	0.79 eV	1
20.	Diodes with band gap energy in the visible spectrum range can function as LED	1

OR

Any one use

Section – B

21. When electric field E is applied on conductor force acting on free electrons

$$\vec{F} = -e\,\vec{E}$$

$$m\vec{a} = -e\vec{E}$$

$\vec{a} = \frac{-e\vec{E}}{m}$

Average thermal velocity of electron in conductor is zero **1**

$$(u_t)_{av} = 0$$

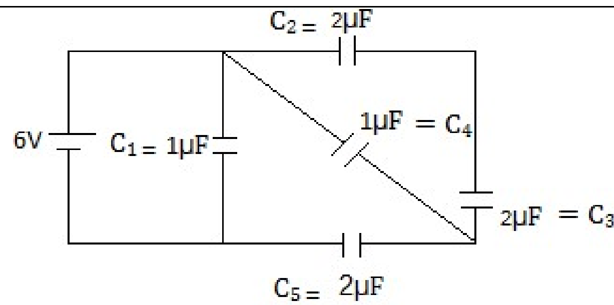
Average velocity of electron in conductors in τ (relaxation time) = v_d (drift velocity)

$$v_d = (u_t)_{av} + a\,\tau$$

$$v_d = 0 + \frac{-eE\tau}{m}$$

$\vec{v_d} = \frac{-e\vec{E}\tau}{m}$ **1**

22.



C_2 and C_3 are in series

$\frac{1}{c'} = \frac{1}{2} + \frac{1}{2} = 1$

$c' = 1\mu f$ **1**

c' & C_4 are in ∥

$C'' = 1 + 1 = 2\mu f$

C'' & c_5 are in series

$\frac{1}{c'''} = \frac{1}{2} + \frac{1}{2} \Longrightarrow c''' = 1\mu f$

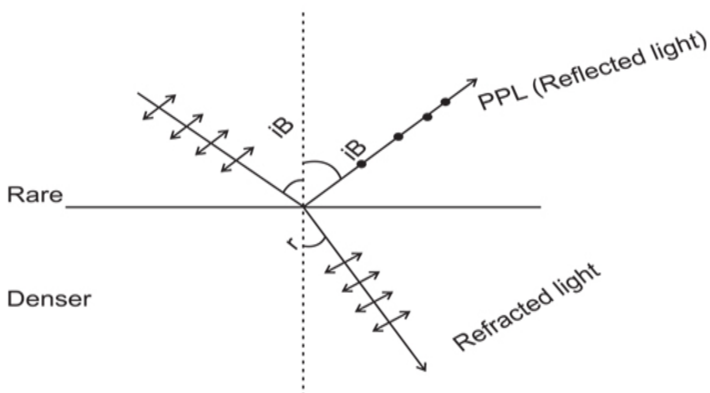
c''' & c_1 are in ∥

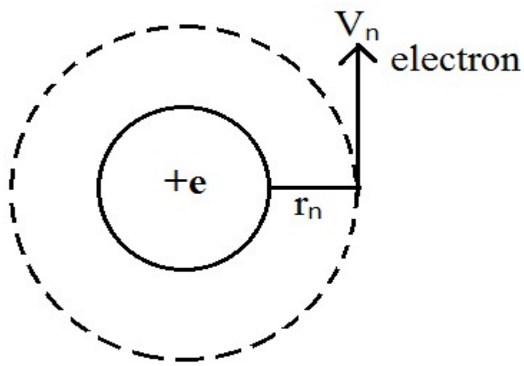
$C_{eq} = 1 + 1 = 2\mu f$ **1**

Energy stored

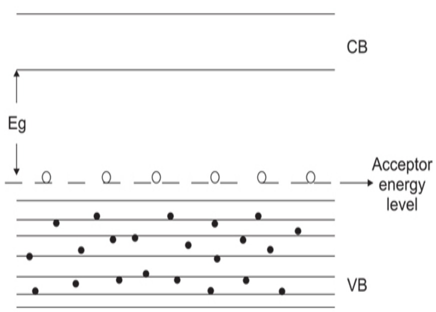
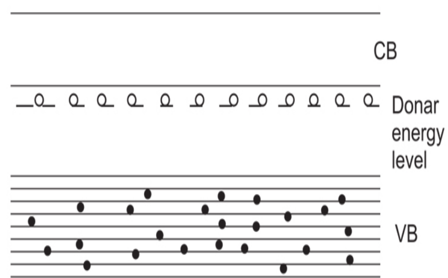
$U = \frac{1}{2}cv^2 = \frac{1}{2}\times 2\times 10^{-6}\times 6^2$

$= 36\times 10^{-6} J$

23.	Gain in KE of particle = Qv $\frac{1}{2}m_p v_p^2 = K_P = q_p V_p$ ----------(i) $V_p = V_\propto = V$ $\frac{1}{2}m_\alpha v_\alpha^2 = K_\propto = q_\propto V_\propto$ -----------(ii)	1
	(ii)/(i) $\frac{m_\alpha v_\alpha^2}{m_p v_p^2} = \frac{q_\alpha}{q_p} = \frac{2}{1}$ $\frac{v_\alpha^2}{v_p^2} = \frac{m_p \times 2}{m_\alpha \times 1} = \frac{2m_p}{4m_p \times 1} = \frac{1}{2}$ $v_\propto : v_p = 1:\sqrt{2}$	1
24.	"The angle of incidence at which the reflected light is completely plane polarized, is called as Brewster's angle (i_B)  	1
	At $i = i_B$, reflected beam 1 to refracted beam $\therefore i_B + r = 90 \Longrightarrow r = 90 - i_B$ Using snell's law $\frac{Sin\ i}{Sin\ r} = \mu$ $\frac{Sin\ i_B}{Sin\ (90 - i_B)} = \mu \Longrightarrow \frac{Sin\ i_B}{Cos\ i_B} = \mu$ $\mu = \tan i_B$	1
25.	wave function $\omega = 2.14eV$ (a) Threshold frequency $\omega = h\nu_0$ $\nu_0 = \frac{\omega}{h} = \frac{2.14\times1.6\times10^{-19}}{6.62\times10^{-34}}$	1

	$= 5.17 \times 10^{14} H_z$ (b) As $k_{max} = eV_0 = 0.6eV$ Energy of photon $E = k_{max} + \omega = 0.6eV + 2.14eV$ $= 2.74eV$ Wave length of photon $\lambda = \frac{hc}{E} = \frac{6.62\times10^{-34}\times3\times10^{-8}}{2.74\times1.6\times10^{-19}}$ $= 4530Å$	1
26.	 centripetal force = electrostatic attraction $\frac{mv_n^2}{r_n} = \frac{1}{4\pi\epsilon0}\frac{e^2}{r_n^2}$ $mv_n^2 = \frac{1}{4\pi\epsilon0}\frac{e^2}{r_n}$ --------(i) as $mv_n r_n = n . \frac{h}{2\pi}$ $v_n = \frac{nh}{2\pi m r_n}$ put in (i) $m . \frac{n^2h^2}{4\pi^2 m^2 r_n^2} = \frac{1}{4\pi\epsilon0}\frac{e^2}{r_n}$ $r_n = \frac{\epsilon0 n^2 h^2}{\pi m e^2}$ **OR** Energy of electron in n = 2 is -3.4eV ∴ energy in ground state = -13.6eV kE = -TE = +13.6eV $E_n = \frac{x}{n^2} \Rightarrow -3.4eV = \frac{x}{2^2} \Rightarrow$ energy in ground state x = - 13.6eV.	1 1 1

	PE = 2TE = -2×13.6eV = -27.2eV	1
27.	(see below)	Any 2x1 =1

P-type semiconductor	n-type semiconductor
1. Density of holes >> density of electron 2. Formed by doping trivalent impurity	1. density of electron>>density of holes 2. formed by doping pentavalent impurity
Energy band diagram for p-type 	Energy band diagram of n-type semiconductor 

OR

Energy of photon $E = \frac{hc}{\lambda} = \frac{6.62\times10^{-34}\times3\times10^{8}}{6000\times10^{-9}\times1.6\times10^{-19}}$eV =2.06eV   1

As $E<E_g$ (2.8eV), so photodiode cannot detect this photon.   1

Section – C

28.

Principle of potentiometer, when a constant current flows through a wire of uniform area of cross-section, the potential drop across any length of the wire is directly proportional to the length.

Let resistance of wire AB be R_1 and its length be 'l' then current drawn from driving cell –

$$I = \frac{V}{R+R1} \text{ and hence}$$ 1

P.D. across the wire AB will be

$$V_{AB} = IR_1 = \frac{V}{R+R1} \times \frac{\varrho l\theta}{a}$$

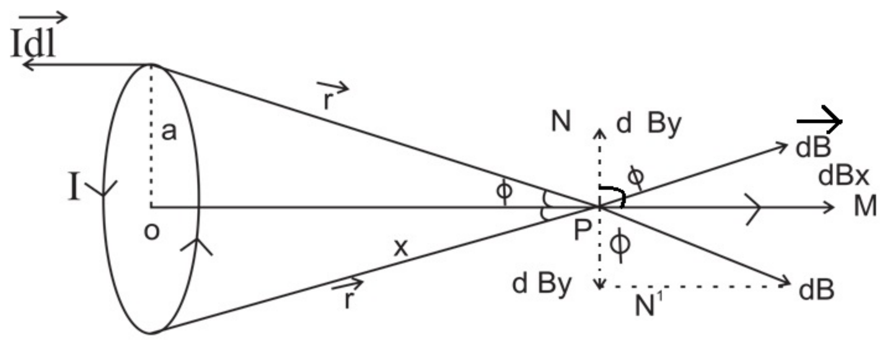
Where 'a' is area of cross-section of wire AB   1

$$\therefore \frac{VAB}{l} = \frac{V\varrho}{(R+R1).a} = \text{constant} = k$$

Where R increases, current and potential difference across wire AB will be   1

	decreased and hence potential gradient 'k' will also be decreased. Thus the null point or balance point will shift to right (towards, B) side.	

29.



1

According to Biot-Savart's law, magnetic field due to a current element is given by

$$\overrightarrow{dB} = \frac{\mu 0}{4\pi}\frac{\overrightarrow{Idl}\times\hat{r}}{r^2} \quad \text{where } r = \sqrt{x^2 + a^2}$$

$$\therefore dB = \frac{\mu 0}{4\pi}\frac{Idl\, sin90^0}{x^2 + a^2}$$ 1/2

And direction of $\overrightarrow{dB}$ is $\perp$ to the plane containing $I\overrightarrow{dl}$ and $\vec{r}$.

Resolving $\overrightarrow{dB}$ along the x – axis and y – axis.

$dB_x = dB \sin\theta$

$dB_y = dB \cos\theta$

taking the contribution of whole current loop we get

$$B_x = \oint dB_x = \oint dB\sin\theta = \int \frac{\mu 0}{4\pi}\frac{Idl}{x^2 + a^2}\frac{a}{\sqrt{x^2 + a^2}}.$$

$$B_x = \frac{\mu 0}{4\pi}\frac{Ia}{(x^2 + a^2)^{3/2}}\oint dl = \frac{\mu 0}{4\pi}\frac{Ia \times 2\pi a}{(x^2 + a^2)^{3/2}}$$ 1/2

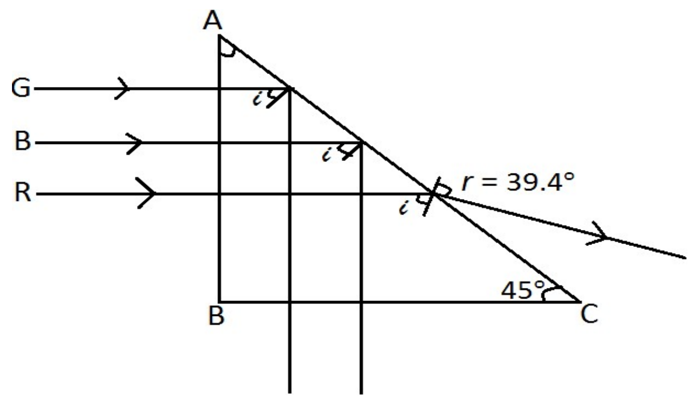
And $B_y = \oint dB_y = \oint dB\cos\theta = 0$

$$\therefore B_P = \sqrt{{B_x}^2 + {B_y}^2} = B_x = \frac{\mu 0}{4\pi}\frac{2IA}{(x^2 + a^2)^{3/2}}$$

$$\therefore \overrightarrow{B_P} = \frac{\mu 0}{4\pi}\frac{2\vec{m}}{(x^2 + a^2)^{3/2}} \left(\because \vec{m} = I\vec{A}\right)$$ 1

For centre x = 0

$$\therefore \left|\overrightarrow{B_o}\right| = \frac{\mu 0}{4\pi}\frac{2I\pi a^2}{a^3} = \mu_0\left(\frac{I}{2a}\right) \text{ in the direction of } \vec{m}$$

30.	∵ resonant frequency for LCR circuit is given by $v_0 = \frac{1}{2\pi\sqrt{LC}}$ $= \frac{1}{2\times3.14\sqrt{3\times27\times10^{-6}}}$ $= 17.69$Hz Or $\omega_0 = 2\pi v_0$= 111rad/s. ∵ quality factor of resonance $Q = \frac{\omega_0}{2\Delta w} = \frac{\omega_0 L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}}$ $\therefore Q = \frac{1}{7.4}\sqrt{\frac{3}{27\times10^{-6}}} = 45.0$ To improve sharpness of resonance circuit by a factor 2, without reducing ω_0 ; reduce R to half of its value i.e. R = 3.7Ω	1 1 1
31.	 Two conditions for T IR – (a) Light must travel from denser to rarer medium (b) $i > i_c$ ∵ $\sin i_c = \frac{1}{\mu}$ $\therefore (i_c)_{Red} = \sin^{-1}\left(\frac{1}{1.39}\right) = 46°$ $(i_c)_{Green} = \sin^{-1}\left(\frac{1}{1.42}\right) = 44.8°$ $(i_c)_{Blue} = \sin^{-1}\left(\frac{1}{1.48}\right) = 43°$ ∵ Angle of incidence at face AC is 45° which is more than the critical angle for Blue and Green colours therefore they will show TIR but Red colour will refract to other medium.	1 1 1
32.	Resolving power (R.P) of an astronomical telescope is its ability to form separate images of two neighboring astronomical objects like stars etc. R.P. = $\frac{1}{d\theta} = \frac{D}{1.22\lambda}$ where D is diameter of objective lens and λ is wave length	1

of light used. 1

$D = 100\text{inch} = 2.54 \times 100\text{cm} = 254\text{cm}$

$= 2.54\text{m}$

$\lambda = 6000\text{Å}$

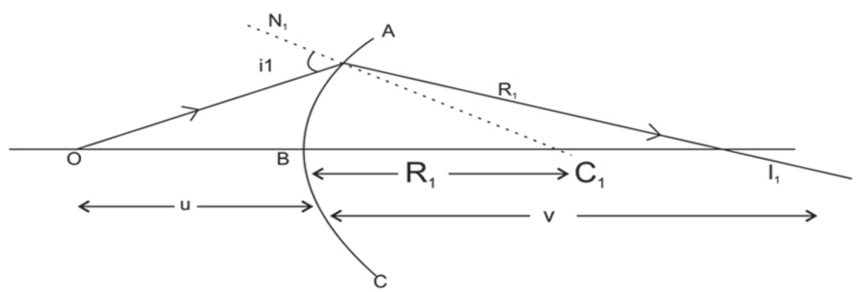
Limit of resolution $d\theta = \frac{1.22\lambda}{D}$ 1

$= \frac{1.22 \times 6000 \times 10^{-10} m}{254 \times 10^{-2} m}$

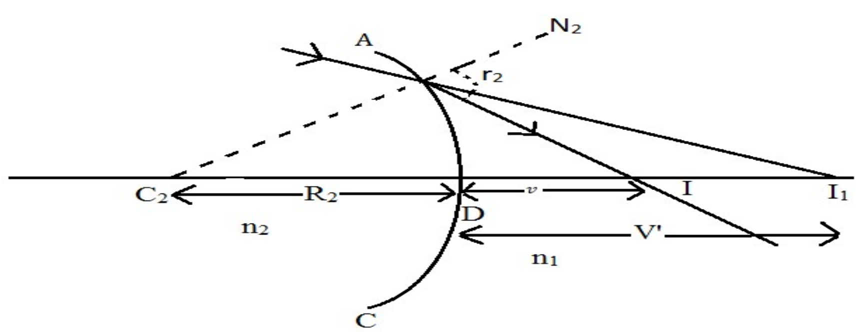
$= 2.9 \times 10^{-10}$

OR

Basic assumptions in derivation of Lens-maker's formula:
(i) Aperture of lens should be small
(ii) Lenses should be thin 1
(iii) Object should be point sized and placed on principal axis.



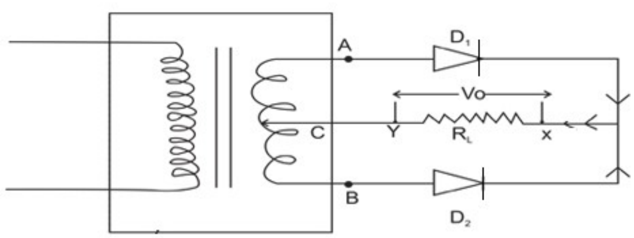
1

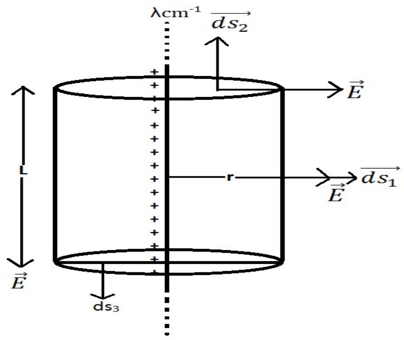
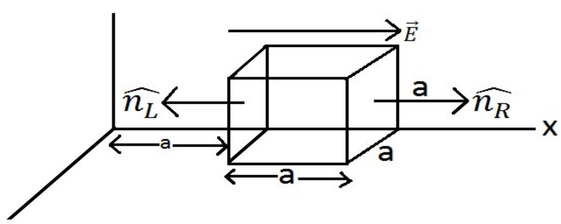


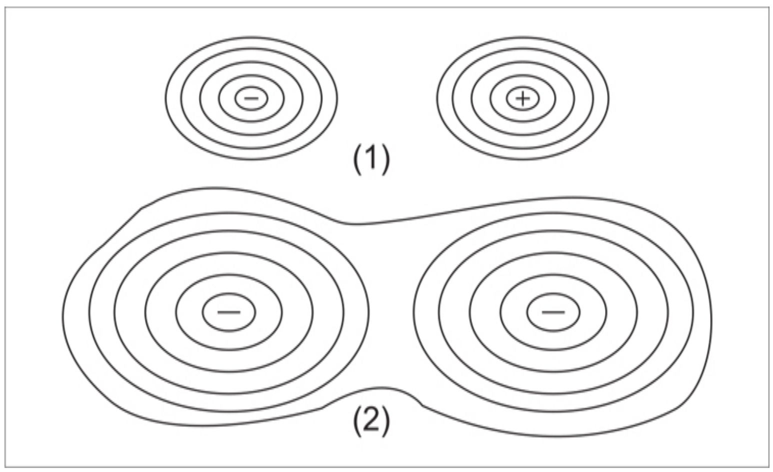
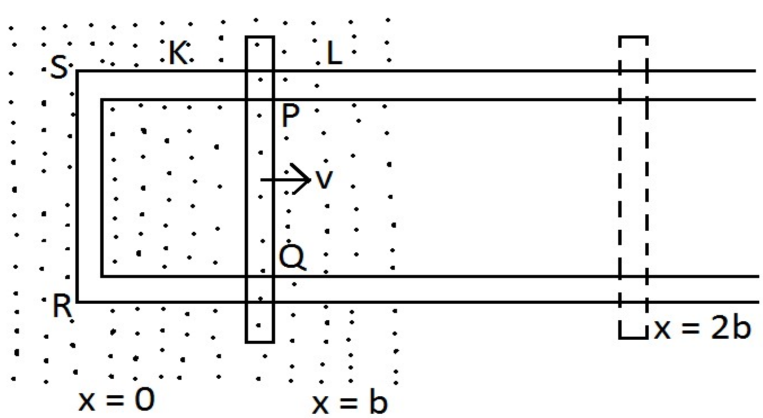
Suppose we have a thin lens of material of refractive index n_2, placed in a medium of refractive index n_1, let o be a point object placed on principle axis then for refraction at surface ABC we get image at I_1 ,

$\therefore \frac{n_2}{V^1} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1}$ ---------(1)

But the refracted ray before goes to meet at I_1 falls on surface ADC and refracts at I_2

	finally; hence I_1 works as a virtual object 2^{nd} refracting surface $\therefore \frac{n_1}{V} - \frac{n_2}{V^1} = \frac{n_1 - n_2}{R_2}$ --------- (2) Equation (1) + (2) $\frac{n_1}{V} - \frac{n_1}{u} = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ $\therefore \frac{1}{V} - \frac{1}{u} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$--------(3) If u = ∞, v = f $\frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$--------(4) Which is lens maker's formula.	1
33.	${}^{238}_{92}U \rightarrow {}^{237}_{91}Pa + {}^{1}_{1}H + Q$ $\because Q = [M_U - M_{Pa} - M_H]\, c^2$ $= [\,238.05079 - 237.05121 - 1.00783]\ u \times c^2$ $= -\,0.00825u \times 931.5\ \frac{MeV}{u}$ $= -\,7.68MeV$ $\because$ Q <0 ; therefore it can't proceed spontaneously. We will have to supply energy of 7.68MeV to ${}^{238}_{92}$Unucleus to make it emit proton.	1 1 1
34.	Circuit Diagram  One possible answer: Change the connection of R from point C to point B. Now No Current flowing through D_2 in the second half. 1 mark for any correct diagram 2 marks for correct explanation	1 2

	Section – D	
35. (a)	 According the Gauss's law – $\oint N, d\vec{s} = \frac{1}{\epsilon_0}\{q\}$ $\int \vec{E}\,\overrightarrow{ds_1} + \int \vec{E}\,\overrightarrow{ds_2} + \int \vec{E}\,\overrightarrow{ds_3} = \frac{1}{\epsilon_0}(\lambda L)$ $\int Eds_1 Cos0 + \int Eds_2 Cos90^o + \int Eds_3 Cos90^o = \frac{\lambda L}{\epsilon_0}$ $E\int ds_1 = \frac{\lambda L}{\epsilon_0}$ $E \times 2\pi rL = \frac{\lambda L}{\epsilon_0}$ $E = \frac{\lambda}{2\pi\epsilon_0 r}$ $\vec{E} = \frac{\lambda}{2\pi\epsilon_0 r}\hat{r}$	1 1 1
35. (b)	 $\because E_x = \propto x = 400x$ $E_y = E_z = 0$ Hence flux will exist only on left and right faces of cube as $E_x \neq 0$ $\because \overrightarrow{E_L} . a^2(n_2) + \overrightarrow{E_R} . a^2\widehat{n_R} = \frac{1}{\epsilon_0}\{qin\} = \phi$ $- E_L . a^2(\bar{n_2}) + a^2 E_R = \phi_{Net}$ $\phi_{Net} = -(400a)a^2 + a^2 (400 \times 2a)$ $= -400a^3 + 800a^3$ $= 400a^3$ $= 400 \times (.1)^3$ $\phi_{Net} = 0.4\ Nm^2c^{-1}$	1

	$\because \phi_{Net} = \frac{1}{\epsilon 0}\{qin\}$ $\therefore qin = \epsilon 0 \phi_{Net}$ $= 8.85 \times 10^{-12} \times 0.4$ $= 3.540 \times 10^{-12} c$	1
	OR	
(a)	Definition of electrostatic potential – SI unit J/c of Volt. Deduction of expression of electrostatic potential energy of given system of charges – $U = \frac{1}{4\pi\epsilon 0}\left[\frac{q1\,q2}{r12} + \frac{q1\,q3}{r13} + \frac{q2\,q3}{r23}\right]$	1 2
(b)		1 1
36.	For forward motion from x = 0 to x = 2b. The flux ϕ_B linked with circuit SPQR is 	

$\phi_B = Blx$ $\quad 0 \le x < b$ 1

Blb $\quad b \le x < 2b$

The induced emf is,

$e = \frac{-d\phi_B}{dt}$

$e = -Blv$ $\quad 0 \le x < b$ 1

$= 0$ $\quad b \le x < 2b$

When induced emf is non-zero, the current İ in the magnitude;

$I = \frac{e}{r} = \frac{Blv}{r}$

The force required to keep arm PQ in constant motion is F =IlB. Its direction is to the left. In magnitude

$F = IlB = \frac{B^2 l^2 v}{r}$; $\quad 0 \le x < b$ 1

$= 0$; $\quad b \le x < 2b$

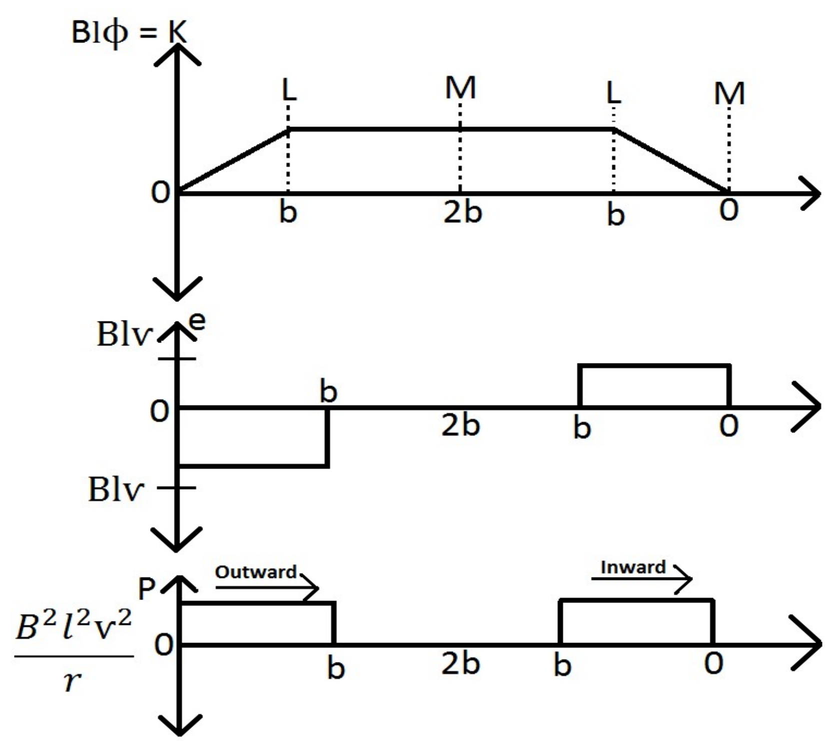
The Joule heating loss is

$P_J = I^2 r$

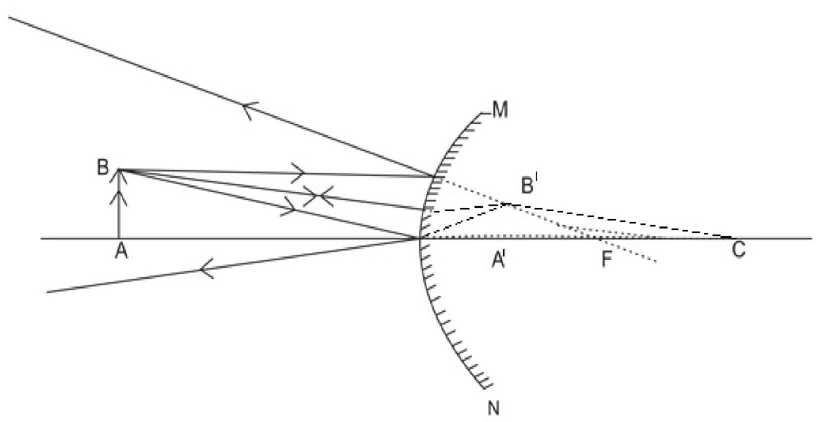
$= \frac{B^2 l^2 v^2}{r}$ $\quad 0 \le x < b$ 1

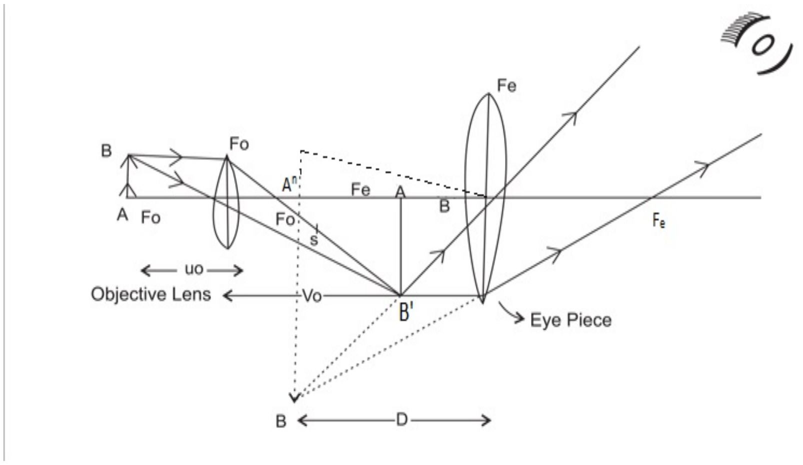
$= 0$ $\quad b \le x < 2b$

One obtains similar expressions for the inward motion from x = 2b to x = 0



1

	OR	
	Working principle of cyclotron Diagram Working of cyclotron with explanation Any two appliations	1 1 2 1
37.		1
	Deduction of mirror formula $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ For a convex mirror f is always +ve. $\therefore f > c$ Object is always placed in front of mirror hence u < 0 (for real object) $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\Rightarrow \quad \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$ As u < 0 u –ve hence $\frac{1}{v} > 0$ $\Rightarrow$ v> 0 i.e. +ve for all values of u. Image will be formed behind the mirror and it will be virtual for all values of u.	2 1 1
	OR	
37. (a)	Ray Diagram : (with proper labeling)	1



	Magnifying power m = $\frac{V_o}{u_o}\left(1 + \frac{D}{fe}\right)$ m = $\frac{L}{f_o}\left(1 + \frac{D}{fe}\right)$	1
37. (b)	$\because$ m = m_o m_e = -30 (virtual, inverted) $\because f_o$ = 1.25cm f_e = 5.0cm Let us setup a compound microscope such that the final image be formed at D, then $m_e = 1 + \frac{D}{fe} = 1 + \frac{25}{5} = 6$	1
	and position of object for this image formation can be calculated – $\frac{1}{Ve} - \frac{1}{ue} = \frac{1}{fe}$ $\frac{1}{-25} - \frac{1}{ue} = \frac{1}{5}$ $-\frac{1}{ue} = \frac{1}{5} + \frac{1}{25} = \frac{6}{25}$ ue = $\frac{-25}{6}$ = - 4.17cm.	1
	$\because$ m = $m_o \times m_e$ $\therefore m_o = \frac{+Vo}{uo} = \frac{-30}{6} = -5$ $\therefore$ V = -5u_o $\frac{1}{Vo} - \frac{1}{uo} = \frac{1}{fo}$ $\frac{1}{-5uo} - \frac{1}{uo} = \frac{1}{1.25}$	

	$\frac{-6}{5uo} = \frac{1}{1.25}$ $uo = -1.5cm \Longrightarrow v_0 = 7.5cm$ Tube length = $V_o + \lvert u_e \rvert$ = 7.5cm + 4.17cm L = 11.67cm Object should be placed at 1.5cm distance from the objective lens.	1