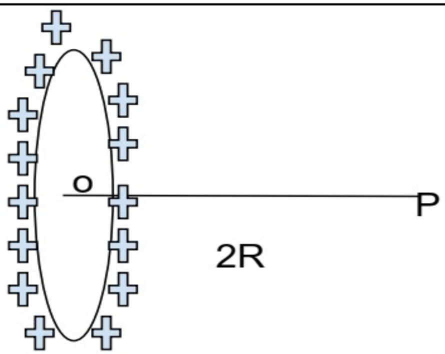
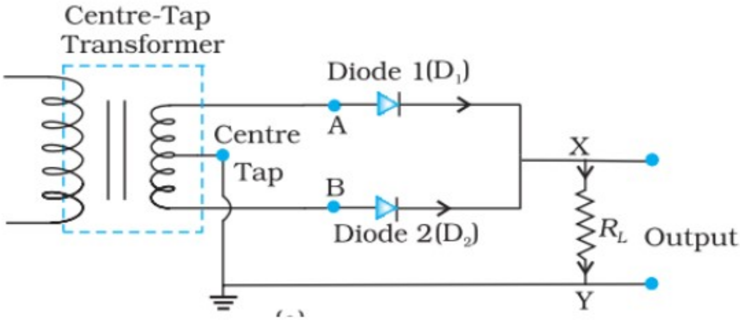
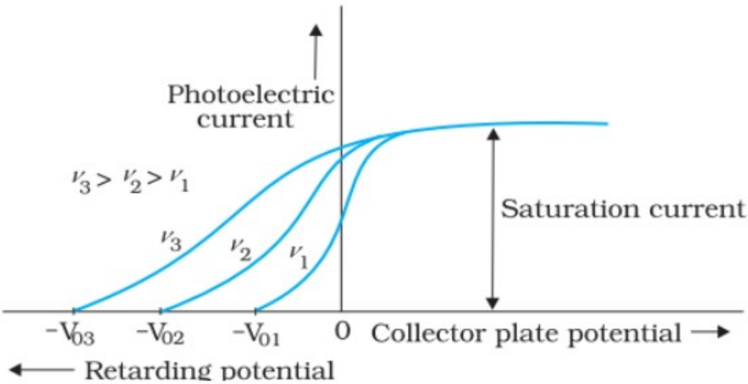
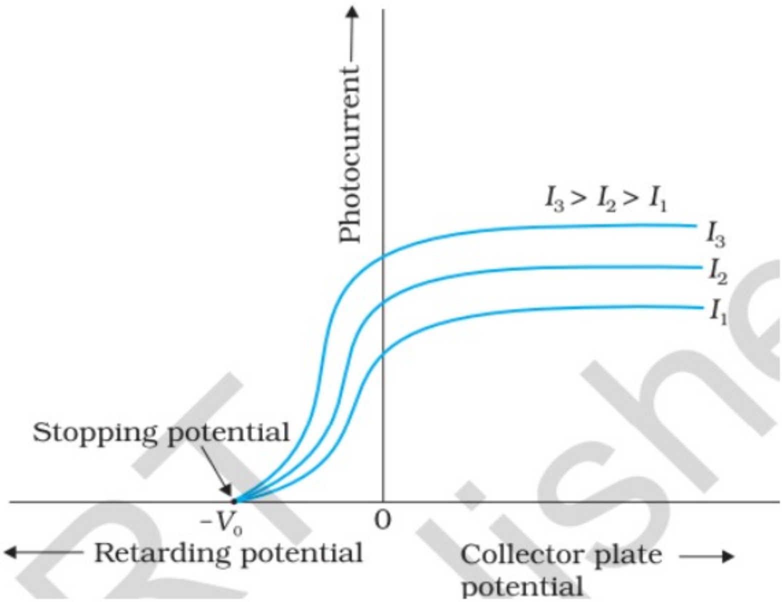
PHYSICS CBSE -04(SOLUTION)

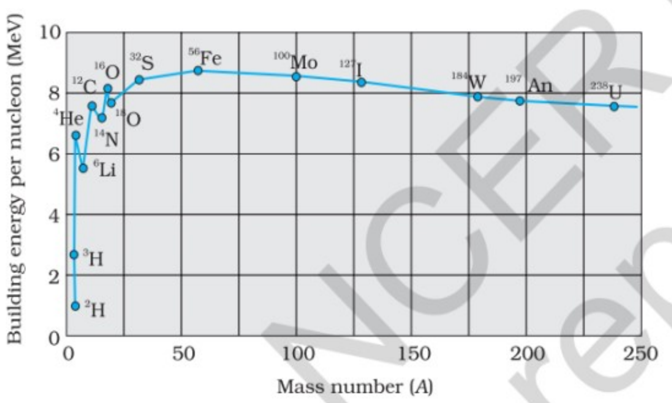
Full Marks : 70

Pass Marks : 21 **Time : Three hours**

Q.No.	Option/Ans/Key point		weightage	Marks
	SECTION: A			
1.	B	infinitely charged thin plane sheet	1	1
2.	C	r= mv/Bq	1	1
3.	D	upwards	1	1
4.	A	inductor	1	1
5.	D	$P/\sqrt{2}$	1	1
6.	D	$\hat{j} \, X \, \hat{k} = \hat{\imath}$	1	1
7.	C	-5cm $P_2=P-P_1=-10-10=-20$, $f_2=100/P_2$ cm = -5cm	1	1
8.	C	R/2	1	1
9.	D	$E=MC^2 \Rightarrow M = E/C^2$	1	1
10.	D	$v_3=v/3$, as $v \propto 1/n$ and for second excited state n=3	1	1
11.	C	nuclear forces are charge independent	1	1
12.	D		1	1
13.	A		1	1
14.	D		1	1
15.	A		1	1
16.	C		1	1

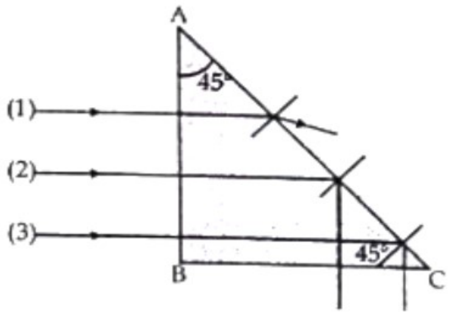
	SECTION: B		
17.	 Potential at P due to any small elemental length dl on the loop is dV=Kdq/r here $r = (R^2+4R^2)^{1/2}$ $V = \int dV = \int Kdq/r = \int K\lambda dl/r$ $= K\lambda 2\pi R/(R^2+4R^2)^{1/2} = \frac{\lambda}{2\sqrt{5}\,\epsilon_0}$	½ ½ ½ + ½	2
18.	$c=E_0/B_0 \Rightarrow B_0=E_0/c=120/3\times10^8 = 4\times10^{-7}$T $\omega = 2\pi\nu = 2 \times 3.14 \times 50 \times 10^6 = 3.14 \times 10^8$ rad s^{-1} $k = \omega/c = 3.14 \times 10^8 / 3 \times10^8 = 1.05$ rad m^{-1} $\lambda = c/\nu = 6.00$ m **OR** An oscillating charge produces an oscillating electric field in space, which produces an oscillating magnetic field, which in turn, is a source of oscillating electric field and so on. The oscillating electric and magnetic fields thus regenerate each other, as the wave propagates through space. The frequency of the electromagnetic wave equals the frequency of oscillation of the charge.	½ ½ ½ ½ 1 1	2

19.		1	2
	correct explanation of conversion of full cycle of AC into DC	1	
20.		1	2
		1	
21.	Here u = – 100 cm, v = ?, R = + 20 cm, n1 = 1, and n2 = 1.5.		

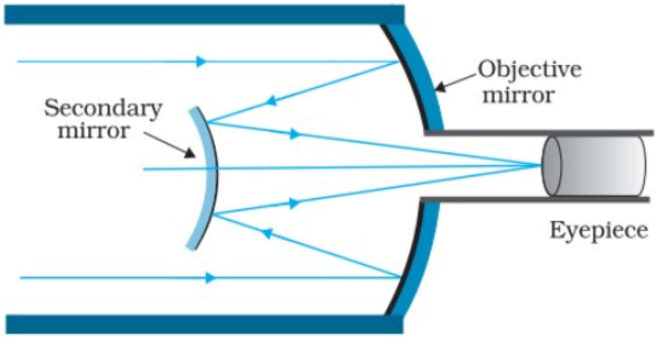
	$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ we then have $\frac{1.5}{v} - \frac{1}{-100} = \frac{(1.5-1)}{20}$ v= +100 cm The image is formed at a distance of 100 cm from the glass surface, in the direction of incident light.	½ ½ 1	2
	SECTION: C		
22.	Energy of Photon $E = \frac{hc}{\lambda}$ = $\frac{6.6X10^{-34}X3X10^{8}}{620X10^{-9}}$ $E = 3.2X10^{-19}J$ $= \frac{3.2X10^{-19}}{1.6X10^{-19}} = 2\ eV$ This corresponds to the transition D will result in emission of wavelength 620 nm. The Balmer series of Hydrogen spectrum can be observed in visible region.	½ ½ ½ ½ 1	3
23.		1	

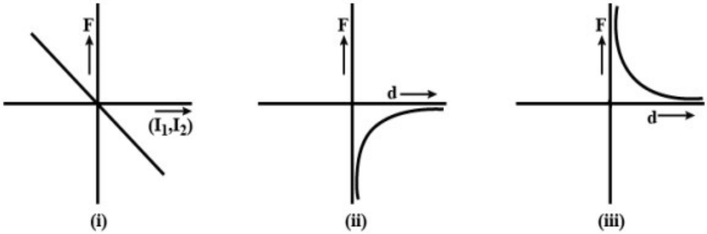
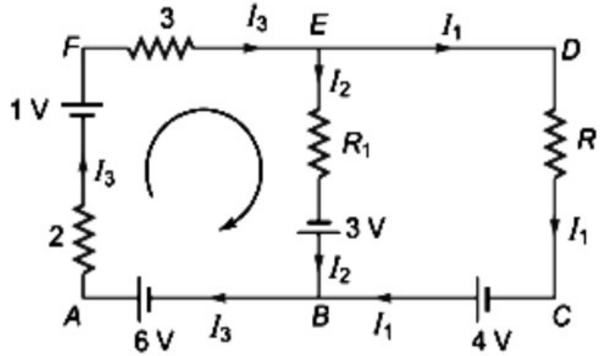
	Release of energy in nuclear fission: when a heavy nucleus (A>235 say) breaks into two lighter nuclei, the binding energy per nucleon increases i.e. nucleons get more tightly bound. This implies that energy would be released in nuclear fission. Release of energy in nuclear fusion: when two very light nuclei join to form a heavy nucleus, the binding energy per nucleon of fused heavier nuclei is more than the binding energy of lighter nuclei, so again energy would be released in nuclear fusion.	1 1	3
24.	As the rays incident normally on face AB they refract without any deviation, thereby they incident at an angle of 45^0 on the face AC if $i > i_c$ then the ray will undergo TIR $\sin i > \sin i_c$	½ ½	

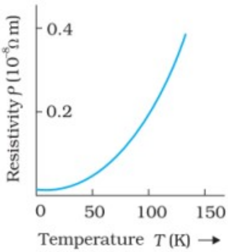
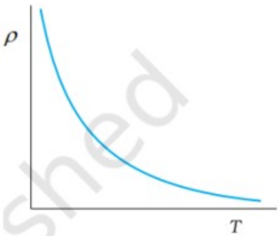
	$\frac{1}{\sin i} < \frac{1}{\sin i_c} = \mu$ as $i = 45^0$ $\frac{1}{\sin 45^0} = \sqrt{2} = 1.414$ as refractive index of 2 and 3 being more than 1.414 these two rays will undergo TIR, and 1 will refract through AC	½ ½	3

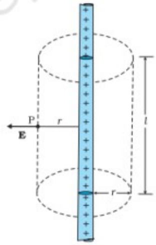
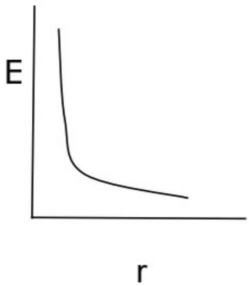


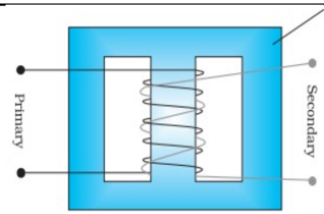
	1

25.		1 ½	
			3
	Any three advantages such as 1. No chromatic aberration 2. economical 3. high resolving power	3 x ½ = 1½	
26.	(a) work done is aligning a magnet from orientation θ_1 to θ_2 is given by		
	W = -mb $(\cos\theta_2 - \cos\theta_1)$	½	
	i. $\theta_1 = 0^0$, $\theta_2 = 90^0$		
	W = -mB(0-1) = mB = 1.5 X 0.22 = 0.33 J	½	
	ii. $\theta_1 = 0^0$, $\theta_2 = 180^0$	½	
	W = -mB(-1-1) = 2mB = 2X1.5 X 0.22 = 0.66 J		
	(b) Torque = mb sinθ	½	
	i. torque = mb Sin 90^0 = 1.5 X 0.22 X 1 = 0.33 J	½	
	ii. torque = mb Sin 180^0 = 0	½	
	OR		3
	We know that F is an attractive (-) force when the currents are like currents. i.e. the product of currents is positive.		

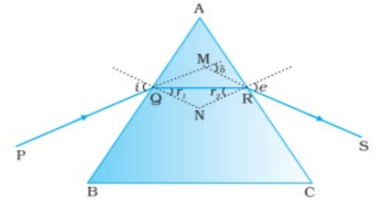
	similarly F is a repulsive(+) force when the currents are unlike. i.e. the product of currents is negative. 	3 X 1 = 3	
27.	 According to Kirchhoff's junction rule at E or B $I_3=I_1+I_2$ Since $I_2=0$, $I_3=I_1$ using loop rule in AFEBA $2I_3+3I_3+I_2R_1=10$ $\Rightarrow 5I_3=10 \Rightarrow I_3=I_1=2A$ The potential difference between A and D, along the branch AFED of the closed circuit, $V_A-2I_3+1-3I_3-V_D=0$ $V_A-V_D = 2I_3-1+3I_3=2X2-1+3X2=9V$	1 ½ ½ ½ ½	3

28.	i.  ii  we know that $\rho = \frac{m}{ne^2\tau}$	1 1	3
	i. In case of conductors with increase in temperature, relaxation time decreases, so resistivity increases. ii. In case of semiconductors with increase in temperature, the number density (n) of free electrons increases, hence resistivity decreases.	½ ½	
	SECTION: D		
29.	i. d, ii. c, iii. c or a iv. b	4x1	4
30.	i. b, ii. a, iii. a iv. a or b	4x1	4

SECTION: E			
31.		1	
	Flux through the Gaussian surface = flux through the curved cylindrical part of the surface = E × 2πrl	1	
	The surface includes a charge equal to = λ l.		
	Gauss's law then gives E × 2πrl = λl/ε 0		
	i.e., $E = \lambda/2\pi\varepsilon_0 r$ Vectorially,		
	E at any point is given by **E**= $\lambda/2\pi\varepsilon_0 r\ \hat{n}$		
		1 1	
	work done in moving the charge q through small distance dr is dW = **F.dr** = qEdr = $\frac{q\lambda dr}{2\pi\epsilon_o r}$ on integrating between r_1 to r_2 W=$\frac{\lambda q}{2\pi\epsilon_0} ln\frac{r_2}{r_1}$	1	
	OR		5
	Correct derivation of $C = \frac{\epsilon_0 A}{d-t+\frac{t}{k}}$	2 ½	
	expression in case of fully filled dielectric $C = \epsilon_0 A/d$	½	
	given C_x = c and C_y = 4c	½	
	as both are in series C_{eff} = c*4c/(c+4c) = 4C/5 = 4	½	

	=> c = 5μF and Cy = 20 μF	½ + ½	
32.	 a. b. Principle: mutual Induction, i.e. change in current passed through one coil will induce the emf in the inductively coupled second coil. derivation of $V_s/V_p = N_s/N_p$ c. Es/Ep = Ns/Np => Es= (40000/200) x 220 = 44,000V potential difference per turn is Es/Ns = 44000/40000= 1.1 V **OR** a. a- capacitive $X_c = \frac{1}{\omega C}$ b- Inductive $X_L = \omega L$ b. i. Phase difference between voltage and current in all the three components are not the same, we cannot add them algebraically. The phasors are to be treated as vectors. So, the vector sum of voltages which is equal to voltage of the source. $V_{eff} = \sqrt{V_R^2 + (V_L - V_C)^2}$ $= \sqrt{200^2 + (250 - 250)^2}$ = 200V ii. As we know $I_{rms} = \frac{V_{rms}}{Z}$ here, as $V_L = V_C$ circuit is in resonance in resonance Z=R $I_{rms} = \frac{V_{rms}}{Z} = \frac{V_{rms}}{R} = 200/40 = 5A$	1 1 1 1 1 1 1 1 1 1	5

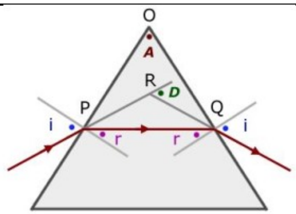
33.



1

derivation of $\delta = i + e - A$

2



½

½

in minimum deviation $r^1=r^2=r \Rightarrow r=A/2=30^0$ ½

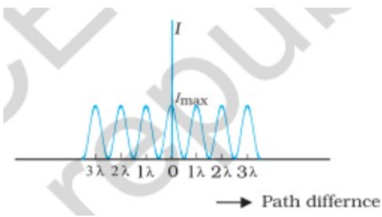
as $i = ¾ A = 45^0$ ½

$\mu = \frac{c}{v} \Rightarrow v = c/\mu = c \sin r / \sin i = 3 \times 10^8 / \sqrt{2}$

5

$v = 2.12 \times 10^8$ m/s 1

OR



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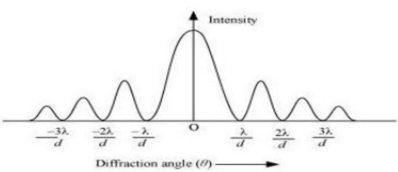

	b. any two differences such as (i) The interference pattern has a number of equally spaced bright and dark bands. The diffraction pattern has a central bright maximum which is twice as wide as the other maxima. The intensity falls as we go to successive maxima away from the centre, on either side. (ii) We calculate the interference pattern by superposing two waves originating from the two narrow slits. The diffraction pattern is a superposition of a continuous family of waves originating from each point on a single slit. (iii) For a single slit of width, a, the first null of the interference pattern occurs at an angle of λ/a. At the same angle of λ/a, we get a maximum (not a null) for two narrow slits separated by a distance a. c. given $\lambda = 5\,x\,10^{-7}m, D = 1m, y = 2.5x10^{-3}m$ we know that the half of the width of the central maximum, $y = \frac{\lambda D}{a} => a = \frac{\lambda D}{y}$ a= 2 X 10^{-4} m	2 x 1 = 2 ½ ½	