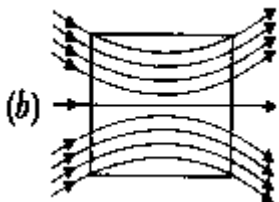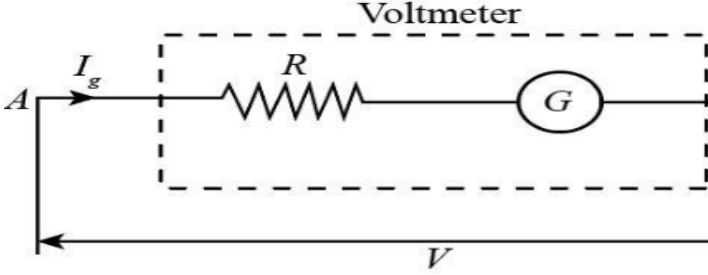# COMMON PRE-BOARD EXAMINATION 2022-23
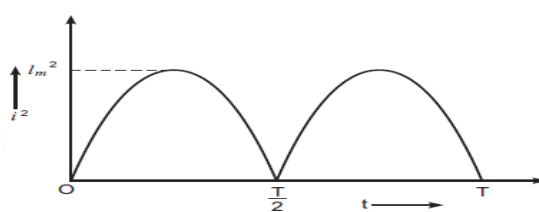
Subject: (Physics - 042)
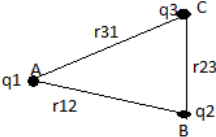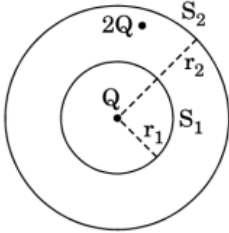
SL.NO	ANSWER KEY	MARKING SCHEME	TOTAL MARKS
	SECTION A		
1.	(c) neutral or positively charged	1	1
2.	(c) 20/7 λ	1	1
3.	(b) 1 µF	1	1
4.	(c) For a uniform electric field, they are concentric spheres.	1	1
5.	(a) (i) and (iv)	1	1
6.	(c)semiconductor	1	1
7.	(b)	1	1
8.	(b) $NA^{-1}m^{-1}$	1	1
9.	(b) less than acceleration due to gravity	1	1
10)	(a) Inertia	1	1
11)	(d) power delivered to the capacitor is zero.	1	1
12)	(d) zero	1	1
13)	(c) ultraviolet rays	1	1
14)	(b) h/e	1	1
15)	(a)the size decreases	1	1
	ASSERTION REASONING		
16)	d) A is false and R is also false	1	1
17)	a) Both A and R are true and R is the correct explanation of A	1	1

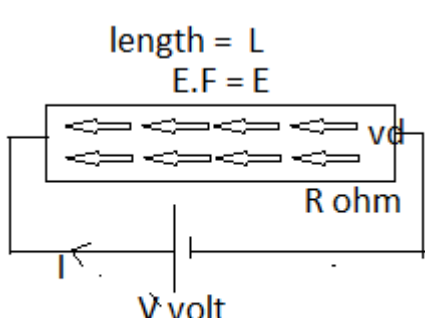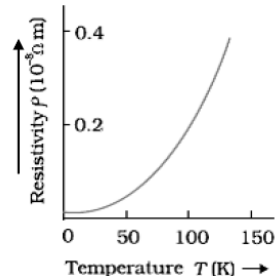| 18)	d) A is false and R is also false	1	1
	SECTION B **(TWO MARKS QUESTIONS)**		
19)	(I) Let an electric dipole is placed in a uniform electric field $\vec{E}$, m θ with the field , force on charge $+q$ $\vec{F}_{+q} = +q\vec{E}$ (along $\vec{E}$) force on charge $-q$ $\vec{F}_{-q} = -q\vec{E}$ (opposite to $\vec{E}$) as two equal and opposite forces are acting on the dipole therefor $\vec{F} = 0$ (ii) We know that work done in rotating a electric dipole from θ_1 θ_1 is the angle of dipole with electric field) is given by , $\quad W = pE(\cos\theta_1 - \cos\theta_2)$ now given $\theta_1 = 0, \theta_2 = 180$ therefore $W = pE(\cos 0 - \cos 180) = 2pE$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
20)	Permanent Magnets: 1) High Retentivity: Magnet should be strong 2) High coercivity: Magnetisation should not get affected by stray Magnetic fields. Electromagnets: 1) High Permeability :core of Iron is used for easy magnetisation. 2) Low Retentivity: For easy magnetisation/demagnetisation.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
	OR Current in the wire, I = 35 A Distance of a point from the wire, r = 20 cm = 0.2 m	$\frac{1}{2}$	

	Magnitude of the magnetic field at this point is given as: $$B = \frac{\mu_0}{4\pi}\frac{2I}{r}$$ Where, μ_0 = Permeability of free space = $4\pi \times 10^{-7}$ T m A^{-1} $$B = \frac{4\pi \times 10^{-7} \times 2 \times 35}{4\pi \times 0.2}$$ $$= 3.5 \times 10^{-5} \text{ T}$$ Hence, the magnitude of the magnetic field at a point 20 cm from the wire is 3.5 × 10−5 T.	$\frac{1}{2} + \frac{1}{2}$ $\frac{1}{2}$	
21)	Lenz's law states that the polarity of **induced emf is such that it produces a current which oppose the change in magnetic flux that produces it.** Emf will be induced in the rod as there is change in magnetic flux. When a metallic rod held horizontally along east-west direction is allowed to fall freely under gravity i.e., **fall from north to south the magnetic flux changes and the emf is induced in it.**	1 1	2
22)	f_1 = 7.5 x 10^6 Hz f_2 = 12 x 10^6 Hz λ_1 = c/f_1 = 40 m λ_2 = c/f_2 = 25 m So the range is 40 m to 25 m	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2

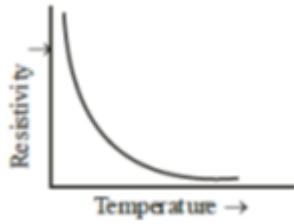| 23)	When a pentavalent impurity atom is added an n- type semiconductor is obtained.	1	2
		1	
	OR	1	
	Doping- The deliberate addition of a desirable impurity in pure semiconductor to enhance the conductivity is called doping. Types of atoms- (i) Pentavalent- Arsenic, Antimony (ii) Trivalent - Boron, Indium	$\frac{1}{2}$ $\frac{1}{2}$	

24)	d= 0.28mm = 0.28 x 10^{-3} m , D = 1.4m , n = 4
	Position of the nth bright fringe from the central fringe =
	           $y_n = nD\lambda/d$
	Y$_4$ = 1.2cm =1.2 x 10^{-2}m
	     Wavelength λ = y$_4$ x d/4D = 1.2 x 10^{-2} x 0.28 x 10^{-3}/4 x 1.4
	         = 6 x 10^{-7}m
	         = 600nm
		$\frac{1}{2}$
		$\frac{1}{2}$
		$\frac{1}{2}$
		$\frac{1}{2}$
			2

25)	(i) Electric flux through a Gaussian surface $\varphi= \dfrac{Total\ charge\ enclosed}{\epsilon 0}$ Net charge enclosed inside the shell, q = 0 $\therefore$ Electric flux through the shell = 0	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2

	(ii) Since the electric field or net charge inside the spherical conducting shell is zero, the net force on charge Q/2 is zero Force on charge A = $$F_A = \frac{1}{4\pi\epsilon_0} \frac{2Q\left(Q+\frac{Q}{2}\right)}{x^2} = \frac{1}{4\pi\epsilon_0} \frac{3Q^2}{x^2}.$$		
	SECTION C (3 MARKS QUESTIONS)		
26)	(i) A galvanometer can be converted into a voltmeter by connecting a large resistance R in series with the galvanometer. The value of R is related to the maximum voltage V to be measured as $R = \frac{V}{I_g} - G$ Voltmeter (b) V=I$_g$(G+R) V=I$_g$(G+R) V=I$_g$(G+980) ….(1) V/2=I$_g$(G+470) ….(2) Solving equation (1) and (2) G=40Ω.	1 DIAGRAM $-\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3
27)	(i)According to Lenz's law, the direction of the induced current is such that to oppose the relative motion between coil and magnet.The coils try to oppose the change in magnetic field caused by moving the magnet suddenly. As N-pole of magnet is moving away the coil will try to attract it by inducing current	1 $\frac{1}{2}$	3

	in such direction that it behaves as a **south pole** i.e. **clockwise direction.** Similarly as S-pole is moving towards the coil it will try to repel it by inducing current in such a direction that it behaves as a **south pole i.e, clockwise.** (ii)The emf is given by $e=\frac{Bl^2\omega}{2}$ = 0.5 x 12 x 400/2 = 100V	$\frac{1}{2}$ $\frac{1}{2}+\frac{1}{2}$	
28)	From graph of i^2-t Average power consumed in resistor R $P_{av} = \frac{1}{\int_0^T dt} \cdot \int_0^T i^2 R\, dt$ $= \frac{i_m^2\, R}{T}\, \int_0^T \sin^2 \omega t\, dt \quad ...(1)$ $= \frac{i_m^2\, R}{2\, T}\, \int_0^T (1-\cos 2\,\omega t)\, dt$ $= \frac{i_m^2\, R}{2T}\, \left[\int_0^T dt - \int_0^T \cos 2\,\omega t\, dt\right] \quad ($ $= \frac{i_m^2\, R}{2\, T}\, [T-0]$ $= \frac{i_m^2\, R}{2}$ (ii)	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3

	$I^2_{rms} = \dfrac{I_1^2}{3} + \dfrac{I_2^2}{3} + \dfrac{I_3^2}{3}$ $= \dfrac{4\,A^2}{3} + \dfrac{4\,A^2}{3} + \dfrac{4\,A^2}{3} = 4A^2$ $I_{rms}= 2A$ OR (i) Impedance of series LCR circuit is given by $Z=\sqrt{R^2+(X_L-X_C)^2}$ or for Z to be minimum, $X_L=X_C$ For wattless current to flow circuits should not have any ohmic resistance i.e., $R = 0$ Power $=V_{rms}I_{rms}\cos\varphi=V_{rms}I_{rms}\cos\varphi$ for $\varphi=90°=\pi/2$ Power $= 0$ $\therefore$ Wattless current flows when the impedance of the circuit is purely inductive / capacitive of the combination of the two. (ii) Brightness of the lamp decreases. This is because on reducing C, X_C increases, Z increases and I decreases.	$\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2} + \dfrac{1}{2}$	
29)	Work function $\varphi_0 = h v_0$ J $\qquad \varphi_0 = h v_0/e$ $\qquad = 6.63 \times 10^{-34} \times 8 \times 10^{14}/1.6 \times 10^{-19}$eV $\qquad = 3.315$eV Use Einstein equation:- Incident energy, $E=\varphi+eV_s$ $\Rightarrow E=(3.31+3.3)$eV $E=6.61ev=(6.61\times10^{-19}\times1.6)$J	$\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$	3

	$E=hv=6.61\times1.6\times10^{-19}$ $\Rightarrow v=\dfrac{6.61\times1.6\times10^{-19}}{6.62\times10^{-34}}=1.6\times10^{15}Hz$ Thus, frequency of light $=v=1.6\times10^{15}Hz$. OR (i) Kinetic energy of photo electrons remains unaffected/It does not depend on the intensity of incident radiation. (ii) (a) $E=hv$ $=6.63\times10^{-34}\times6.0\times10^{14}$ $=3.98\times10^{-19}J=\dfrac{3.98\ x\ 10^{-19}}{1.6\ x\ 10^{-19}} = 2.49eV$ (b) No. of photons emitted per second, $n=\dfrac{P}{E} =\dfrac{2.0\ x\ 10^{-3}}{3.98\ x\ 10^{-19}}$ $=5.0\times10^{15}$ photons per second	$\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2} + \dfrac{1}{2}$ $\dfrac{1}{2}$ $\dfrac{1}{2}$	

30)	$E_f - E_i = 12.5$ eV
	$E_i = -13.6$ eV
	$E_f = -1.1$ eV $= \frac{-13.6}{n^2}$ eV
	   $n^2 = 13.36$
	     $n = 3.35$
	So hydrogen will be excited to the third energy level
	
	For wavelength of the first member of the Lyman series
	If the electron jumps
	from n=2 to n=1, then the wavelength of the radiation is given as:
	
	$\frac{1}{\lambda} = R(\frac{1}{1^2} - \frac{1}{2^2}) = \frac{3R}{4}$
	
	   $\frac{3 \times 1.097 \times 10^7}{4}$
	
	   $\lambda = 121.54 \times 10^{-9}$ m
	
	For wavelength of the first member of the Balmer series
	If the electron jumps
	from n=3 to n=2, then the wavelength of the radiation is given as:
	
	$\frac{1}{\lambda} = R(\frac{1}{2^2} - \frac{1}{3^2}) = \frac{5R}{36}$
	
	   $\frac{1}{\lambda} = \frac{5 \times 1.097 \times 10^7}{36}$
	
	   $\lambda = 656.3 \times 10^{-9}$ m
		$\frac{1}{2}$
		
		$\frac{1}{2}$
		
		$\frac{1}{2}$
		
		$\frac{1}{2}$
		
		$\frac{1}{2}$
		
		$\frac{1}{2}$
			3

	SECTION D-LONG ANSWER QUESTIONS-5 MARKS		
31)	[i] Region II $\frac{\sigma 1 - \sigma 2}{2\varepsilon o}$ towards right Region III $\frac{\sigma 1 + \sigma 2}{2\varepsilon o}$ towards right [i] $C = \frac{\varepsilon_0 A}{d}$	 $\frac{1}{2} + \frac{1}{2}$ $\frac{1}{2} + \frac{1}{2}$	5

$$= \frac{8.85 \times 10^{-12} \times 5 \times 10^{-3}}{2.5 \times 10^{-3}} F$$
$$= 17.7 \times 10^{-12} F$$

$\frac{1}{2} + \frac{1}{2}$

[ii] $Q = CV$

$$= 17.7 \times 10^{-12} \times 100 C = 17.7 \times 10^{-10} C$$

$\frac{1}{2} + \frac{1}{2}$

[iii]
$Q^1 = k\, C \times v = 8 \times 17.7 \times 10^{-12} \times 100 = 1.16 \times 10^{-8}$ C

$\frac{1}{2} + \frac{1}{2}$

OR

[i]

$U_A = 0$

$U_B = \dfrac{Kq_1q_2}{r_{12}}$

$U_C = \dfrac{kq_1q_3}{r_{31}} + \dfrac{kq_2q_3}{r_{23}}$

$U = \dfrac{Kq_1q_2}{r_{12}} + \dfrac{kq_2q_3}{r_{23}} + \dfrac{kq_3q_1}{r_{31}}$

Fig- $\frac{1}{2}$

$\frac{1}{2}$
$\frac{1}{2}$
$\frac{1}{2} + \frac{1}{2}$
$\frac{1}{2}$

[ii]

Flux through S_1 , $\Phi_1 = \dfrac{Q}{\epsilon_0}$ [1/2]

Flux through S_2 , $\Phi_2 = \dfrac{Q+2Q}{\epsilon_0} = \dfrac{3Q}{\epsilon_0}$ [1/2]

Ratio of flux = 1:3   1/2]

No change in flux through S_1 with dielectric medium inside the s

$\frac{1}{2}$
$\frac{1}{2}$
$\frac{1}{2}$
$\frac{1}{2}$

32)	[i] In the presence of battery I = n A e V_d & $V_d = \frac{e\tau}{m}E$ ---[b] & E = $\frac{V}{L}$ I = n A e² $\frac{\tau}{m}$ x $\frac{V}{L}$ $\frac{V}{I} = \frac{mL}{nA\tau e^2}$ But $R = \frac{mL}{nA\tau e^2}$ or $\frac{V}{I}$ = R , ohms law [ii] [iii] $V_d = \frac{e\tau}{m}\frac{V}{L}$, drift speed becomes 1/3 rd OR [i]	1 fig- [$\frac{1}{2}$] [$\frac{1}{2}$] [$\frac{1}{2}$] [$\frac{1}{2}$] [$\frac{1}{2}$] [$\frac{1}{2}$] [1] [$\frac{1}{2}$ +$\frac{1}{2}$] 1	5

Resistivity vs Temperature graph

$[\frac{1}{2}]$
$[\frac{1}{2}]$

[ii] [a] increases

  [b] decreases

[iii]

$\frac{1}{2}$

$\frac{1}{2}$

Applying loop rule to both the lower and upper loops, we get 4

$$40I_3 + 20I_2 = 80 + 40$$

$\frac{1}{2}$

Adding the two equations, we get

$$80I_3 + 20(I_1 + I_2) = 160$$

Or $80I_3 + 20\,I_3 = 160$

$\frac{1}{2}$

Or $I_3 = \dfrac{160}{100} = 1.6A$

Again, $40 \times 1.6 + 20I_1 = 40$

Or $20I_1 = 40 - 64 = -24$

$\frac{1}{2}$

Or $I_1 = -\dfrac{24}{20} = -1.2A$

33)

incident wavefront
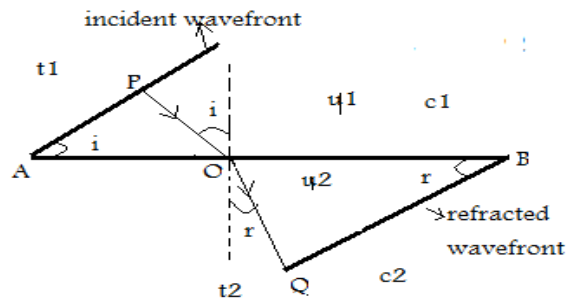
figure $\frac{1}{2}$

[i] Total time taken

$$t = \frac{AO\ sini}{C1} + \frac{[AB-AO]\ sinr}{C2}$$

$[\frac{1}{2}]$

$$t = \frac{AO\{ sini}{C1} - \frac{sinr\}}{C2} + \frac{AB\ sinr}{C2}$$

$[\frac{1}{2}]$

$$\frac{sini}{sinr} = \frac{C1}{C2} = \mu = \text{Snell's law}$$

$[\frac{1}{2}]$

[ii] No – energy depends on the amplitude of the wave

$\frac{1}{2} + \frac{1}{2}$

[iii]

[a] $sin\theta = \frac{n\lambda}{d}$ and n=1

d = 1.4 x 10⁻⁶ m

$[\frac{1}{2}]$
$[\frac{1}{2}]$

[b] $sin\theta = \frac{[2n+1]\lambda}{d\ \ \ 2}$ and n=1

$[\frac{1}{2}]$

d = 2.1 x10⁻⁶ m

$[\frac{1}{2}]$

OR

[i] Labelled ray diagram
[ii]Any 2 advantages
[iii] For convex lens
1/f = 1/v − 1/u   or
1/+10 = 1/v − 1/-30
V = +15 cm

For concave lens
1/f = 1/v − 1/u   or
 1/-10 = 1/v − 1/+10
V = infinity

[2]
[1]

$\frac{1}{2}$
$\frac{1}{2}$

$\frac{1}{2}$
$\frac{1}{2}$

5

	SECTION-E- CASE STUDY BASED QUESTIONS		
34)	(i) more in cladding.	1	4
	(ii) There is no loss of intensity of light in reflecting prism/total internal reflection takes place in prism.	1	
	No change, does not depends Or (iii) Maximum for Violet. $f_R > f_V$ and focal length is inversely proportional to Magnifying power.	[1+1] 1 $\frac{1}{2} + \frac{1}{2}$	
35)	(i) 1.1eV	1	4
	(ii) increases	1	
	(iii) Diffusion / drift /barrier potential - any 2 OR Knee voltage: It is the positive potential at which current through the diode increases rapidly It is the maximum negative potential difference up to which a diode can tolerate without the breakdown .	1+ 1 [1] [1]	