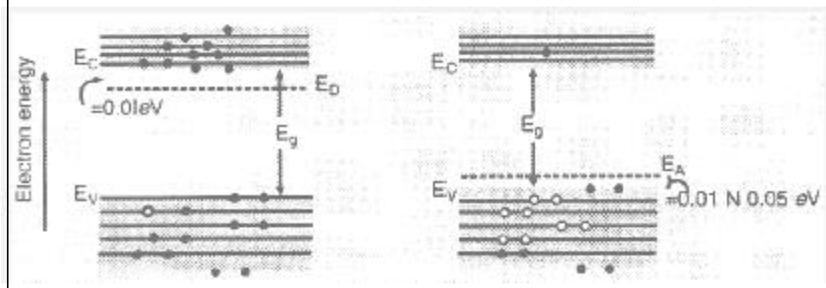
CLASS: XII

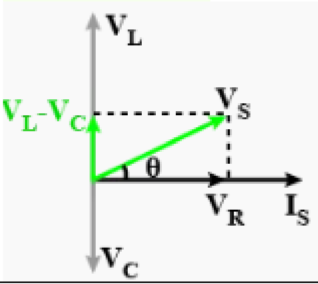
COMMON PRE-BOARD EXAMINATION
SESSION 2022-23
PHYSICS (042)

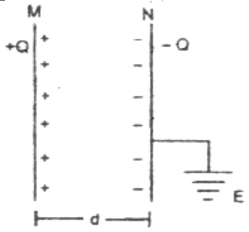
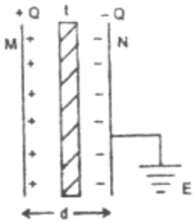
Maximum Marks: 70

(MARKING SCHEME)

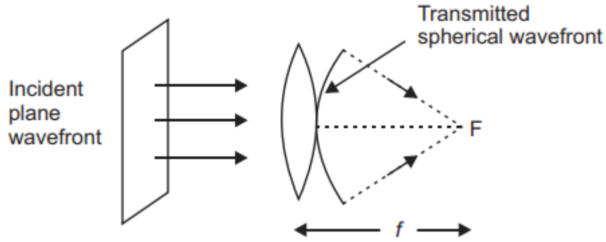
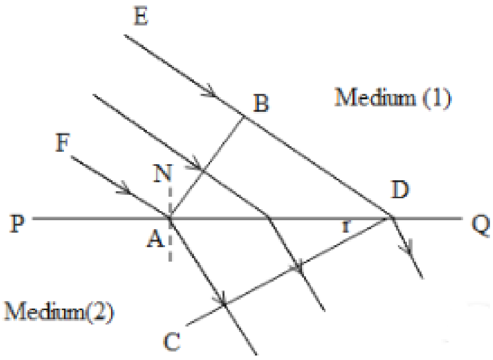
Q.N	VALUE POINTS	MARKS	TOTAL
1.	(d)	1	
2.	(c)	1	
3.	(c)	1	
4.	(b)	1	
5.	(b)	1	
6.	(b)	1	
7.	(a)	1	
8.	(b)	1	
9.	(d)	1	
10.	(a)	1	
11.	(b)	1	
12.	(d)	1	
13.	(c)	1	
14.	(d)	1	
15.	(a)	1	
16.	(d)	1	
17.	(c)	1	
18.	(b)	1	
19.	An oscillating charge produces an oscillating electric field in space which further produces an oscillating magnetic field which in turn is a source of electric field. These oscillating electric and magnetic field, hence, keep on regenerating each other and an electromagnetic wave is produced	1 1	2
20.	(a) Magnetic Susceptibility: It is defined as the ratio of the magnetisation M to the magnetising field intensity H. Magnetic susceptibility in terms of magnetic permeability $X_m = \mu_r - 1$ (b) A is a diamagnetic material , B is a ferromagnetic material.	½ ½ ½ ½	2
21.	I. Lyman II. Balmer III. Paschen b. Paschen OR $\Delta m = 4m(^1_1\text{H}) - m(^4_2\text{He})$ Energy released $(Q) = [4.\, m(^1_1\text{H}) - m(^4_2\text{He})] \times 931$ MeV $= [4 \times 1.007825 - 4.002603] \times 931 \text{ MeV} = 26.72 \text{ MeV}$	½ ½ ½ ½ ½ ½ ½ ½	2
22.	$\mu = \dfrac{\sin\left[\dfrac{(A+D_m)}{2}\right]}{\sin\left(\dfrac{A}{2}\right)}$	½ ½	

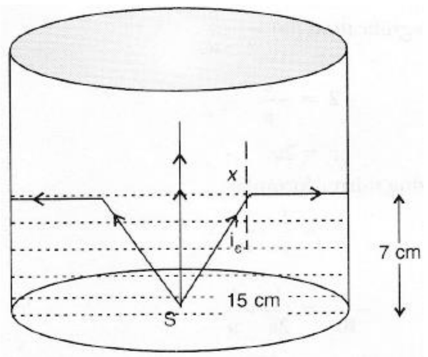
	Given $D_m = A$ $\therefore\ \mu = \dfrac{\sin A}{\sin\frac{A}{2}} = \dfrac{2\sin\frac{A}{2}\cos\frac{A}{2}}{\sin\frac{A}{2}} = 2\cos\frac{A}{2}$ $\therefore\ \cos\frac{A}{2} = \frac{\sqrt{3}}{2}$ or $\frac{A}{2} = 30^o\ \therefore\ A = 60^o$	½ ½	2
23.	When a forward bias is applied to a p-n junction, it lowers the value of the potential barrier. The potential barrier opposes the applied voltage in the event of a forward bias. So the width of depleted region decreases. Diode starts to conduct. OR  	1 1 1 1	2
24.	Here, $a = A$ and $b = 2A, \phi = \pi/3,$ $R = ?$ $R = \sqrt{a^2 + b^2 + 2ab\cos\phi}$ $= \sqrt{A^2 + 4A^2 + 2A.2A\cos\pi/3}$ $= \sqrt{5A^2 + 4A^2 \times \frac{1}{2}} = A\sqrt{7}$	1 1	2
25.	$\lvert q_1\rvert = \lvert q_2\rvert = 1.6 \times 10^{-19}C$ and distance between two charges is $2a = 4.3nm$ Dipole moment $p = 1.6 \times 10^{-19} \times 4.3 \times 10^{-9}Cm = 6.88 \times 10^{-28}Cm$	1 1	2
26.	According to the Lorentz force law, when a particle carrying a charge of one coulomb, and moving perpendicularly through a magnetic field of one tesla, at a speed of one meter per second, experiences a force with magnitude one newton. F=qvBsinθ.....(1) The equation (1) can also be written as: B=Fqvsinθ.....(2) Where, B=Magnetic field, F=Force, q=Charge , v=Velocity If F=1N, q=1C, v=1ms^{-1}, θ=90^o Then, the SI unit of B $B = \dfrac{1N}{1C.1\,ms^{-1}.\sin 90^o}$ $B = 1NA^{-1}m^{-1} = 1\,tesla$ Therefore, when a charge of 1C1C, moving with velocity 1ms−11ms−1, normal to the magnetic field, experiences a force of 1N1N, then the magnetic field is said to be one tesla.	1 ½ ½ ½ ½	3

27.	(i) Induced emf (voltage) in a coil ε = - L dI/dt $$\frac{\varepsilon_1}{\varepsilon_2} = \frac{L_1\frac{dI}{dt}}{L_2\frac{dI}{dt}} = \frac{L_1}{L_2} = \frac{4}{3}$$	1	
	(ii) Power supplied P = εI As power is same for both coils $$\varepsilon_1 I_1 = \varepsilon_2 I_2$$ $$\Rightarrow \frac{I_1}{I_2} = \frac{\varepsilon_2}{\varepsilon_1} = \frac{3}{4}$$	1	3
	(iii) Energy stored in a coil $U = \frac{1}{2}LI^2$ $$\therefore \frac{U_1}{U_2} = \frac{\frac{1}{2}L_1I_1^2}{\frac{1}{2}L_2I_2^2} = \frac{L_1I_1^2}{L_2I_2^2} = \frac{3}{4}$$	1	
28.	For inductor, $V_L = IX_L = I\omega L$ For capacitance, $V_C = IX_C = \frac{I}{\omega C}$ For resistance, $V_R = IR$	1	
	From the phasor diagram, $V_s^2 = V_R^2 + (V_L - V_C)^2$ $(IZ)^2 = (IR)^2 + (I\omega L - \frac{I}{\omega C})^2$ $Z = \sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}$ Current is given as: $I = \frac{V_s}{Z}$	1	3
		1	
29.	(i) Since , $\lambda \propto \frac{1}{\nu}$ As the threshold frequency of metal Y is greater than of metal X. Thus metal X has greater threshold wavelength.	1	
	(ii) The kinetic energy of the emitted electrons depends on the work function of metal Y is greater than that X The kinetic energy of electrons emitted from metal X will have greater kinetic energy .	1	3
	(iii) If the distance between light source and metal is changed , the intensity of the light falling on the surface will decrease. But the kinetic energy of the emitted electron is independent of the intensity of the light falling and hence there will be no change in the kinetic energy of the emitted electrons.	1	

30.	In the given transition, energy emitted, $E = E_2 - E_1 = -0.85 - (-3.4) = 2.55eV.$ $\frac{hc}{\lambda} = 2.55 \times 1.6 \times 10^{-19} J,$ $\lambda = \frac{hc}{2.55 \times 1.6 \times 10^{-19}} m = \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{2.55 \times 1.6 \times 10^{-19}}$ $= 4.853 \times 10^{-7} m = 4853Å$ This wavelength belongs to Balmer series of hydrogen atom.	1 1 1	3
31.	 If σ is surface charge density of the plate, then electric field between the plates is given by E = σ/∈0 ....(i) when ∈0 is absolute permittivity of the free space. The electric field between the two plates is also given by $E = \frac{v}{d} \Rightarrow V = Ed = \frac{\sigma}{\epsilon_0} d$ Since, $\sigma = \frac{q}{A}$ then $v = \frac{qd}{\epsilon_0 A}$ $c = \frac{q}{v} = \frac{q}{\frac{qd}{\epsilon_0 A}}$ $= \frac{q \cdot \epsilon_0 A}{qd} = \frac{\epsilon_0 A}{d}$ Suppose a conducting slab (dielectric) slab thickness t (t < d) is introduced between the two plates of the capacitor. Then the reduced electric field inside the slab will be $E = E_0 - \frac{p}{\epsilon_0}$  $v = Et + E_0(d - t)$ $E = \frac{E_0}{k}$, then $v = \frac{E_0}{k} t + E_0(d-t) = E_0\left(d - t + \frac{1}{k}\right)$ $\therefore V = \frac{q}{\epsilon_0 A}\left(d - t + \frac{t}{k}\right)$ So, capacitance of the capacitor on introduction of dielectric slab is given by $c = \frac{q}{v} = \frac{q}{\epsilon_0 A\left(d - t + \frac{1}{k}\right)}$ $\therefore C = \frac{\epsilon_0 A}{d - t\left(1 - \frac{1}{k}\right)}$	½ ½ ½ ½ ½	5

	capacitors of capacitances C_2 and C_3 are joined in parallel and their equivalent capacitance C_{23}=7+3=10μF Now C_1,C_{23} and C_4 are joined in series , hence their equivalent capacitance C. is given by $\frac{1}{C.} = \frac{1}{C_1} + \frac{1}{C_{23}} + \frac{1}{C_4} = \frac{1}{10} + \frac{1}{10} + \frac{1}{15} = \frac{8}{30}$ As C_5 is in parallel to C. , hence equivalent capacitance C_{eq} of the arrangement is $C_{eq} = C. + z = (3.75 + z)\mu F$ $\therefore$ Energy of the system $U = \frac{1}{2} C_{eq}, V^2$, where U = 160 mJ = 0.16 J and V = 200 V $\therefore 0.16 = \frac{1}{2} \times C_{eq}(200)^2 \Rightarrow C_{eq} = \frac{0.16 \times 2}{(200)^2} = 8 \times 10^{-6} F = 8\mu F$ As $C_{eq} = (3.75 + z) = \mu F = 8\mu F$, hence we have z = $4.25\mu F$ OR (a) refer to ncert (b) refer to ncert (c)Length of side = 10 cm Angle of inclination "θ" = 30° Flux= E. ds = 200 NC^{-1} x 10 x 10^{-2} x cos (60°) Flux = 10 V.m Thus the electric flux passing through the sheet is 10 V.m	½ 1 1 2 2 1	5
32.	(a) According to Kirchhoff's Current Law, The total current entering a junction or a node is equal to the charge leaving the node as no charge is lost. Kirchhoff's Voltage Law: *The sum of voltages around a loop is zero.*Kirchhoff's Voltage Law can be written as, $\sum v_n = 0$ (b) For the mesh EFCAE $- 30I_1 + 40 - 40(I_1 + I_2) = 0$ Or $7I_1 - 4I_2 = - 4$ Or $7I_1 + 4I_2 = 4$ ...**(I)** For the mesh ACDBA $40(I_1 + I_2) - 40 + 20I_2 - 80) = 0$ Or $40(I_1 + 60I_2 - 120 = 0$ Or $2I_1 + 3I_2 = 6$ ...**(II)**	1 1 1 1 ½ ½	5

	Solving (I) and (II), we get $I_1 = \frac{-12}{13} A$ $I_2 = \frac{34}{13} A$ $\therefore$ Current through arm = $AC = I_1 + I_2 = \frac{22}{13} A$ OR (a) Refer to ncert. (b) Refer to ncert. (c) Refer to ncert.	1 3 1	5
33.	  $\sin i = \sin\angle BAD = \frac{BD}{AD} = \frac{c_1 r}{AD}$ .... (1) Similarly, $\sin r = \sin\angle ADC = \frac{AC}{AD} = \frac{c_2 r}{AD}$ .... (2) Dividing equation (2) by equation (1), $\frac{\sin i}{\sin r} = \frac{c_1}{c_2}$ This is the refractive index of the second medium (2) with respect to the first medium (1). $\frac{c_1}{c_2} = \frac{n_2}{n_1}$ $\therefore \frac{\sin i}{\sin r} = \frac{n_2}{n_1}$ This equation proves Snell's law.	1 1 1	5

	$\lambda = 590nm = 590 \times 10^{-9}m$ $\mu = 1.5$ $c = v\lambda$ $\frac{c}{\lambda} = v$ $v = \frac{3 \times 10^8}{590 \times 10^{-9}}$ Hence, frequency = $5 \times 10^{14} Hz$. During refraction, frequency of light remains unchanged whereas speed and wavelength of light will change. Therefore, after refraction, frequency = 5×10^{14} Hz. Speed = $\frac{c}{\mu} = \frac{3 \times 10^8}{\mu} = \frac{3 \times 10^8}{1.5} = 2 \times 10^8 ms^{-1}$ Wavelength = $\frac{\lambda}{\mu} = \frac{590 \times 10^{-9}}{1.5} = 393nm$.	½ ½+ ½ ½	
34.	1. (i) Angle of incidence > critical angle (ii) light goes from denser to rarer medium 2. IR or visible light 3. n= 1/sinC = 1/sin30° = 2 Speed of light in medium v = c/n = $(3 \times 10^8)/2 = 1.5 \times 10^8$m/s = 1.5×10^8m/s 3. OR  $\mu = \frac{1}{\sin i_C}$ $\text{Sin } i_C = \frac{3}{4}$ $\cos i_C = \frac{\sqrt{7}}{4}$ $\tan i_C = \frac{3}{\sqrt{7}}$ $\tan i_C = \frac{x}{7} \Rightarrow \frac{3}{\sqrt{7}} \Rightarrow \frac{x}{7} \Rightarrow x$ $= 3\sqrt{7}\text{cm}$ Area $= \pi x^2 = 63\pi \text{ cm}^2$	½ ½ 1 1 1 1 1	4

35	(1) Semiconductors that are chemically pure, free from impurities are termed as intrinsic semiconductors. The number of holes and electrons is therefore determined by the properties of the material itself instead of the impurities. (2) When a positive bias is applied to the junction, current will flow. The holes are attracted to the negative terminal and the electrons to the positive terminal so that the holes from the p side are “injected” into the n side and vice-versa. The two types of carriers are injected into the side in which they are minority carriers. This is minority carrier injection. (3) Silicon. Silicon diode is easier to produce than germanium diode due to the widespread availability of silicon. The silicon diode is less sensitive than the germanium diode, hence the operation of silicon diodes is stable with changes in temperature. The energy gap for germanium is less (0. 72eV) than the energy gap of silicon (1. 1eV). OR $1\text{ppm} = 1$ part per million $= \frac{1}{10^6}$. so no. of pentavalent As atoms doped in given Si crystal, $= \frac{5 \times 10^{28}}{10^6} = 5 \times 10^{22} m^{-3}$. As one pentavalent atoms donates one free electron to the crystal structure, so no. of free electrons in the given Si crystal, $n_e = 5 \times 10^{22} m^{-3}$ Number of holes, $n_h = \frac{n_i^2}{n_e} = \frac{(1.5 \times 10^{16})^2}{5 \times 10^{22}}$ $4.5 \times 10^9 m^{-3}$	1 1 1 (Any two) 1 ½ ½	4