Solution | CBSE-XII | Test No-PB_6 | Vidyarthi & Shiksha |

Pre-Board Examination : 2025-26

Sub : Physics

(The figures in the margin indicate full marks for the questions)

Time – 3 hours **Full marks-70**

Section A (Each question carries 1 mark)	
1	Relative permittivity and permeability of a material are , and M, respectively. Which of the following values of these quantities are allowed for a diamagnetic material? a) $\varepsilon_r = 1.5$, $\mu_r = 1.5$. b) $\varepsilon_r = 0$, $\mu_r = 1.5$. c) $\varepsilon_r = 1.5$, $\mu_r = 0.5$. d) $\varepsilon_r = 0.5$, $\mu_r = 0.5$
Ans	Correct Option (c) $\varepsilon_r = 1.5$, $\mu_r = 0.5$ Explanation: For diarnagnetic material, $0 < \mu_r < 1$ and for any material, $\varepsilon_r > 1$.
2	An electric dipole placed in an electric field of intensity 2 × 105 N/C at an angle of 30°experiences a torque equal to 4 Nm. The charge on the dipole of dipole length 2cm is (a) 7 μC. (b) 8 Mc. (c) 2mC (d) 5 mC

Ans	We know, $\tau = pE.\sin\theta \Rightarrow p = \dfrac{\tau}{E.\sin\theta}$ $\Rightarrow q \times 2l = \dfrac{4}{2\times 10^5 \times 0.5}$ $(\because p = q \times 2l)$ $(\because 2l = 0.02m)$ $\Rightarrow q = \dfrac{4}{2\times 10^5 \times 0.5 \times 0.02} = 2 \times 10^{-3}$ C $q = 2$ mC
3	Light of frequency 6.4 x 10^{14} Hz is incident on a metal of work function 2.14 eV. The maximum kinetic energy of the emitted electrons is about (a) 0.25 eV. (b) 0.51 eV. (c) 1.02 eV. (d) 0.10 eV
Ans	The energy E of a photon is given by the formula $E = hf$, where h is Planck's constant $E = \dfrac{hf}{1.6\times 10^{-19}} = \dfrac{6.63\times 10^{-34}\times 6.4\times 10^{14}}{1.6\times 10^{-19}}$ $E \approx \dfrac{42.432\times 10^{-20}}{1.6\times 10^{-19}} = 2.652$ eV Einstein's photoelectric equation states that $\Rightarrow K_{max} = E - \Phi$ Given $\Phi = 2.14$ eV $\Rightarrow K_{max} = 2.652$ eV $- 2.14$ eV $\Rightarrow K_{max} \approx 0.512$ eV
4	The refractive index of the material of an equilateral prism is √ 3. What is the angle of Minimum deviation? (a) 45°. (b) 60°. (c) 37°. (d) 30°

Ans	$$n = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$ Substituting $n = \sqrt{3}$ and $A = 60°$ $$\Rightarrow \sqrt{3} = \frac{\sin\left(\frac{60°+\delta_m}{2}\right)}{\sin\left(\frac{60°}{2}\right)} = \frac{\sin\left(\frac{60°+\delta_m}{2}\right)}{\sin(30°)} = \frac{\sin\left(\frac{60°+\delta_m}{2}\right)}{0.5}$$ $$\Rightarrow \frac{\sqrt{3}}{2} = \sin\left(\frac{60° + \delta_m}{2}\right)$$ $$\Rightarrow \sin(60°) = \sin\left(\frac{60° + \delta_m}{2}\right)$$ $$\Rightarrow 60° = \frac{60° + \delta_m}{2} \Rightarrow 60° + \delta_m = 120° \Rightarrow \delta_m = 60°$$
5	Two a-particles have the ratio of their velocities as 3: 2 on entering the magnetic field. If they move in different circular paths, then the ratio of the radii of their paths is a) 2: 3. b) 3: 2. c) 9:4. d) 4: 9
Ans	$$\text{As} \quad qvB = \frac{mv^2}{r}$$ $$\therefore\ r = \frac{mv}{qB} \Rightarrow r \propto v$$ $$\text{or} \quad \frac{r_A}{r_B} = \frac{v_A}{v_B} = \frac{3}{2}$$
6	The relative magnetic permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then a) X is paramagnetic and Y is ferromagnetic

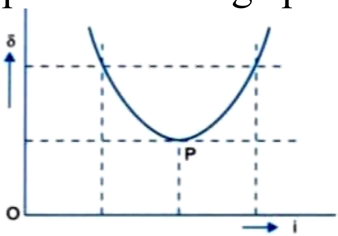
	b) X is diamagnetic and Y is ferromagnetic c) X and Y both are paramagnetic d) X is diamagnetic and Y is paramagnetic
<u>**Ans**</u>	d) X is diamagnetic and Y is paramagnetic
7	7.If an ammeter is to be used in place of a voltmeter, then we must connect with the ammeter a: (a) low resistance in parallel. (b) high resistance in parallel (c) high resistance in series. (d) low resistance in series
<u>**Ans**</u>	(c) high resistance in series
8	A force of 4N is acting between two charges in air. If the space between them is completely filled with glass (relative permittivity = 8), then the new force will be (a) 2N. (b) 5N. (c) 0.5N d) 0.2N
<u>**Ans**</u>	According to Coulomb's Law, the force between two point charges in a medium is inversely proportional to the relative permittivity ϵ_r , of that medium. The formula is expressed as: $$F_{medium} = \frac{F_{vacuum}}{\epsilon_r}$$ In air ($\epsilon_r \approx 1)$ is $F_{air} = 4N$ and the relative permittivity of glass is $\epsilon_r = 8,$ $$F_{glass} = \frac{4\text{ N}}{8} = 0.5\text{ N}$$

9	The large scale transmission of electrical energy over long distances is done with the use of transformers. The voltage output of the generator is stepped-up because of (a) reduction of current. (b) reduction of current and voltage both (c) power loss is cut down. (d) a and c both
Ans	(d) a and c both
10	A magnetic flux linked with a coil varies as $\phi = 2t^2 - 6t + 5$ where ϕ is in weber and t is in second. The induced current is zero at a) t= 0. b) t = 1.5. c) t=3. d) t = 5
Ans	According to **Faraday's Law of Induction,** the induced EMF is $$E = -\frac{d\phi}{dt}$$ By **Ohm's Law**, the induced current I in a coil with resistance R is: $$I = \frac{E}{R} = -\frac{1}{R} \cdot \frac{d\phi}{dt}$$ For the induced current to be zero ($I = 0$), $$\frac{d\phi}{dt} = 0 \Rightarrow \frac{d}{dt}(2t^2 - 6t + 5) = 0$$ $$\Rightarrow 4t - 6 = 0 \Rightarrow t = \frac{6}{4} = 1.5$$
11	The diagram below shows the electric field (E) and magnetic field (B) components of an electromagnetic wave at a certain time and location.

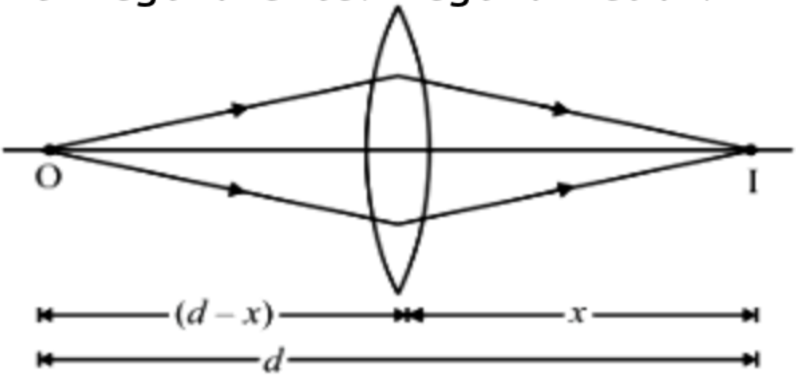
	 The direction of the propagation of the electromagnetic wave is a) perpendicular to E and B and out of plane of the paper b) perpendicular to E and B and into the plane of the paper c) parallel and in the same direction as E d) parallel and in the same direction as B
Ans	a) perpendicular to E and B and out of plane of the paper
12	The ionisation potential of hydrogen is 13.6 V. The energy of the atom in n = 2 state will be a) -10.2 eV. b) - 6.4eV c) - 3.4 eV. d) - 4.4 eV
Ans	Ionization energy, Hydrogen atom energy levels The energy of an electron in a hydrogen atom in the nth energy level is given by the formula: $E_n = -\frac{13.6}{n^2}$ eV. For n = 2,we have: $E_2 = -\frac{13.6}{2^2} = -\frac{13.6}{4} = -3.4$ eV
13	**For Questions 13 to 16, two statements are given –one labeled Assertion (A) and other labeled Reason (R). Select the correct answer to these questions from the options as given below.**

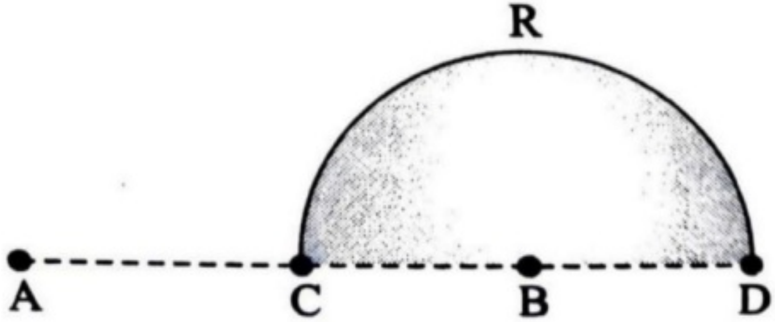
	(a)If both Assertion and Reason are true and Reason is correct explanation of Assertion. **(b)If both Assertion and Reason are true but Reason is not the correct explanation of Assertion .** **(c)If Assertion is true but Reason is false.** **(d)If both Assertion and Reason are false.** **Assertion (A) :** Photoelectric effect demonstrates the wave nature of light. **Reason(R)**: The number of photoelectrons is proportional to the frequency of light.
Ans	**(d)If both Assertion and Reason are false.**
14	**Assertion (A) :** Putting p type semiconductor slab directly in physical contact with n type semiconductor slab cannot form the p-n junction. **Reason(R):** The roughness at contact will be much more than inter atomic crystal spacing and continuous flow of charge carriers is not possible.
Ans	a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
15	**Assertion (A):** In Bohr's model of the atom, the angular momentum of the electron is quantized. **Reason (R):** The electron in an atom revolves in circular orbits around the nucleus under the influence of electrostatic forces.
Ans	**a)** Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation for

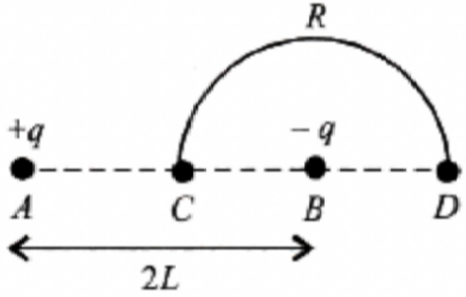
	Assertion (A)
16	**Assertion (A):** Refractive index of glass with respect to air is different for red light and violet light. **Reason (R):** Refractive index of a pair of media does not depends on the wavelength of light used.
Ans	(C) A is true but R is false.
	Section B (Each question carries 2 marks)
17	**17.**(a)Name the device which utilizes unilateral action of a p-n diode to convert ac into dc. (b)Draw the input &output waveform of a full wave rectifier.
18	Calculate binding energy per nucleon of $^{209}\mathbf{Bi}_{83}$ nucleus. Given that mass of $^{209}\mathbf{Bi}_{83}$ = 55.934939u, mass of proton = 1.007825u, mass of neutron = 1.008665u . (given: 1 u = 931 MeV) .

Ans	The nucleus is Bismuth-209 ($^{209}_{83}\mathrm{Bi}$) **Atomic Number (Z):** 83 (number of protons) **Mass Number (A):** 209 (total nucleons) **Number of Neutrons (N):** $A - Z = 209 - 83 = \mathbf{126}$ **Given Nuclear Mass (M):** $208.980388\ \mathrm{u}$ **Mass of Proton (m_p):** $1.007825\ \mathrm{u}$ **Mass of Neutron (m_n):** $1.008665\ \mathrm{u}$ $1\ \mathrm{u} = 931.5\ \mathrm{MeV}$ The mass defect of the nucleus is: $$\Delta m = [Z \cdot m_p + N \cdot m_n] - M$$ $$\Delta m = [83 \times 1.007825 + 126 \times 1.008665] - 208.980388$$ $$\Delta m = [83.649475 + 127.091790] - 208.980388$$ $$\Delta m = 210.741265 - 208.980388 = \mathbf{1.760877}\ \mathrm{u}$$ **Total Binding Energy (BE)** $$BE = \Delta m \times 931.5\ \mathrm{MeV/u}$$ $$BE = 1.760877 \times 931.5 \approx \mathbf{1640.26}\ \mathrm{MeV}$$ $$BE_{avg} = \frac{BE}{A} = \frac{1640.26\ \mathrm{MeV}}{209} \approx \mathbf{7.848}\ \mathrm{MeV/nucleon}$$
19	A plot, between the angle of deviation (δ) and angle of incidence (i), for a triangular prism is shown in figure: Explain why any given value of ‘δ’ corresponds to two values of angle of incidence. State the significance of point P on the graph. 

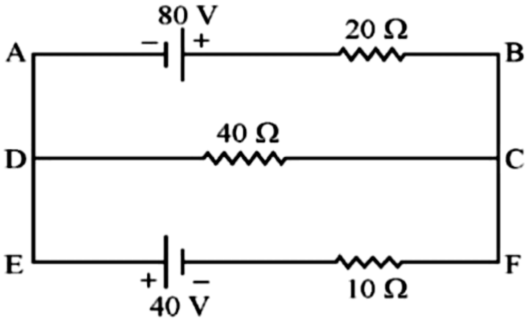
Ans	The plot of deviation (δ) vs. incidence (i) is a U-shaped curve because $\delta = i + e - A$ For a given δ, the two incident angles (i_1, i_2) correspond to swapping incident and emergent angles (i and e), producing identical refraction. Point P represents the angle of minimum deviation (δ_{min}), where i = e and the ray passes symmetrically.
20	A potential difference V is applied to a conductor of length L , diameter D. How are the electric field E, the drift velocity V_d and resistance R affected when (i) V is doubled. (ii) D is doubled.
Ans	We know drift velocity is given by $\lvert V_d \rvert = \frac{e\tau}{m}E$ Also $E = \frac{V}{L}$ So $\lvert v_d \rvert = \frac{e\tau}{m}\left(\frac{V}{L}\right)$ **(i)** When V is halved drift velocity (v_d) gets halved **(ii)** When L is doubled drift velocity (v_d) gets halved **(iii)** When D is halved drift velocity (v_d) remains same.
21	Show that the least possible distance between an object and its real image in a convex lens is 4f, where f is the focal length of the lens.

Ans	Let d be the least distance between object and image for a real image formation.  $\frac{1}{f}=\frac{1}{v}-\frac{1}{u} \Rightarrow \frac{1}{f}=\frac{1}{x}+\frac{1}{d-x}=\frac{d}{x(d-x)}$ $\Rightarrow fd = xd - x^2$ $\Rightarrow x^2 - dx + fd = 0$ $x = \frac{d \pm \sqrt{d^2-4fd}}{2}$, For real roots of x, $d^2 - 4fd \geq 0$ $d \geq 4f$.
	Or An astronomical telescope has focal lengths 100 cm & 10 cm of objective and eyepiece lens respectively when final image is formed at least distance of distinct vision, magnification power of telescope will be?
Ans	• **Focal length of the objective lens** (f_o): 100 cm • **Focal length of the eyepiece lens** (f_e): 10 cm • **Least distance of distinct vision** (D): 25 cm $M = \frac{f_o}{f_e}\left(1+\frac{f_e}{D}\right) = \frac{100}{10}\left(1+\frac{10}{25}\right) = 10 \times 1.4 = 14$

Section C (Each question carries 3 marks)	
22	(a)What are coherent sources. (b)Explain Young's double slit experiment. (c)Write the expression for the fringe width.
23	Charges $(+q)$ and $(-q)$ are placed at the points A and B respectively which are a distance 2L apart. C is the midpoint between A and B. What is the work done in moving a charge +Q along the semicircle CRD. (see figure) 

Ans	
Ans	 From figure, $AC = L$, $BC = L$, $BD = BC = L$ $AD = AB + BD = 2L + L = 3L$ Potential at C is given by $V_C = \frac{1}{4\pi\varepsilon_0}\left[\frac{q}{AC} + \frac{(-q)}{BC}\right] = \frac{1}{4\pi\varepsilon_0}\left[\frac{q}{L} - \frac{q}{L}\right] = 0$ Potential at D is given by $V_D = \frac{1}{4\pi\varepsilon_0}\left[\frac{q}{AD} + \frac{(-q)}{BD}\right] = \frac{1}{4\pi\varepsilon_0}\left[\frac{q}{3L} - \frac{q}{L}\right]$ $= \frac{1}{4\pi\varepsilon_0}\frac{q}{L}\left[\frac{1}{3} - 1\right] = \frac{-q}{6\pi\varepsilon_0}$. Work done in moving charge +Q along the semicircle CRD is given by $W = [V_D - V_C](+Q) = \left[\frac{-q}{6\pi\varepsilon_0} - 0\right](Q) = \frac{-qQ}{6\pi\varepsilon_0 L}$ Potential at C is zero because the charges are equal and opposite and the distances are the same. Potential at D due to -q is greater than

	that at A (+q), because D is closer to B. Therefore it is negative.
24	The ground state energy of hydrogen atom is -13.6 eV. (a)What is the kinetic energy of the electron in this state? (b)What is the potential energy of the electron in this state? (c)Which of the answers above would change if the choice of the zero of potential energy is changed?
Ans	In the Bohr model of the hydrogen atom, the total energy E is the sum of the kinetic energy K and the potential energy U. The kinetic energy : K = - E Potential energy : U = 2E Given the ground state energy E = -13.6 eV, we find the kinetic energy: (a) K = -E = - (-13.6 eV) = +13.6 eV (b) U = 2E = 2(-13,6 eV) = - 27.2 eV (c) If the choice of the zero of potential energy is changed , the **potential energy** (and consequently the total energy) would change, while the kinetic energy remains the same.
25	Using Kirchhoff's rules, calculate the current through 40Ω and 20Ω in the circuit shown in below figure

	
Ans	**Using Kirchhoff's loop rule on ABCDA,** $80 - 20I_1 - 40I_2 = 0$ $\Rightarrow 8 - 2I_1 - 4I_2 = 0$ $\Rightarrow I_1 + 2I_2 - 4 = 0$ $\Rightarrow I_1 + 2I_2 - 4 = 0$ **......(1)** **Using Kirchhoff's loop rule on CDEFC,** $-40I_2 - 40 + 10(I_1 - I_2) = 0$ $\Rightarrow -40I_2 - 40 + 10I_1 - 10I_2 = 0$ $\Rightarrow -50I_2 - 40 + 10I_1 = 0$ $\Rightarrow I_1 - 5I_2 - 4 = 0$ **......(2)** **Subtracting (2) from (1), we get** $\Rightarrow 7I_2 = 0 \Rightarrow I_2 = 0$ **Substituting the value of I_2 in (1), we get** $I_1 = 4A$ **Hence, there is no current through the 40Ω resistor and 4A current flows through the 20Ω resistor.**
26	(a) State the principle & the working of a moving coil galvanometer. (b) Why concave magnets are used in it , give reason.

27	(i) Arrange the following electromagnetic waves in the descending order of their wavelengths. (a) Microwaves (b) Infrared rays (c) Ultraviolet radiation (d) g-rays (ii) Write one use each of any two of them.
Ans	The electromagnetic waves arranged in descending order (longest to shortest) of their wavelengths are: **(a) Microwaves** (10^{-1} to 10^{-3} m) **(b) Infrared rays** (10^{-3} to 7×10^{-7} m) **(c) Ultraviolet radiation** (4×10^{-7} to 10^{-8} m) **(d) γ-rays** (less than 10^{-11} m) Below are the uses for two of the waves listed above: **Microwaves:** Used in radar systems for aircraft navigation and in microwave ovens for cooking/heating food. **Infrared rays:** Used in remote control switches for electronic devices (like TVs) and in night vision goggles. **Ultraviolet radiation:** Used in water purifiers to kill bacteria and for sterilizing surgical instruments. **γ-rays:** Used in the treatment of cancer (radiotherapy) and to sterilize medical equipment.
28	(a) Define mutual inductance and write its SI unit. (b) Two circular loops, one of small radius r and other of larger radius R, such that R>>r, are placed coaxially with centres coinciding . Obtain the mutual inductance of the arrangement.

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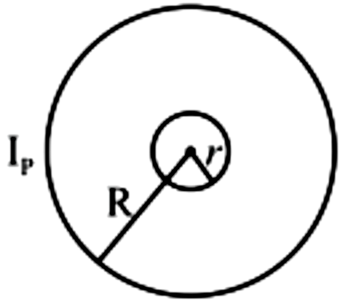
<tr><td>Ans</td><td>


Let a current IP flow through the circular loop of radius R. The magnetic induction at the centre of the loop is

$$B_P = \frac{\mu_0 I_P}{2R}$$

As, r << R, the magnetic induction BP may be considered to be constant over the entire cross sectional area of inner loop of radius r. Hence magnetic flux linked with the smaller loop will

$$\phi_S = B_P A_S = \frac{\mu_0 I_P}{2R}\pi r^2$$
$$\Longrightarrow \phi_S = M I_P$$
$$\Longrightarrow M = \frac{\phi_S}{I_P} = \frac{\mu_0 \pi r^2}{2R}$$
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OR

(a) Two long straight parallel current carrying conductors are kept 'r' distant apart in air.The direction of current in both the conductors is
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same. Find the magnitude of force per unit length.

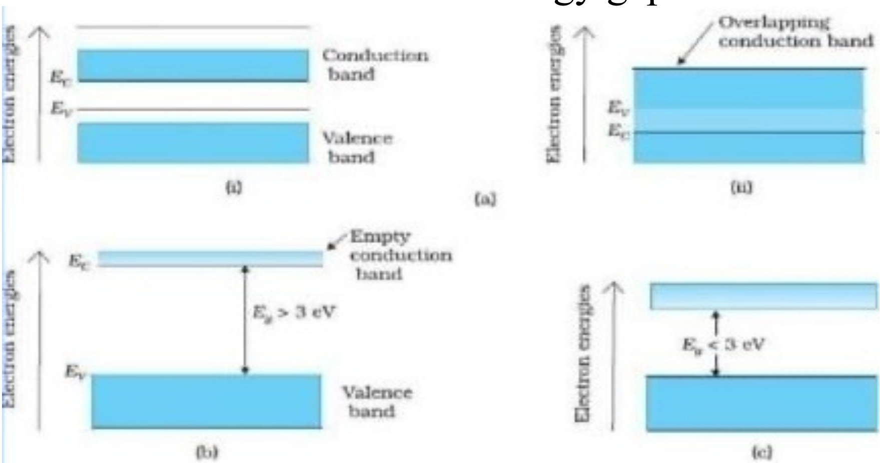
(b) What will be the direction of the force between them when

(i) When current flows in same direction.

(ii)When current flows in opposite direction.

Section D (Each question carries 4 marks)

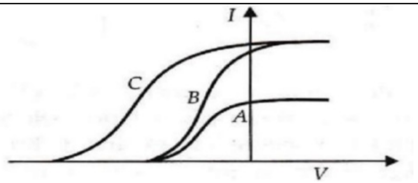
29 From Bohr's atomic model, we know that the electrons have well defined energy levels in an isolated atom. But due to inter atomic interactions in a crystal, the electrons of the outer shells are forced to have energies different from those in isolated atoms. Each energy level splits into a number of energy levels forming a continuous band. The gap between top of valence band and bottom of the conduction band in which no allowed energy levels for electrons can exist is called energy gap.



Following are the energy band diagrams for conductor fig (ii), for insulators fig (b) and for

semiconductors fig (c).
(i) In an insulator energy band gap is
(a) Eg = 0 eV
(b) Eg>3eV
(c) Eg<3eV
(d) None of this
(ii) In a semiconductor, separation between conduction and valence band is of the order of
(a) Eg = 0 eV
(b) Eg > 3eV
(c) Eg < 3eV
(d) None of these
(iii) Based on the band theory of conductors, insulators and semiconductors, the forbidden gap is smallest in
(a) conductor
(b) insulators
(c) semiconductors
(d) All of these
(iv) Solids having highest energy level partially filled with electrons are
(a) semiconductor
(b)conductor
(c) insulator
(d) none of these
OR
What is the highest occupied band in solids?
(a) conduction band
(b) valence band
(c) forbidden band

	(d) semiconductor band
Ans	(i) (b) Eg > 3eV (ii) (c) Eg < 3eV (iii) (a) conductor (iv) (c) insulator Or (iv) (b) valance band
30	It is the phenomenon of emission of electrons from a metallic surface when light of a suitable frequency is incident on it. The emitted electrons are called photo electrons. Nearly all metals exhibit this effect with ultraviolet light but alkali metals like lithium, sodium, potassium, cesium etc. show this effect even with visible light. It is an instantaneous process i.e. photoelectrons are emitted as soon as the light is incident on the metal surface. The number of photoelectrons emitted per second is directly proportional to the intensity of the incident radiation. The maximum kinetic energy of the photoelectrons emitted from a given metal surface is independent of the intensity of the incident light and depends only on the frequency of the incident light. For a given metal surface there is a certain minimum value of the frequency of the incident light below which emission of photoelectrons does not occur. (i)In a photoelectric experiment plate current is plotted against anode potential.



(A) A and B will have same intensities while B and C will have different frequencies.

(B) B and C will have different intensities while A and B will have different frequencies.

(C) A and B will have different intensities while B and C will have equal frequencies

(D) B and C will have equal intensities while A and B will have same frequencies.

(ii) Photoelectrons are emitted when a zinc plate is

(A)Heated

(B) hammered

(C) Irradiated by ultraviolet light

(D) subjected to a high pressure

(iii)The threshold frequency for photoelectric effect on sodium corresponds to a wavelength of 500nm. Its work-function is about

(A) 4×10^{-19}J (B) 1J (C) 2×10^{-19}J (D) 3×10^{-19}J

(iv)The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential is

(A) 2V (B) 4V (C) 6V (D) 10V

OR

The minimum energy required to remove an electron from a substance is called its

(A)Work function (B) kinetic energy

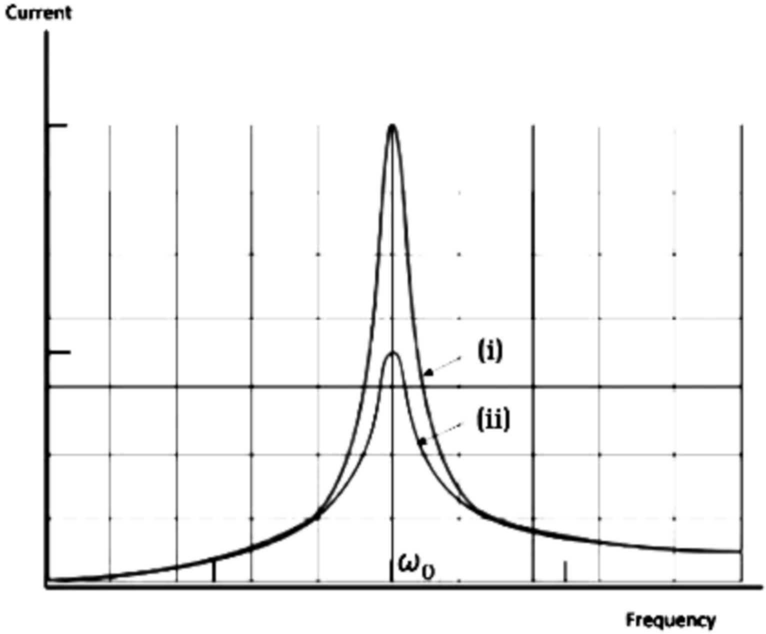
(C) stopping potential (D) potential energy

Ans	(i) (A) A and B will have same intensities while B and C will have different frequencies. (ii) (C) Irradiated by ultraviolet light. (ii) $W_0 = \frac{hc}{\lambda_0} = \frac{6.63\times10^{-34}\times3\times10^{8}}{5000\times10^{-10}} = 4\times10^{-19}$ J (iv) Ans- (B) 4V Energy of incident photons (E): 6 eV Maximum kinetic energy of photoelectrons (K_{max}): 4 eV The stopping potential (V_0) is related to the maximum kinetic energy $K_{max} = eV_0 \Rightarrow 4\text{ eV} = e \times V_0$ $\Rightarrow V_0 = 4$ V Or (A) Work function
	Section E (Each question carries 5 marks)
31	(a)Draw a ray diagram for the formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2. Hence derive lens maker's formula. A converging lens has a focal length of 10 cm in air. It is made of a material of refractive index 1.6. If it is immersed in a liquid of refractive index 1.3, find its new focal length.

Ans	The Lens Maker's Formula relates the focal length f, the refractive index of the lens n_g, the refractive index of the medium n_m, and the radii of curvature R_1 and R_2: $\frac{1}{f} = (\frac{n_g}{n_m} - 1)(\frac{1}{R_1} - \frac{1}{R_2})$ $\Rightarrow \frac{1}{10} = (\frac{1.6}{1.0} - 1)K = 0.6K \Rightarrow K = \frac{1}{6}$ Now, for the lens immersed in the liquid ($n_l = 1.3$): $\frac{1}{f_l} = (\frac{n_g}{n_l} - 1)(\frac{1}{R_1} - \frac{1}{R_2}) = (\frac{n_g}{n_l} - 1)K$ $\Rightarrow \frac{1}{f_l} = (\frac{1.6}{1.3} - 1)(\frac{1}{6}) = (\frac{1.6 - 1.3}{1.3})(\frac{1}{6}) = (\frac{0.3}{1.3})(\frac{1}{6})$ $\Rightarrow \frac{1}{f_l} = \frac{3}{13} \times \frac{1}{6} = \frac{1}{13 \times 2} = \frac{1}{26}$ $\Rightarrow f_l = 26$ cm
	OR (a)Define a wavefront. How is it different from a ray? (b)Using Huygens's construction of secondary wavelets draw a diagram showing the passage of a plane wavefront from a denser to a rarer medium.Using it verify Snell's law. (c)In a double slit experiment using light of wavelength 600nm and the angular width of the fringe formed on a distant screen is 0.1° (degree). Find the spacing between the two slits.

	(d) Write two differences between interference pattern and diffraction pattern.
Ans	The angular width (θ) of the fringe in the double-slit experiment is given by, $\theta = \frac{\lambda}{d}$ Where d = Spacing between the slits Given: The wavelength of light, λ = 600 nm The angular width of the fringe, $\theta = 0.1° = \frac{\pi}{1800} = 0.0018$ rad $\therefore d = \frac{\lambda}{\theta} = \frac{600 \times 10^{-9}}{18 \times 10^{-4}} = 0.33 \times 10^{-3}$ m
32	(a) Draw graphs showing the variations of inductive reactance and capacitive reactance with frequency of applied ac source. (b)Draw the phasor diagram for a series LRC circuit connected to an AC source. (c)When an alternating voltage of 220V is applied across a device X, a current of 0.25A flows which lags behind the applied voltage in phase by π/2 radian. If the same voltage is applied across another device Y, the same current flows but now it is in phase with the applied voltage. (i)Name the devices X and Y. (ii)Calculate the current flowing in the circuit when the same voltage is applied across the series combination of X and Y.

Ans	**(i)** In device X, the Current lags behind the voltage by π/2, X is an inductor. In device Y, Current in phase with the applied voltage, and Y is resistor. **(ii)** We are given that, Current = $\frac{V}{X_L}$ $\Longrightarrow 0.25 = \frac{220}{X_L}$ $\Longrightarrow X_L = 880\Omega$ Again, Current = $\frac{V}{R}$ $\Longrightarrow 0.25 = \frac{220}{R}$ $\Longrightarrow R = 880\Omega$ For the series combination of X and Y, Equivalent impedance Z = $\sqrt{880^2 + 880^2}$
	OR (a) A series LCR circuit is connected to an ac source. Using the phasor diagram , derive the expression for the impedance of the circuit. (b)Plot a graph to show the variation of current with frequency of the ac source, explaining the nature of its variation for two different resistances R_1 and R_2 ($R_1 < R_2$) at resonance.
Ans	**The curve (i) is for R_1 and the curve (ii) is for R_2.**

	
33	(a)Find the expression for the capacitance of a parallel plate capacitor of area A and plate separation d if a dielectric slab of thickness t(t<d) is introduced between the plates of capacitor. (b)A parallel plate capacitor, of capacitance 20 pF, is connected to a 100 V supply. After sometime the battery is disconnected, and the space, between the plates of the capacitor is filled with a dielectric, of dielectric constant 5. Calculate the energy stored in the capacitor.

Ans	- Initial capacitance, $C_0 = 20\text{ pF} = 20 \times 10^{-12}\text{ F}$ - Voltage supplied by battery, $V_0 = 100\text{ V}$ - Dielectric constant, $k = 5$ Since the capacitor is connected to the battery initially, the charge stored is: $Q = C_0 \times V_0 = 20 \times 10^{-12} \times 100 = 2 \times 10^{-9}\text{ C}$ The capacitance increases by the dielectric constant: $C = k \times C_0 = 5 \times 20 \times 10^{-12} = 1 \times 10^{-10}\text{ F}$ Since the battery is disconnected, charge Q remains constant. Energy stored is: $E = \frac{Q^2}{2C} = \frac{(2 \times 10^{-9})^2}{2 \times 1 \times 10^{-10}} = \frac{4 \times 10^{-18}}{2 \times 10^{-10}} = 2 \times 10^{-8}\text{ J}$
	OR A parallel plate capacitor of capacitance C is charged to a potential 'V' by a battery. Q is the charge stored on the capacitor .Without disconnecting the battery, the plates of the capacitor are pulled apart to a larger distance of separation. What changes will occur in each of the following quantities? Will they increase, decrease or remain the same? Give an explanation in each case. (a) Capacitance (b) Charge
Ans	(a) Capacitance: Decreases • Explanation: The capacitance of a parallel plate capacitor is given by

	$$C = \frac{\epsilon_0 A}{d}$$ where d is the distance between plates. As the plates are pulled apart, the distance d increases, causing the capacitance C to decrease. (b) Charge: Decreases • Explanation: Since the battery remains connected, the voltage V across the capacitor remains constant. Using the relationship Q = CV, if the capacitance C decreases and the voltage V is constant, the charge Q stored on the capacitor must also decrease .