CBSE

ADDITIONAL PRACTICE QUESTIONS

Physics-Theory (Marking Scheme)

Class XII | 2023–24

Maximum marks: 70 **Time Allowed: 3 hours**

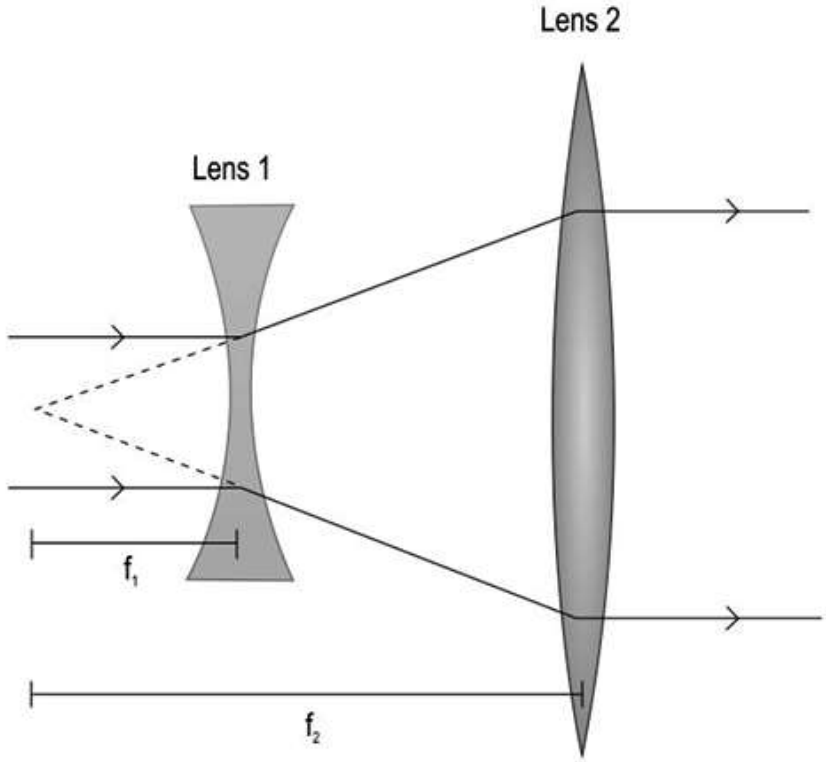
General instructions:

<table>
<tr><th>Q.No</th><th>Answers</th><th>Marks</th></tr>
<tr><td></td><td>SECTION A</td><td></td></tr>
<tr><td>1</td><td>C. 2.4×10^{-5} J</td><td>1</td></tr>
<tr><td>2</td><td>A. 14.4×10^{-15} N</td><td>1</td></tr>
<tr><td>3</td><td>B. y-intercept</td><td>1</td></tr>
<tr><td>4</td><td><table><tr><td></td><td>kinetic energy</td><td>potential energy</td></tr><tr><td>C</td><td>decreases</td><td>increases</td></tr></table></td><td>1</td></tr>
<tr><td>5</td><td>C. Current I cannot have a magnitude of more than 15 A in the upward direction.</td><td>1</td></tr>
<tr><td>6</td><td>B. only P and R</td><td>1</td></tr>
<tr><td>7</td><td>B. $B_3<B_1<B_2$</td><td>1</td></tr>
<tr><td>8</td><td>C. E || B and the particle has an initial velocity along the electric field</td><td>1</td></tr>
<tr><td>9</td><td>A. only I</td><td>1</td></tr>
<tr><td>10</td><td>D. 5×10^4 $Vm^{-1}s^{-1}$</td><td>1</td></tr>
<tr><td>11</td><td>A. only P</td><td>1</td></tr>
<tr><td>12</td><td>
B.</td><td>1</td></tr>
<tr><td>13</td><td>D. Both Assertion and Reason are false.</td><td>1</td></tr>
<tr><td>14</td><td>B. Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.</td><td>1</td></tr>
<tr><td>15</td><td>A. Both assertion and reason are true and reason is the correct explanation for assertion.</td><td>1</td></tr>
<tr><td>16</td><td>C. Assertion is true but Reason is false.</td><td>1</td></tr>
<tr><td></td><td>SECTION B</td><td></td></tr>
<tr><td>17</td><td>When an intrinsic semiconductor is doped with pentavalent impurities, the number of electrons increases much more than the thermally produced electrons. (0.5 marks)

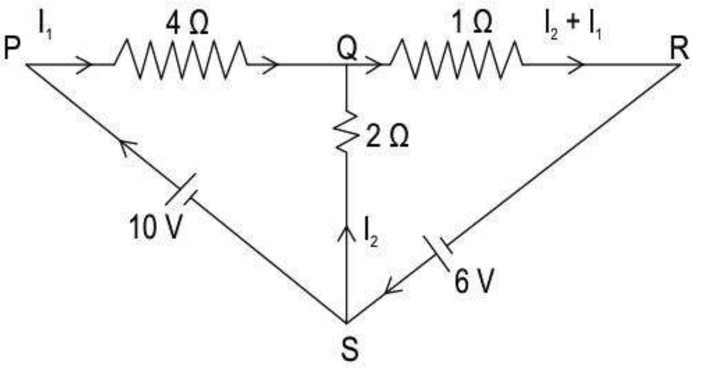
This causes the thermally generated holes to recombine with the electrons generated, thereby decreasing the number of holes. (1 mark)</td><td>2</td></tr>
</table>

	As the doping concentration increases, more electrons are produced, causing more electron-hole recombination and hence hole concentration decreases *(0.5 marks)*	
18	(a) $\lambda_\alpha > \lambda_p$ $\lambda_p = \frac{h}{m_p v_p}$ $\lambda_\alpha = \frac{h}{m_\alpha v_\alpha}$ $Since, m_\alpha = 4m_p$ $\lambda_\alpha = \frac{h}{4m_p v_\alpha}$ $For, \lambda_\alpha > \lambda_p$ $\frac{h}{4m_p v_\alpha} > \frac{h}{m_p v_p}$ $v_p > 4v_\alpha$ For the above condition of $v_p > 4v_\alpha$, λ_α will be greater than λ_p. *(0.5 marks for writing the expression for λ, 0.5 marks for writing the relationship between the masses of the two particles, and 0.5 marks for final velocity relation.)* (b) $\lambda_\alpha = \lambda_p$ $For, \lambda_\alpha = \lambda_p$ $\frac{h}{4m_p v_\alpha} = \frac{h}{m_p v_p}$ $v_p = 4v_\alpha$ For the above condition of $v_p = 4v_\alpha$, λ_α will be equal to λ_p. *(0.5 marks for final velocity relation.)*	2
19	Lens maker's formula $\frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ *(0.5 marks)* For the plano-concave lens, $\frac{1}{f_1} = (n_{21} - 1)\left(\frac{1}{-R} - \frac{1}{\infty}\right)$ $f_1 = -\frac{R}{n_{21}-1}$ *(0.5 marks)* For the plano-convex lens,	2

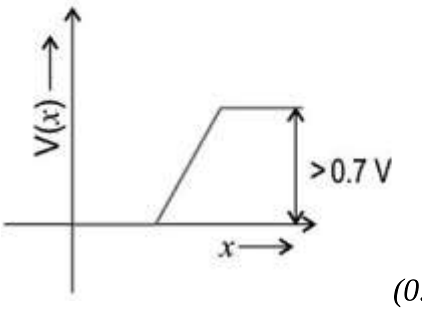
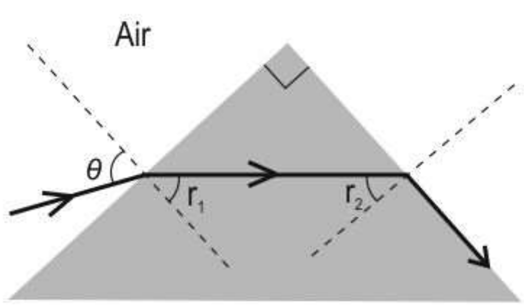
	$\frac{1}{f_2} = (n_{21} - 1)\left(\frac{1}{\infty} - \frac{1}{-R}\right)$ $f_2 = \frac{R}{n_{21}-1}$ *(0.5 marks)* $f_1:f_2 = -1:1$ *(0.5 marks)*	
20	(a) Since the wires are connected in parallel, the potential difference 'V' across both wires will be the same. The wires have the same resistivity ρ Let the length of wires P and Q be L_1 and L_2 respectively. Let the drift velocities electrons in wires P and Q be v_{d1} and v_{d2} respectively. $I = neAv_d$ *(0.5 marks)* v_d - drift velocity $L_1/L_2 = 1/2$ $V = RI = (\rho L/A)\ I$ <u>For wire P:</u> $V = (\rho L_1/A)\ neAv_{d1}$ ....(i) *(0.5 marks)* <u>For wire Q:</u> $V = (\rho L_2/A)\ neAv_{d2}$ ....(ii) *(0.5 marks)* Equating (i) and (ii) $L_1 v_{d1} = L_2 v_{d2}$ $v_{d1}/v_{d2} = L_2/L_1$ $v_{d1}/v_{d2} = 2/1$ Hence, the ratio of drift velocities of electrons in wires P and Q is 2:1.*(0.5 marks)*	2
21	Concave lens should be placed before the convex lens. *(1 mark)* The distance between the lenses should be f_2-f_1, where f_2 is the focal length of the convex lens and f_1 is the focal length of the concave lens. *(1 mark)* (OR)	2

	 *(1 mark for drawing the concave lens before the convex lens. 1 mark for marking the focal lengths correctly.)*	
OR	Apparent depth of image = 15 cm Real depth = n × apparent depth = 4/3 × 15 = 20 cm *(1 mark)* For the concave mirror, u = -5 cm, v = 20 - 10 cm $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ $\frac{1}{f} = \frac{1}{10} + \frac{1}{-5}$ $f = -10cm$ *(1 mark)*	2
	SECTION C	
22	For the first reaction mass of reactants = 1.00728 + 7.0160 = 8.12328 amu mass of products = 2 × 4.0026 = 8.0052 mass of reactants > mass of products *(1 mark)* Hence, the reaction is exothermic. *(0.5 marks)* For the second reaction mass of reactants = 7.0160 + 4.0026= 11.0186 amu mass of products = 1.0087 + 10.1294 = 11.1381 mass of reactants < mass of products *(1 mark)* Hence, the reaction is endothermic. *(0.5 marks)*	3

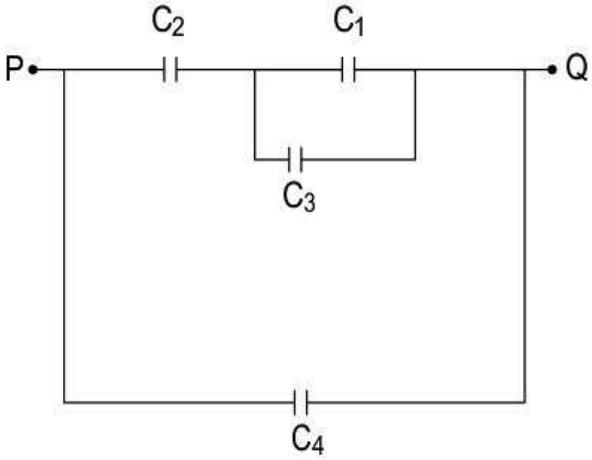
23	(a) Given E = 10 V/m V_x = 10 V Δ r = 2 m $\lvert \Delta V \rvert = \vec{E}.\Delta\vec{r}$ = 10 x 2 = 20 V *(0.5 marks)* Since, the potential decreases in the direction of the electric field, the potential at surface Y will be more than the potential at surface X. V = 20 + 10 = 30V *(0.5 marks)* (b) Given: q = 2 C Work done in moving charge from Y to X along Path 1= (V_x - V_y)q W = (10 - 30) × 2 W = -20 × 2 = - 40 J *(1 mark)* Work done in moving charge along Path 2 will be the same as work done along Path 1. *(0.5 marks)* This is because the work done between two surfaces is independent of the path since the force acting on the charge is conservative in nature. *(0.5 marks)*	3
24	(a) $\lambda = 2\pi r/n$ *(0.5 marks)* If n = 3, λ = circumference /3 *(0.5 marks)* (b) $\lambda = 2\pi r/n$ Since $r \propto n^2/Z$ $\lambda \propto n/Z$ *(0.5 marks)* (i) For the third orbit of He atom, n/Z = 3/2 (ii) For the fourth orbit of He atom, n/Z = 4/2 =2 (iii) For the third orbit of Li atom n/Z = 3/3 = 1 (iv) For the sixth orbit of Be atom n/Z = 6/4 = 3/2 *(1 mark for correct calculation of all n/Z)* Therefore, an electron in the third orbit of He atom will have the same de Broglie wavelength as the electron in the sixth orbit of Be atom. *(0.5 marks)* *(Full marks will be awarded if calculations are done based on velocity of electrons.)*	3

25	Give 0.5 marks for the correct representation of current in the circuits.  By using Kirchhoff's second law for closed-loop PQS we get $- 4I_1 + 2I_2 + 10 = 0$ $4I_1 - 2I_2 = 10$ $2I_1 - I_2 = 5$....(i) *(0.5 marks)* By using Kirchhoff's second law for closed-loop QRS we get $- (I_1 + I_2)1 + 6 - 2I_2 = 0$ $I_1 + 3I_2 = 6$.....(ii) *(0.5 marks)* solving (i) and (ii), we get $7I_1 = 21$ $\therefore I_1 = 21/7 = 3$ A *(0.5 marks)* $I_2 = 1$ A *(0.5 marks)* $I_1 + I_2 = 3 + 1 = 4$ A *(0.5 marks)* Therefore, the current across 4 Ω resistor is 3 A, across 2 Ω resistor is 1 A, and across 1 Ω resistor is 4 A.	3
26	(a) For a charged particle executing a circular path, $\theta = 90°$ $\therefore$ F = qvB *(0.5 marks)* Since the charged particle executes a circular path $mv^2/r = qvB$ $q/m = v/rB$ *(0.5 marks)* Since, v and B are constant for both the particles, $q/m \propto 1/r$ q/m: charge-to-mass ratio As $r_B > r_A$, particle A has a greater charge-to-mass ratio than B. *(1 mark)* (b) A proton has a greater charge-to-mass ratio than an alpha particle. *(0.5 marks)* Hence, particle A is likely to be a proton. *(0.5 marks)*	3
27	(a) Their frequencies will be different. A radio wave is an EM wave and an infrasonic wave is a sound wave. Since they have different speeds in air, their frequencies are different. (or) $f = v/\lambda$; since they have different speeds in air, they will have different frequencies.	3

	(1 mark for the correct answer. No marks will be awarded if reason is not written.) (b) Frequency of electric field = frequency of magnetic field = 60 kHz *(0.5 marks)* $E_{rms} = c\ B_{rms}$ $E_{rms} = 3 \times 10^8 \times 8 \times 10^{-9} = 2.4$ V/m *(1 mark for the correct answer with the unit. Accept any correct unit.)* Direction of electric field - along the horizontal north-south line. *(0.5 marks)*	
28	(a) Maximum induced emf (ε_{max}) = N × B × A × ω *(0.5 marks)* where, N = 50, B = 0.4 T, ω = 2πf = 2×π×60, r = d/2 = 0.2/2 = 0.1 m Therefore, $A = \pi r^2 = \pi \times (0.1)^2$ *(0.5 marks)* Substituting we get, $\varepsilon_{max} = 50 \times 0.4 \times (3.14 \times 0.1 \times 0.1) \times (2 \times 3.14 \times 60)$ = 236.63 V (0.5 marks each for the substitution and final answer.) (b) if the ring is rotated about its axis or the ring is translated in the magnetic field *(1 mark for any one correct answer)* *[Accept any other valid correct answer.]*	3
OR	$L_p = [\frac{\mu_o \mu_r N_p^2 A_p}{l_p}] = [\frac{\mu_o \times 1 \times (200)^2 \times A}{l}]$ $L_q = [\frac{\mu_o \mu_r N_q^2 A_q}{l_q}] = [\frac{\mu_o \times 500 \times (50)^2 \times A}{l}]$ $[\frac{L_p}{L_q}] = [\frac{200^2}{500x50^2}]$ $= 0.032$ Therefore, $L_q = [\frac{L_p}{0.032}]$ $= [\frac{2}{0.032}]$ $L_q = 62.5mH$ *(1 mark for correct formula. 0.5 marks for substitution. 0.5 mark for the calculation. 1 mark for the correct answer)*	3
	SECTION D	
29	(a) No, Fatima cannot charge the battery of a phone by connecting it directly to ac power supply. *(0.5 marks)* The mobile devices require a 5V DC to get charged. Connecting the battery	4

	directly to 220V ac power supply will cause an excess flow of current produces a large amount of heat which can destroy the phone. *(0.5 marks)* (b) D_1 is reverse biased, hence the width of its depletion region increases, and the potential barrier also increases. *(0.5 marks)*  *(0.5 marks)* OR The secondary coil of the transformer provides alternating current. Hence if the battery of the phone is directly connected to the output terminals of the transformer, for one-half cycle the battery will get charged and for the next half, it will get discharged. *(0.5 marks)* Hence, the charging of the battery will not take place. *(0.5 marks)* (c) Both D_1 and D_2 will be forward-biased for one-half of the cycle of ac voltage and reverse-biased for the next half cycle. Hence, the combination of D_1 and D_2 behaves as a half-wave rectifier. *(1 mark)* Thus only one-half of the ac voltage gets rectified in a cycle. *(0.5 marks)* Hence, the frequency of output voltage will be 50 Hz. *(0.5 marks)*	
30	(i) C. A reflection of the objects in front of the glass case is seen on the case. (ii) B. 2t (iii) D. $\lambda/4n_2$ **OR** D. $\lambda/2n_2$ (iv) $\lambda/2$	4
	SECTION E	
31	(a)  At the 1st surface, using Snell's law $\sin\theta = n \sin r_1$	5

	$\sin r_1 = \sin\theta/n$ *(0.5 marks)* $r_2 = A - r_1 = 90 - r_1$ *(0.5 marks)* At the second interface, $\sin r_2 = \sin 90/n$ $\sin r_2 = 1/n$ *(0.5 marks)* $\sin(90 - r_1) = 1/n$ $\cos r_1 = 1/n$ *(0.5 marks)* Squaring both sides $\cos^2 r_1 = 1/n^2$ $1 - \sin^2 r_1 = 1/n^2$ $1 - (\sin^2\theta/n^2) = 1/n^2$ Solving, $n = \sqrt{(1+\sin^2\theta)}$ *(1 mark)* (b) For an equilateral prism A = 60° *(0.5 marks)* Using Snell's law at the first surface, $\sin i = n \sin r$ *(0.5 marks)* At minimum deviation $r = A/2 = 60/2 = 30°$ *(0.5 marks)* $\sin i = n \sin(30)$ $\sin i = n(1/2)$ $i = \sin^{-1}(n/2)$ *(0.5 marks)*	
OR	(a) The bright fringes will appear less bright because the intensity of light from one of the slits is reduced. *(1 mark)* The dark fringes will appear less dark/brighter because the intensity of light from the two slits is not the same and the intensities do not completely cancel each other out. *(1 mark)* (b) (i) $\lambda = 500$ nm $= 500 \times 10^{-9}$ m; D = 2 m; d= 1 mm $= 1 \times 10^{-3}$ m Width of central maximum $= 2\lambda D/d$ *(0.5 marks)* $= 2 \times 500 \times 10^{-9} \times 2/(1 \times 10^{-3})$ = 2 mm *(0.5 marks)* (ii) Since the wavelength of red light is more the green light and the width of the central maximum is directly proportional to wavelength, the width of the central maximum will increase when red light is used. (1 mark for full answer.) (c) (i) Increase slit width, so that the slit width is comparable to the wavelength of sound. *(0.5 marks)* (ii) Replace the screen with a sound detector. *(0.5 marks)*	5

32	(a) V = 300 V C = 100 µF Energy = $1/2\ CV^2$ *(0.5 marks)* $= 1/2 \times 100 \times 10^{-6}\ (300)^2$ = 4.5 J *(0.5 marks)* (b) q = CV *(0.5 marks)* $q = 100 \times 10^{-6} \times 300 = 0.03$ C *(0.5 marks)* (c) Capacitance of a parallel plate capacitor $C = (\in_0 A)/d$ *(0.5 marks)* C = 100 µF $d' = 2d$ $C' = (\in_0 A)/d'$ $C' = (\in_0 A)/2d = 100/2 = 50$ µF Hence, if the distance between the plates of the capacitor is increased two times the capacitance of the capacitor decreases by 1/2 ie becomes 50 µF. *(0.5 marks)* (c) The slope of the q vs V graph gives the capacitance of a parallel plate capacitor. When the space between the plates of a capacitor is filled with a substance of dielectric constant K, its capacitance increases K times. *(0.5 marks)* Greater the slope of the q vs V graph, the higher the capacitance. *(0.5 marks)* As line A has a greater slope it represents greater capacitance and corresponds to scenario *(1 mark)*	5
OR	(a) The arrangement of capacitors is equivalent to:  C_1 and C_3 are in parallel. $C_p = 6 + 6 = 12$ µF C_p and C_2 are in series *(0.5 marks)* $1/C_s = 1/12 + 1/6 = 1/12 + 2/12 = 3/12$ $C_s = 4$ µF *(0.5 marks)* C_s and C_4 are in parallel	5

	$C_{net} = 4 + 6 = 10\ \mu F$ *(1 mark)* (b) We know that $C = Q/V$ Charge on C_4 $Q_4 = 10 \times 6 = 60\ \mu C$ *(0.5 marks)* Net capacitance of C_1 and $C_3 = 6 + 6 = 12\ \mu F$ Net capacitance of C_1, C_3 ,and C_2 is : $1/C = 1/12 + 1/6 = 3/12 = 1/4$ $C = 4\ \mu F$ Net charge across C_1, and C_3 ,and C_2 $Q = C V = 4 \times 10 = 40\ \mu C$ *(0.5 marks)* Since the charge in the series combination is the same, Net charge across C_1 and $C_3 = 40\ \mu C$ *(0.5 marks)* Potential across C_1 and $C_3 = Q/C = 40/12 = 10/3$ V Charge across C_1 $Q_1 = C_1 \times V = 6 \times 10/3 = 20\ \mu C$ *(0.5 marks)* Ratio of charges across C_1 and C_4 $Q_1/ Q_4 = 20/60 = 1:3$ *(1 mark)*	
33	(a) $X_L = 2\pi f L$ *(0.5 marks)* $L = X_L /2\pi f$ $L = 20/(2 \times 3.14 \times 100) = 0.032$ H *(0.5 marks)* (b) A battery is a source of direct current and thus f = 0 Hz. *(0.5 marks)* As $X_L = 2\pi fL$, the inductive reactance of the inductor becomes zero. *(0.5 marks)* (c) $P_{avg} = V_{rms}I_{rms} \cos\varphi$ where φ is the phase difference between current and voltage in the circuit. Phase difference is 90° for pure inductive circuit. *(0.5 marks)* $\therefore P_{avg} = 0$ *(0.5 marks)* (d) Power dissipated in an LCR circuit is maximum when $X_L = X_C$ $f = 1/2\pi\sqrt{(LC)}$ $f = 0.398 \times 10^3$ Hz f = 398 Hz *(1 mark)* Under this condition of resonance, the circuit behaves as a pure resistive circuit. Hence phase difference between current and voltage is 0°. *(1 mark)*	5
OR	(a) The voltage across the secondary coil is given by: $N_p/N_s = V_p/V_s$ *(1 mark)* where $N_p = 500$, $N_s = 50$ and $V_p = 240$ V Therefore, $V_s = V_p \times (N_s/N_p)$	5

	$= 240 \times (50/500)$ $= 24$ V *(1 mark)* (b) Current in the secondary coil is given by: $I_s = V_s/R_s$ *(0.5 marks)* where $V_s = 24$ V and Rs = 20 ohms Therefore, $I_s = 24/20$ $= 1.2$ A *(1 mark)* Current in the primary coil is given by: $I_p/I_s = N_s/N_p$ *(0.5 marks)* where $I_s = 1.2$ A, $N_s = 500$ and $N_p = 50$ Therefore, $I_p = (N_s/N_p) \times (I_s)$ $= (50/500) \times (1.2)$ $= 0.12$ A *(1 mark)*		