DIRECTORATE OF GOVERNMENT EXAMINATIONS, CHENNAI- 6
HSE SECOND YEAR EXAMINATION – MARCH/APRIL – 2023

PHYSICS KEY ANSWER

NOTE:

1. Answers written with Blue or Black ink only to be evaluated.
2. Choose the most suitable answer in Part A from the given alternatives and write the option code and their corresponding answer.
3. For answers in Part – II , Part – III , Part – IV like reasoning , explanation, narration, description and listing of points, students may write in their own words but without changing the concepts and without skipping any point.
4. In numerical problems if formula is not written , marks should be given for the remaining correct steps.
5. In graphical representation, physical variables for X-axis and Y-axis should be marked.

TOTAL MARKS : 70

PART-I

Answer all the Questions : 15x1=15

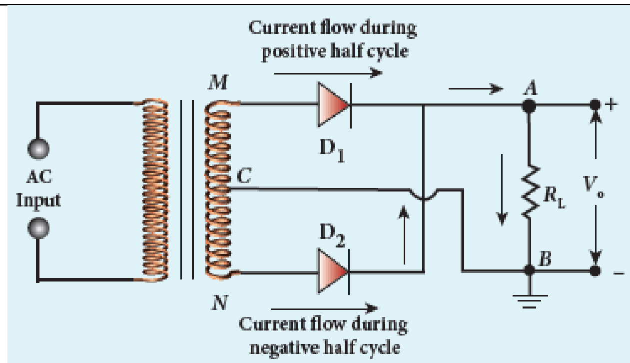
Q.NO	OPTION	TYPE-A	Q.NO.	OPTION	TYPE-B
1	c	$\lambda_p \propto \lambda_e^2$	1	b	Shape memory alloys
2	c	$\frac{3}{8} I$	2	c	900 Vm^{-1}
3	c	900 Vm^{-1}	3	c	4.5 Ω
4	c	4.5 Ω	4	b	Water
5	d	Yellow–Violet–Orange–Silver	5	a	–40 V
6	d	$\frac{h}{\pi}$	6	a	+Z direction
7	b	2 D	7	c	Energy density
8	c	Energy density	8	b	2 D
9	a	+Z direction	9	d	1.1eV
10	b	30^0	10	c	$\frac{3}{8} I$
11	c	Voltage regulator	11	b	30^0
12	a	– 40 V	12	d	Yellow–Violet–Orange–Silver
13	b	Water	13	d	$\frac{h}{\pi}$
14	d	1.1eV	14	c	Voltage regulator
15	b	Shape memory alloys	15	c	$\lambda_p \propto \lambda_e^2$

PART-II

Answer any **Six** Questions : **Q.No. 24 is Compulsory** **6x2=12**

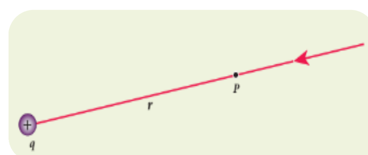
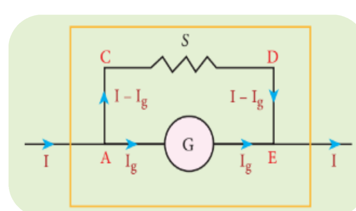
16	The electric field at a point P at a distance r from the point charge q is defined as the force experienced by a unit charge placed at that point. (or) The force experienced by unit positive charge (or) $\vec{E} = \frac{\vec{F}}{q_0}$ (or) $\vec{E} = K\frac{q}{r^2}\hat{r}$ (or) $\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}$	2 2 1	2
17	Q factor is defined as the ratio of voltage across L or C at resonance to Applied voltage. (or) $Q - \text{factor} = \frac{Voltage\ across\ L\ (or)\ C\ \ at\ resonance}{Applied\ Voltage}$ (or) $Q = \frac{I_m X_L}{I_m R}$ (or) $Q = \frac{X_L}{R}$ (or) $Q = \frac{\omega_r L}{R}$ (or) $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$	2 2 1	2
18	The line integral of magnetic field over a closed loop is μ_0 times net current enclosed by the loop. (or) $\oint \vec{B}\,.\,\vec{d\ell} = \mu_0 I_{enclosed}$	2 1	2
19	The total internal reflection of light that happens inside the diamond. n=2.417 (or) $i_c = 24.4°$	1 1	2
20	$I \propto a^2$ (or) $I_1 \propto a_1^2$ and $I_2 \propto a_2^2$ $\frac{I_1}{I_2} = \frac{a_1^2}{a_2^2}$ (or) $\frac{a_1}{a_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{36}{1}}$ $\frac{a_1}{a_2} = \frac{6}{1}$ (or) $I \propto a^2$ (or) $I_{max} \propto (a_1 + a_2)^2$ and $I_{min} \propto (a_1 - a_2)^2$ $\frac{I_{max}}{I_{min}} = \frac{(a_1+a_2)^2}{(a_1-a_2)^2}$ (or) $\frac{(a_1+a_2)}{(a_1-a_2)} = \sqrt{\frac{I_{max}}{I_{min}}} = \sqrt{\frac{36}{1}}$ $\frac{(a_1+a_2)}{(a_1-a_2)} = \frac{6}{1}$ and $\frac{a_1}{a_2} = \frac{7}{5}$	1 ½ ½ 1 ½ ½	2
21	The minimum energy needed for an electron to escape from the metal surface is called work function. **Unit** - eV or Joule (or) $\phi_0 = h\,\nu_o$	1½ ½ 1	2

<table>
<tr><td>22</td><td>Activity or decay rate is the number of nuclei decayed per second.
Unit : Becquerel (or) curie
(or)
R = $\left|\frac{dN}{dt}\right|$ (or) $R = \lambda N_0 e^{-\lambda t}$ (or) $R = R_0 e^{-\lambda t}$ (or) $R = \lambda N$</td><td>1½
½

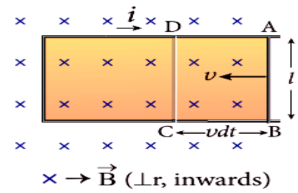
1</td><td>2</td></tr>
<tr><td>23</td><td>
</td><td>2</td><td>2</td></tr>
<tr><td>24</td><td>$R_T = R_0 (1 + \propto (T - T_0))$
Substitution
Answer 3.96 Ω</td><td>1
½
½</td><td>2</td></tr>
</table>

PART-III

Answer Any **Six** Questions : **Q.No. 33 is Compulsory** **6×3=18**

<table>
<tr><td>25</td><td>Diagram and explanation
Upto V = $-\frac{1}{4\pi\varepsilon_0}\int_{\infty}^{r}\frac{q}{r^2}\,\hat{r}\,.\,\overrightarrow{dr}$
$V = \frac{1}{4\,\pi\,\varepsilon_0}\frac{q}{r}$
</td><td>1
1
1</td><td>3</td></tr>
<tr><td>26</td><td>**Kirchhoff's current rule :** It states that the algebraic sum of the currents at any junction of a circuit is zero.
Kirchhoff's voltage rule :It states that in a closed circuit, the algebraic sum of the products of the current and resistance of each part of the circuit is equal to the total emf included in the circuit.</td><td>1½
1½</td><td>3</td></tr>
<tr><td>27</td><td>By connecting low resistance in parallel with the galvanometer we can convert galvanometer into an ammeter.
Diagram


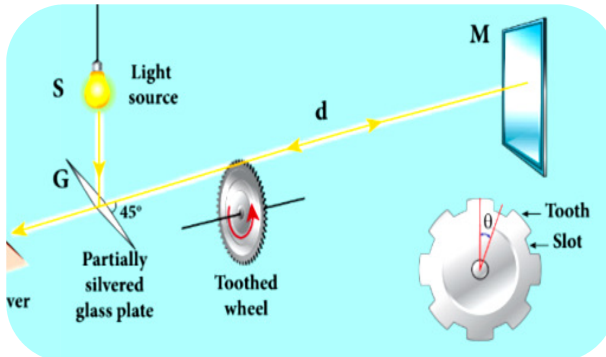
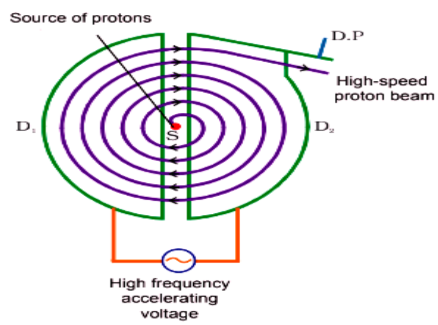
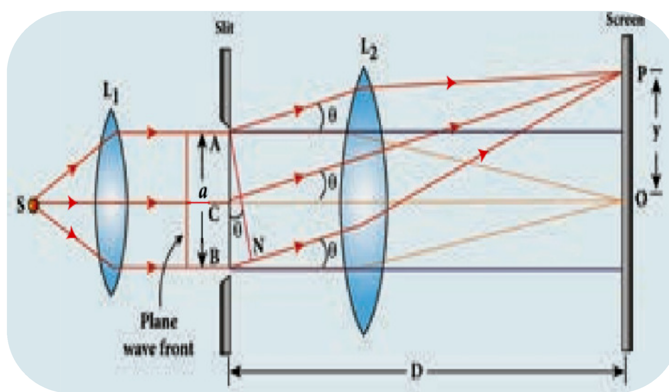
Upto S=$\frac{I_g}{I-I_g}R_g$ (or) $I_g = \frac{S}{S+R_g}\,I$
$\frac{1}{R_{eff}} = \frac{1}{R_g} + \frac{1}{S}$ (or) $R_{eff} = \frac{R_g\,S}{R_g+S}$ (or) $\theta = \frac{1}{G}I_g$ (or) $\theta\alpha I_g$ (or) $\theta\alpha I$</td><td>1
½
1
½</td><td>3</td></tr>
</table>

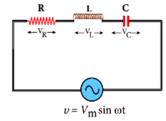
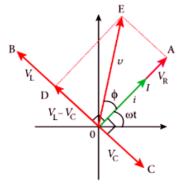
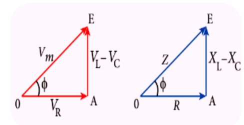
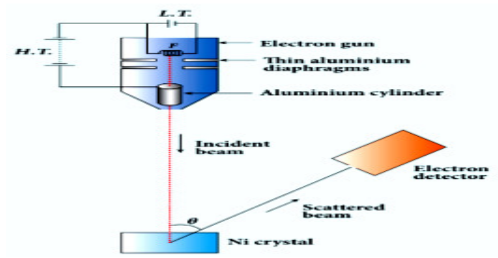
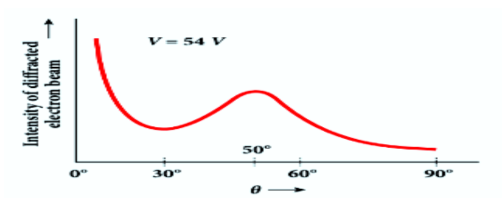
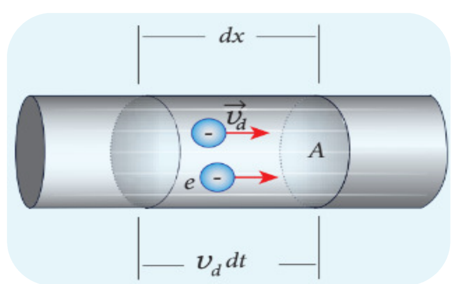
28	Diagram & Explanation upto $\frac{d\phi_B}{dt} = Blv$ $\mathcal{E}$ = Blv 	1 1 1	3
29	The dark lines in the solar spectrum are known as Fraunhofer lines. The absorption spectra for various materials are compared with the Fraunhofer lines in the solar spectrum, which helps in identifying elements present in the Sun's atmosphere	2 1	3
30	R_{net} = 2 + 2 = 4Ω I= $\frac{V}{R} = \frac{10}{4}$ I = 2.5 A	1 1 1	3
31	Optical path of a medium is defined as the distance d' light travels in vacuum in the same time it travels a distance d in the medium Optical path **d′ = n d** Where, **d′** ––– distance travelled by the light in vacuum **n** ––– Refractive index of the medium **d** ––– distance travelled by the light in medium	1½ ½ 1	3
32	Laws of photo electric effect – **any Three**	3×1	3
33	Number of atoms in 1 kgOf $^{235}_{92}U$ $N = \frac{6.02\ X\ 10^{23}}{235}\ X\ 1000$ Total energy, $Q = \frac{6.02\ X\ 10^{26}}{235} X\ 200\ MeV\ = 5.123\ X\ 10^{26} MeV$ In terms of joule , $Q\ = 8.197\ X\ 10^{13}\ J$	1 1 1	3

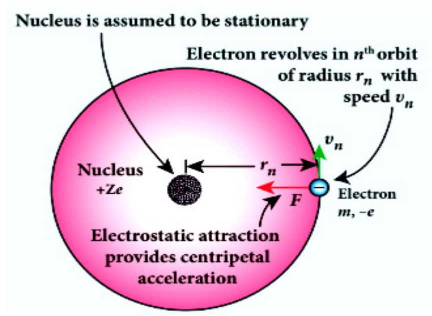
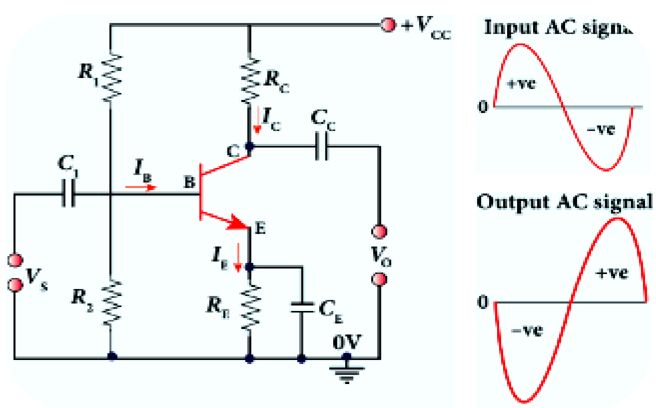
PART-IV

Answer all the Questions : **5×5=25**

34 (a)	(i) Coulomb's law – Statement (or) Formula (ii) Differences between coulomb's force and gravitational force (Any Three)	2 1 3	5
(OR)			

34 (b)	Diagram Explanation upto $\theta = \frac{\pi}{N}$ upto $t = \frac{\pi}{N\omega}$ $v = \frac{2dN\omega}{\pi}$  	1 1 1 1 1	5
35 (a)	Principle Diagram Construction and working Upto $r = \frac{mv}{Bq}$  $f = \frac{Bq}{2\pi m}$ (or) $T = \frac{2\pi m}{Bq}$ (or) $KE = \frac{q^2B^2r^2}{2m}$	1 1 1 1 1	5
(OR)			
35 (b)	Diagram Explanation Path difference $\delta = \frac{a}{2} sin\theta$  Condition for first minimum a sin θ = λ Condition for second minimum a sinθ = 2λ Condition for third minimum a sinθ = 3λ Condition for n^{th} minimum a sinθ = nλ Where n = 1, 2, 3,......	1 1 1 1 1	5

36 (a)	Series RLC circuit Diagram & Explanation  Phasor diagram  OR  Upto $V_m^2 = V_R^2 + (V_L - V_C)^2$ Upto Z = $\sqrt{R^2 + (X_L - X_C)^2}$ tan ϕ = $\frac{V_L - V_C}{V_R}$ (or) tan ϕ = $\frac{X_L - X_C}{R}$	1 1 1 1 1	5
	(OR)		
36 (b)	Diagram  Explanation Graph  λ = $\frac{12.27}{\sqrt{V}}A^0 = \frac{12.27}{\sqrt{54}}\ A^0 = 1.67A^0$	1 2 1 1	5
37 (a)	Diagram  Explanation Up to $I = \frac{dQ}{dt}$ $I = n\, e\, A\, v_d$ $\vec{J} = -\sigma\, \vec{E}$ (or) $\vec{J} = \sigma\, \vec{E}$	1 1 1 1 1	5
	(OR)		

37 (b)	Diagram Upto $\lvert\vec{F}_{coulomb}\rvert = \lvert\vec{F}_{centripetal}\rvert$ $r_n = \dfrac{4\pi\varepsilon_0 (m v_n r_n)^2}{Z m e^2}$ Upto $r_n = a_0 \dfrac{n^2}{Z}$ $v_n = \dfrac{h}{2\pi m a_0}\dfrac{Z}{n}$ (or) $v_n \,\alpha\, \dfrac{1}{n}$  	1 1 1 1 1	5
38 (a)	Any **Four** properties of EM waves $n = \sqrt{\epsilon_r\, \mu_r}$ $n = \sqrt{2.5 \times 2.25} = 2.37$ (no unit)	4×1 ½ ½	5
	(OR)		
38 (b)	Circuit diagram  Explanation $I_C = \beta I_B$ (or) $\beta = \dfrac{I_C}{I_B}$ (or) $V_{CE} = V_{CC} - I_C R_C$ Explanation during positive half cycle Explanation during Negative half cycle	1 1 1 1 1	5