VELLORE DISTRICT

FIRST REVISION EXAMINATION - 2022

12 - PHYSICS – ANSWER KEY

MARKS 70

QUESTION NO	OPTION	ANSWER	MARKS
1	D	0.1 H	1
2	D	ENERGY DENSITY	1
3	B	$1.2\ Am^2$	1
4	A	$100k\Omega$	1
5	C	MORE THAN BEFORE	1
6	B	$NA^{-1}m^{-1}$	1
7	D	$820^\circ C$	1
8	B	0.83	1
9	C	Nm^2C^{-1}	1
10	C	$\frac{R}{4}$	1
11	B	0.637	1
12	C	UNIFORMLY CHARGED INFINITE PLANE	1
13	A	$\vec{F} = q(\vec{V} \times \vec{B})$	1
14	C	400V	1
15	D	COPPER DECREASES & GERMANIUM INCREASES	1

PART- II

II. Answer any six of the following questions. Q.no 24 compulsory.

(6X2 = 12 marks)

16	**GAUSS LAW:** The total electric flux through a closed surface $\Phi_E = \frac{Q}{\varepsilon_0}$ **Q – Net charge enclosed by the surface**		2
17	**Q-factor :** Q-factor = voltage across L or C at resonance / applied voltage		2
18	**Fleming left hand rule :** Stretch forefinger, the middle finger and the thumb of the left hand such that they are in mutually perpendicular directions. If forefinger points the direction of magnetic field, the middle finger points the direction of the electric current, then thumb will point the direction of the force experienced by the conductor.		2

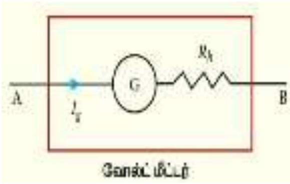
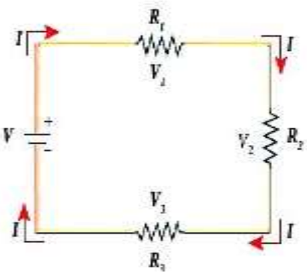
19	**Thermistor:** A semiconductor with a negative temperature coefficient of resistance is called a thermistor.		2
20	**Methods of producing induced emf:** Induced emf can be produced by changing magnetic flux in any of the following ways. (i) By changing the magnetic field *B* (ii) By changing the area *A* of the coil and (iii) By changing the relative orientation θ of the coil with magnetic field		2
21	**Electric dipole:** Two equal and opposite charges separated by a small distance constitute an electric dipole.		2
22	$F = k\,\frac{q_{m_A} q_{m_B}}{r^2}$ $q_{m_A} = q_{m_B} = q_m$ $9 \times 10^{-3} = 10^{-7} \times \frac{q_m^2}{(10 \times 10^{-2})^2}$ $q_m^2 = 900$ $q_m = 30\ NT^{-1}$	1 ½ ½	2
23	**Seebeck effect:** Seebeck discovered that in a closed circuit consisting of two dissimilar metals, when the junctions are maintained at different temperatures an emf (potential difference) is developed.		2
24	$\Phi_E = \vec{E}.\vec{A} = EA\cos\theta$ $= 100 \times 5 \times 10 \times 10^{-4} \times \cos 60^\circ$ $\Phi_E = 0.25 Nm^2C^{-1}$	1 ½ ½	2

PART- III

III. Answer any six of the following questions. Q.no 33 compulsory.

(6X3 = 18 marks)

25	**Explanation** $dW = V\,dQ$ Here $V = \frac{Q}{C}$ $dW = \frac{Q}{C}\,dQ$ (அ) $\int dW = \int_0^Q \frac{Q}{C}\,dQ$ $W = \frac{Q^2}{2C}$ $U_E = \frac{Q^2}{2C}$ (அ) $U_E = \frac{1}{2}CV^2$	1 ½ ½ 1	3

26	A Galvanometer is converted into voltmeter by connecting a high resistance in series with it.  $R_v = R_g + R_h$ $I_g = \frac{V}{R_g + R_h}$ $R_h = \frac{V}{I_g} - R_g$ **Voltmeter is always connected in parallel in a circuit. An ideal voltmeter has Infinite resistance**	½ ½ ½ ½ ½ ½	3
27	**Diagaram.** $V_1 = IR_1$; $V_2 = IR_2$; $V_3 = IR_3$  $V = V_1 + V_2 + V_3$ $V = IR_1 + IR_2 + IR_3$ $V = I(R_1 + R_2 + R_3)$ $V = IR_S$ $\boxed{R_S = R_1 + R_2 + R_3}$  **The total or equivalent resistance is the sum of the individual resistances**	1/2 1/2 1/2 1/2 1/2 1/2	3
28	**Explaination** $\omega_r = \frac{1}{\sqrt{LC}}$ (அ) $f_r = \frac{1}{2\pi\sqrt{LC}}$ $X_L = X_C$	1 1 1	3
29	$B_{staright\ wire} = \frac{\mu_0 I}{2\pi r}$ $B_{straight\ wire} = \frac{4\pi \times 10^{-7} \times 1}{2\pi \times 1}$ $B_{straight\ wire} = 2 \times 10^{-7} T$	1 1 1	3
30	**Kirchoff`s first rule**: It states that the algebraic sum of the currents at any junction of a circuit is zero. **Kirchoff`s second 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.	1½ 1½	3

31	**Advantages:** (i) Generation of AC is Cheaper (ii) Transmission losses are small. (iii) Easily can be converted into DC with the help of rectifiers. **Disadvantages :** (i) Cannot be used for certain applications. (ii) At high voltages it is more Dangerous.	1½ 1½	3
32	**Applications of capacitors: (any three).** (i) The flash which comes from the camera when we take photographs is due to the energy released from the capacitor, called a flash capacitor (ii)During cardiac arrest, a device called heart defibrillator is used to give a sudden surge of a large amount of electrical energy to the patient's chest to retrieve the normal heart function (iii) Capacitors are used in the ignition system of automobile engines to eliminate sparking. (iv) Capacitors are used to reduce power fluctuations in power supplies and to increase the efficiency of power transmission.	1 1 1	3
33	*CURRENT* $I = \frac{P}{V}$ $= \frac{2 \times 10^6}{10 \times 10^3} = 200A$ *POWER LOSS* $= I^2R$ $= (200)^2 \times 40 = 1.6 \times 10^6 W$	1 ½ 1 ½	3

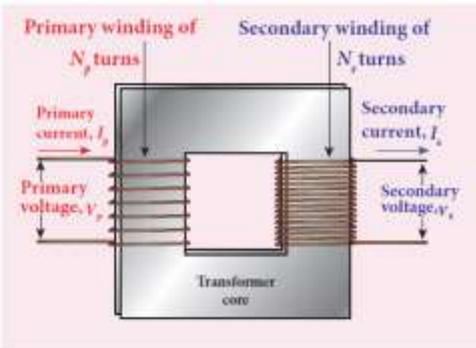
PART - IV

IV Answer the following questions. **(5X5 = 25 marks)**

34 A

Principle : Mutual induction ½

Diagaram. ½



Construction: ½

Working:

$$\varepsilon_P = -N_P \frac{d\phi_B}{dt} \quad \text{(or)}$$ ½

$$v_P = -N_P \frac{d\phi_B}{dt}$$ ½

$$\varepsilon_S = -N_S \frac{d\phi_B}{dt} \quad \text{(or)}$$

$$v_S = -N_S \frac{d\phi_B}{dt}$$ ½

$$\frac{v_S}{v_P} = \frac{N_S}{N_P} = K$$

For an Ideal transformer (5 marks)

Input power = Output power ½

$$v_P i_P = v_S i_S$$

$$\frac{v_S}{v_P} = \frac{N_S}{N_P} = \frac{i_P}{i_S}$$ ½

(or)

$$\frac{v_S}{v_P} = \frac{N_S}{N_P} = \frac{I_P}{I_S} = K$$

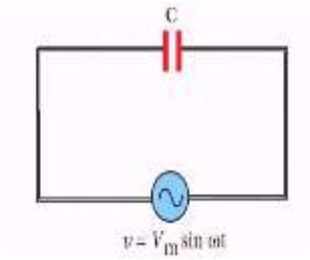
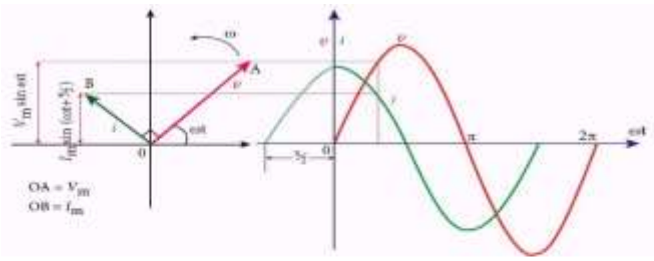
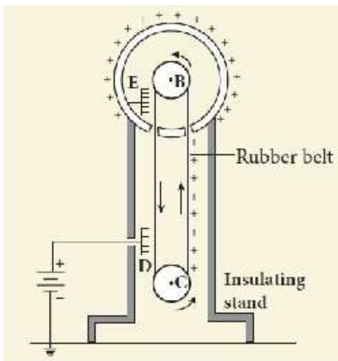
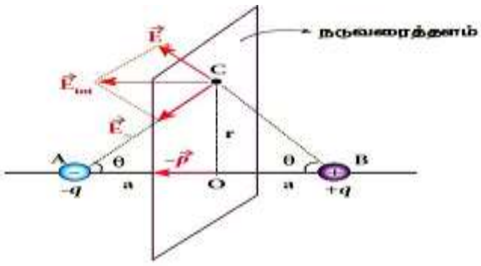
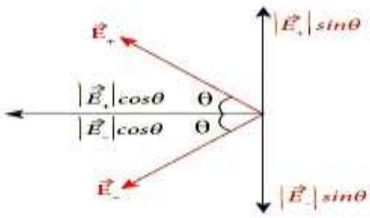
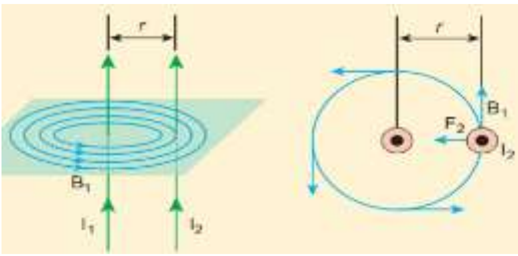
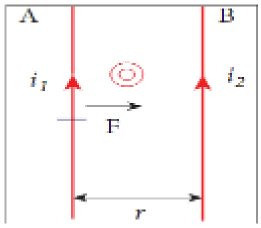
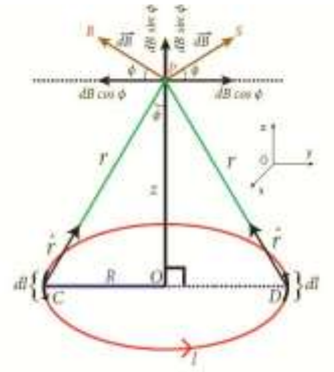
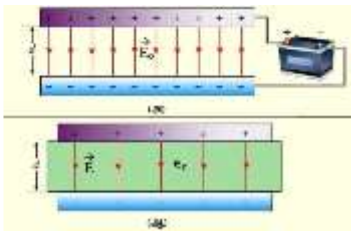
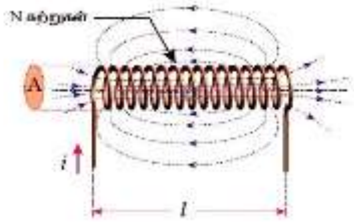
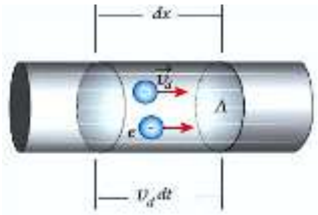
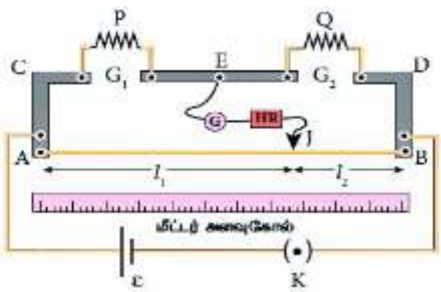
	For a Step up transformer $K > 1, v_S > v_P,\ N_S > N_P, I_P > I_S$ For a step down transformer $K < 1, v_S < v_P, N_S < N_P, I_P < I_S$ Efficiency of transformer $\eta = \frac{Output\ power}{Input\ power} \times 100\%$	½ ½	
34 B	**Explanation** **Diagaram**  $v = V_m \sin \omega t$ $v - \frac{q}{C} = 0$ $q = CV_m \sin \omega t$ $i = \frac{dq}{dt} = \frac{d(CV_m \sin \omega t)}{dt}$ $i = CV_m \omega \cos \omega t$ $i = \frac{V_m}{1/\omega C} \sin(\omega t + \frac{\pi}{2})$ $i = I_m \sin\left(\omega t + \frac{\pi}{2}\right)$ Here, $I_m = \frac{V_m}{1/\omega C}$ In a capacitive circuit current leads the voltage by $\frac{\pi}{2}$. *Phase diagrm* 	½ ½ ½ ½ ½ 1 ½ ½ ½	5
35 A	**Van-de-graff generator:** **Principle :** **Electrostatic induction & Action of points.** **Diagaram**  **Construction** **Working** The leakage of charges can be reduced by enclosing the machine in a gas filled steel chamber at very high pressure. **Uses** : The high voltage produced in this Van de Graaff generator is used to accelerate positive ions (protons and deuterons) for nuclear disintegrations and other applications.	1 1 1 1 ½ ½	5
35 B	**Explaination**	½	

	Diagram  	½	
	$\overrightarrow{E_{tot}} = -\lvert E_{+}\rvert \cos\theta\ \hat{P} - \lvert E_{-}\rvert \cos\theta\, \hat{P}$	½	
	$\lvert \overrightarrow{E_{+}}\rvert = \lvert \overrightarrow{E_{-}}\rvert = \frac{1}{4\pi\varepsilon_o}\frac{q}{(r^2+a^2)}$	½	5
	$\overrightarrow{E_{tot}} = -\frac{1}{4\pi\varepsilon_o}\frac{2q\cos\theta}{(r^2+a^2)}\hat{P}$	½	
	$\cos\theta = \frac{a}{\sqrt{r^2+a^2}}$	½	
	$\overrightarrow{E_{tot}} = -\frac{1}{4\pi\varepsilon_o}\frac{2qa}{(r^2+a^2)^{\frac{3}{2}}}\hat{P}$	½	
	$\vec{P} = 2aq\,\hat{P}$	½	
	$\overrightarrow{E_{tot}} = -\frac{1}{4\pi\varepsilon_o}\frac{\vec{P}}{(r^2+a^2)^{\frac{3}{2}}}$	½	
	$r >> a$ $\quad \overrightarrow{E_{tot}} = -\frac{1}{4\pi\varepsilon_o}\frac{\vec{P}}{r^3} \quad (r^2 \gg a^2)$	½	
36 A	Explaination	½	
	Diagram  	1	
	$\vec{B}_1 = \frac{\mu_o I_1}{2\pi r}(-\hat{i}) = -\frac{\mu_o I_1}{2\pi r}\hat{i}$	½	
	$d\vec{F} = \left(I_2 d\vec{l} \times \vec{B}_1\right) = -I_2 dl \frac{\mu_o I_1}{2\pi r}(\hat{k} \times \hat{i})$	½	5
	$= -\frac{\mu_o I_1 I_2 dl}{2\pi r}\hat{j}$	½	
	$\frac{\vec{F}}{l} = -\frac{\mu_o I_1 I_2}{2\pi r}\hat{j}$	½	
	$\vec{B}_2 = \frac{\mu_o I_2}{2\pi r}\hat{i}$		
	$\vec{F} = \left(I_1 d\vec{l} \times \vec{B}_2\right) = I_1 dl \frac{\mu_o I_2}{2\pi r}(\hat{k} \times \hat{i})$	½	
	$= \frac{\mu_o I_1 I_2 dl}{2\pi r}\hat{j}$	½	
	$\frac{\vec{F}}{l} = \frac{\mu_o I_1 I_2}{2\pi r}\hat{j}$	½	

36 *B*	**Explaination** **Diagram**  $\mathrm{d}\vec{B} = \frac{\mu_o}{4\pi}\frac{I\vec{dl}\times\hat{r}}{r^2}$ **(a)** $\mathrm{d}B = \frac{\mu_o}{4\pi}\frac{\mathrm{Idl}\sin\theta}{r^2} = \frac{\mu_o}{4\pi}\frac{Idl}{r^2}$ $\vec{B} = \int d\vec{B} = \int dB\sin\phi\,\hat{k}$ $= \frac{\mu_0 I}{4\pi}\int\frac{dl}{r^2}\sin\phi\,\hat{k}$ $\sin\phi = \frac{R}{\left(R^2+z^2\right)^{1/2}}$ மற்றும் $r^2 = R^2 + z^2$ $\vec{B} = \frac{\mu_0 I}{4\pi}\frac{R}{\left(R^2+z^2\right)^{3/2}}\hat{k}\left(\int dl\right)$ $\vec{B} = \frac{\mu_0 NI}{2}\frac{R^2}{\left(R^2+z^2\right)^{3/2}}\hat{k}$ $\vec{B} = \frac{\mu_0 NI}{2R}\hat{k}$	½ ½ ½ ½ ½ ½ ½ ½ 1	5
37 **A**	**Explaination** **Diagram**  $C_o = \frac{Q_o}{V_o}$ $E = \frac{E_o}{\varepsilon_r}$ $V = Ed = \frac{E_o}{\varepsilon_r}d = \frac{V_o}{\varepsilon_r}$ $C = \frac{Q_o}{V} = \varepsilon_r\frac{Q_o}{V_o} = \varepsilon_r C_o$ $C = \frac{\varepsilon_r\varepsilon_o A}{d} = \frac{\varepsilon A}{d}$ $U_o = \frac{1}{2}\frac{{Q_o}^2}{C_o}$ $U = \frac{1}{2}\frac{{Q_o}^2}{C} = \frac{1}{2}\frac{{Q_o}^2}{\varepsilon_r C_o} = \frac{U_o}{\varepsilon_r}$ $\varepsilon_r > 1$ $U < U_o$	½ ½ ½ ½ ½ ½ ½ ½ ½ ½	5
37 **B**	**Explaination** **Diagram**	1 ½	5

	Magnetic induction inside solenoid $B = \mu_0 ni$ Magnetic flux per turn $\phi_B = BA = (\mu_0 ni)A$ Total magnetic flus  $N\phi_B = nl(\mu_0 ni)A$ $\therefore [N = nl]$ $N\phi_B = (\mu_0 n^2 Al)i$ $N\phi_B = L\,i$ $L = \mu_0 n^2 Al$ $L = \mu\, n^2 Al$ (or) $L = \mu_0 \mu_r n^2 Al$	½ 1 ½ 1 ½	
38 *A*	Explaination Diagram  $V_d = \frac{dx}{dt}$ $dx = V_d dt$ Electrons available in the volume of length dx = Volume X number of electrons per unit volume $= (AV_d dt)n$ $dQ = e(AV_d dt)n$ $I = neAV_d$ $\vec{J} = ne\vec{V_d}$ $[\vec{V_d} = -\frac{e\tau}{m}\vec{E}]$ $\vec{J} = -\frac{ne^2\tau}{m}\vec{E}$ $\vec{J} = \sigma\vec{E}$ $\sigma = \frac{ne^2\tau}{m}$	½ ½ ½ 1 ½ ½ ½ ½ ½	5
38 *B*	Explaination Diagram  $\frac{P}{Q} = \frac{R}{S} = \frac{r.AJ}{r.JB}$ $\frac{P}{Q} = \frac{AJ}{JB} = \frac{l_1}{l_2}$ $P = Q\frac{l_1}{l_2}$ $\rho = P\frac{\pi a^2}{l}$	1 1 ½ 1 1 1/2	5