H

COMMON QUARTERLY EXAMINATION - 2023

Standard - XII Reg.No.

Time: 3.00 hrs. **PHYSICS** Thoothukudi District *Marks: 70*

PART - I

Answer all the questions: **15×1=15**

1. Which charge configuration produces a uniform electric field?
   a) Uniformly charged infinite plane b) point charge c) Uniformly charged spherical cell d) Uniformly charged infinite line
2. An electric dipole is placed at an alignment angle of 30° with an electric field of 2×10^5N/c. It experience a torque equal to 8Nm. The charge on the dipole if the dipole length of 1cm is
   a) 4mc b) 8mc c) 5mc d) 7mc
3. A capacitor is charged by a battery of voltage V and charge stored in it is Q. When the battery is disconnected from the capacitor and the dielectric medium is inserted between the plates, now the capacitance of capacitor and energy stored in the capacitor are
   a) increases, increases b) increases, decreases
   c) decreases, decreases d) decreases, increases
4. The resistance of a uniform wire of Length L and cross section area is A. The resistance of the same material having length 2L and cross section area 2A is
   a) R b) 2R c) R/2 d) R/4
5. If a current of 7.5A is maintained in a wire for 45 seconds then the charge flowing through the wire is
   a) 6C b) 365.5C c) 3C d) 337.5C
6. A wire connected to a power supply of 230V has power dissipation P1. Suppose the wire is cut into two equal pieces and connected parallel to the same power supply. In this case power dissipation is P2. The ratio P2/P1 is
   a) 1 b) 2 c) 3 d) 4
7. Magnetic field at any point at the distance R due to a long straight conductor carrying current varies as
   a) R^2 b) R c) $1/R^2$ d) 1/R
8. The vertical component of earth's magnetic field at a place is equal to the horizontal component, what is the value of angle of dip at this place?
   a) 30° b) 45° c) 60° d) 90°
9. A circular coil of radius 5cm and 50 terms carries a current of 3 ampere. The magnetic dipole moment of the coil is nearly
   a) 1.0 Am^2 b) 1.2 Am^2 c) 0.5 Am^2 d) 0.8 Am^2
10. The instantaneous values of alternating current and voltage in circuit are $i = 1/\sqrt{2}\,\sin(100\,\pi t)$, $v = 1/\sqrt{2}\,\sin(100\,\pi t + \pi/3)$ The average power consumed in the circuit is
    a) 1/4 watt b) 1/2 watt c) 1/8 watt d) $\sqrt{3}/4$ watt
11. The values of L, C and R of an AC circuit are 1H, 9F and 3ohm respectively. The quality factor for the circuit is
    a) 1 b) 9 c) 1/9 d) 1/3
12. In an oscillating LC circuit, the maximum charge on the capacitor is Q. The charge on the capacitor when 75% of total energy stored in inductor is
    a) Q/2 b) $Q/\sqrt{3}$ c) $Q/\sqrt{2}$ d) Q
13. Which of the following is an Electromagnetic wave?
    a) Beta rays b) Gamma rays c) Alpha rays d) all the above
14. Fraunhofer lines are an example of ______ spectrum.
    a) line emission b) line absorption c) band emission d) band absorption

15. Which of the following electromagnetic radiations is used for viewing objects through fog?
    a) Microwave b) Gamma rays c) X - rays d) infra red

PART - B

Answer any 6 questions only
Question number 19 is compulsory. **6×2=12**

16. What is an equipotential surface?
17. Define electri dipole moment.
18. Define temperature coefficient of of resistance.
19. A cell supplies a current of 0.9A through a 2 ohm resistor and a current of 0.3A through a 7 ohm resistor. Calculate the internal resistance of the cell.
20. State Fleming's left hand rule.
21. Is an ammeter connected in series or parallel in a circuit? why?
22. State lenz law.
23. Mention the ways of producing induced emf.
24. Calculate the speed of electromagnetic wave in medium if the amplitude of electric and magnetic fields are 3×10^{4} N/C and 2×10^{-4} T.

PART - C

Answer any 6 question only.
Question number 31 is compulsory. **6×3=18**

25. Write down the properties of electric field lines for charges
26. Obtain the expression for capacitance of a parallel plate capacitor.
27. Explain about the cells conncted in series
28. Write a short note on Super conductors.
29. State Tangent Law.
30. Calculate the magnetic field at the centre of a square loop which carries a current of 1.5 ampere, length of each side being 50cm.
31. The equation for an alternating current is given by i = 77 sin314t. Find the peak current, frequency, time period.
32. List the advantages and disadvantages of AC over DC.
33. Write down the properties of electromagnetic waves.

PART - D

Answer all the questions: **5×5=25**

34. Derive the expression for electric field due to an electric dipole on its axial line.
    (OR)
    Derive the expressions for resultant capacitance, when capacitors are connected in series and in parallel.
35. Describe the microscopic model of current and obtain the general from of ohm's law.
    (OR)
    How the emf of two cells are compared using potentiometer?
36. Derive the expression for the force on a current carrying conductor in a magnetic field.
    (OR)
    Discuss the working of Cyclotron in detail.
37. Derive an expression for phase angle between the applied voltage and current in RLC circuit.
    (OR)
    Explain the construction and working of transformer.
38. Write down the Maxwell equations in integral form.
    (OR)
    Explain the types of emission spectrum.

A.MUTHUGANESH., M.Sc.,M.Phil.,B.Ed.
P.G.Asst., (Physics)
K.V.S.Matric Hr.Sec.School
Thoothukudi - 628 002.

COMMON QUARTERLY EXAMINATION - THOOTHUKUDI DISTRICT

XII - PHYSICS - ANSWER KEY

A.Muthuganesh., M.Sc.,M.Phil., B.Ed., PhD.,
Departement of Physics.,
K.V.S.Matric.Hr.Sec.School.,
Thoothukudi - 628002.

Part - I

1. a. Uniformly charged infinite plane
2. b. 8 mc
3. b. Increases, decreases
4. a. R
5. d 337.5 C
6. d. 4
7. d. 1/R
8. b. 45°
9. b. 1.2 Am^2
10. c. 1/8 watt
11. c. 1/9
12. a. Q/2
13. b. Gamma rays
14. b. line absorption
15. d. Infra red.

Part – B

16. An equipotential surface is a surface on which all the points are at the same electric potential.

17. The electric dipolemoment is defined as $\vec{p} = q\vec{r}_+ + (-q)\vec{r}_-$

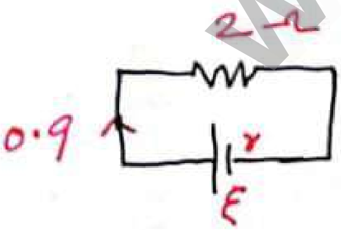
$\vec{r}_+$ is the position vector of +q from the origin
$\vec{r}_-$ is the position vector of −q from the origin

(OR)

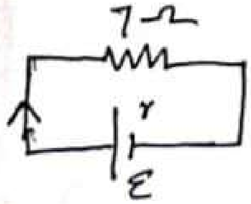
The magnitude of dipole-moment is equal to the product of the magnitude of one of the charges and the distance between them. $(\vec{p}) = 2qa$.

18. Temperature coefficient of resistance: It is defined as the ratio of increase in resistance (resistivity) per degree rise in temperature to its resistance (resistivity) at T_0. (OR) $\alpha = \frac{\Delta R}{R_0 \Delta T}$ (1 mark)

19.



= 0·3



$\varepsilon = I_1(R_1 + r) = I_2(R_2 + r)$

$0.9(2 + r) = 0.3(7 + r)$

$3(2 + r) = 7 + r$

$6 + 3r = 7 + r$ $\therefore 2r = 1$ $r = 0.5\,\Omega$

20. Fleming Left hand rule:

Fore finger – direction of magnetic field

Middle finger – direction of electric current.

Thumb – direction of force experienced by the conductor.

21. An ammeter must offer low resistance such that it will not change the current passing through it. So ammeter is connected in series to measure the circuit current.

22. Lenz's law: It states that the direction of induced current is such that it always opposes the cause responsible for its production.

23. 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.

24. $$V = \frac{E_0}{B_0} = \frac{3 \times 10^4}{2 \times 10^{-4}} = 1.5 \times 10^8 \ m s^{-1}$$

Part C

25. i) The electric field lines start from positive charge and end at negative charges or at infinity.

ii) The electric field vector at a point in space is tangential to the electric field line at that point

iii) The electric field lines are denser in the region where electric field has larger magnitude and less dense where electric field is of smaller magnitude.

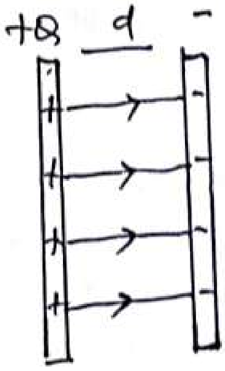
iv) No two electric field lines intersect each other.

v) The number of electric field lines that eminate from the positive charge or end at the negative charge is directly proportional to the magnitude of charges.

26. $E = \frac{\sigma}{\epsilon_0}$ and σ is Q/A $\therefore E = \frac{Q}{A\epsilon_0}$

Electric potential difference between the plates

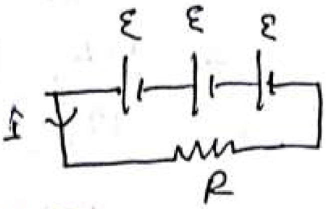
$$V = Ed = \frac{Qd}{A\epsilon_0}$$



Capacitance of the capacitor.

$$C = \frac{Q}{V} = \frac{Q}{\frac{Qd}{A\epsilon_0}} = \frac{\epsilon_0 A}{d}$$

27. Cells in Series:



i) Total emf of the battery = $n\varepsilon$

ii) Total resistance in the circuit = $nr + R$

iii) Current $I = \dfrac{n\varepsilon}{nr+R}$

Case i) $r << R$ ∴ $I = \dfrac{n\varepsilon}{R} \simeq nI_1$ $[I_1 = \dfrac{\varepsilon}{R}]$

Case ii) $r >> R$ ∴ $I = \dfrac{n\varepsilon}{nr} = \dfrac{\varepsilon}{r}$

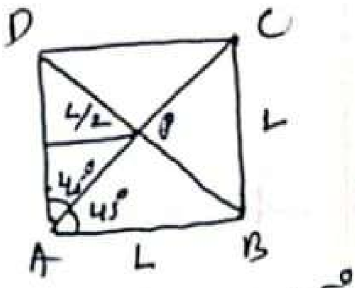
28 Super conductor: —

* The resistance of certain material becomes zero below certain temperature T_c - known as critical temperature.
* The material which exhibit this property are known as superconductor.

29 Tangent law:

When a magnetic needle or magnet is freely suspended in two mutually perpendicular uniform magnetic fields it will come to rest in the direction of the resultant of the two fields.

30. $B_{AP} = \frac{\mu_0 I}{4\pi a}[\sin\theta_1 + \sin\theta_2]$



$\theta_1 = \theta_2 = 45^\circ$

$= \frac{\mu_0 I}{4\pi\left(\frac{L}{2}\right)}(\sin 45^\circ + \sin 45^\circ)$

$= \frac{\mu_0 I}{2\pi L}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right)$

$B_{AP} = \frac{\mu_0 I}{2\pi L}\frac{2}{\sqrt{2}} = \frac{\mu_0 I}{\sqrt{2}\pi L}$

|||ly For 4 sides $B = 4\left(\frac{\mu_0 I}{\sqrt{2}\pi L}\right)$, $I = 1.15\,A$, $L = 50\,cm = 0.5\,m$

$B = \frac{4 \times 4\pi \times 10^{-7} \times 1.5}{\sqrt{2}\,\pi \times 0.5} = 3.4 \times 10^{-6}\,T.$

31. $i = 77 \sin 314 t$

$i = I_m \sin \omega t$ $\therefore$ $I_m = 77\,A$

$\omega = 2\pi f = 314 \therefore f = \frac{314}{2 \times 3.14} = 50\,Hz$

$T = \frac{1}{f} = \frac{1}{50} = 0.02\,s$

32. Advantages of AC:

1. Generation of AC is cheaper than that of DC.
2. Transmission losses are small
3. AC can be easily converted into DC by rectifier.

Disadvantages of AC:

1. AC can't be used for charging batteries, electro plating, etc
2. At high voltages it is more dangerous to work with AC than DC.

33. Properties of electromagnetic waves:- (six points)

i) EM waves are produced by any accelerated charges.

2) They donot require medium for propagation.

3) EM waves are transverse in nature.

4) They travel with speed of light in vacuum or free space $c = \frac{1}{\sqrt{\mu_0 \epsilon_0}} = 3 \times 10^8 \, ms^{-1}$

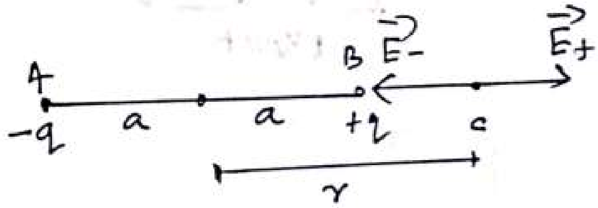
5. They are not deflected by Electric and magnetic fields

6. They can exhibit Interference, diffraction and polarisation.

7. EM waves carry Energy, Linear momentum and angular momentum.

Part-IV.

34 (a)



$\vec{E}_+ = \frac{1}{4\pi\epsilon_0} \frac{q}{(r-a)^2}$ along BC

$\vec{E}_- = \frac{1}{4\pi\epsilon_0} \frac{q}{(r+a)^2}$ along CA

$\vec{E}_- = -\frac{1}{4\pi\epsilon_0} \frac{q}{(r+a)^2} \hat{p}$

$\vec{E}_{tot} = \vec{E}_+ + \vec{E}_-$

$= \frac{q}{4\pi\epsilon_0} \left[\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2} \right] \hat{p}$

$= \frac{q}{4\pi\epsilon_0} \left[\frac{4ra}{(r^2-a^2)^2} \right] \hat{p}$

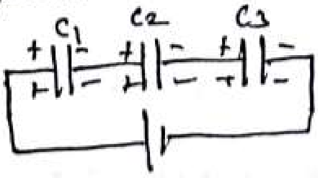
$(r >> a)$

$\vec{E}_{tot} = \frac{1}{4\pi\epsilon_0} \frac{4aq}{r^3} \hat{p}$

$2aq \hat{p} = \vec{p}$

$\vec{E}_{tot} = \frac{1}{4\pi\epsilon_0} \frac{2\vec{p}}{r^3}$

34 (b) Capacitor in Series:-



* Each capacitor stores same amount of charge.

* $V = V_1 + V_2 + V_3$

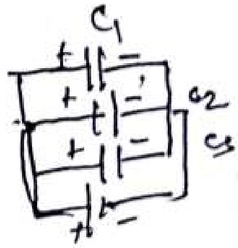
$Q = CV$,

$V = \frac{Q}{C_1} + \frac{Q}{C_2} + Q/C_3$

$\frac{Q}{C_s} = \frac{Q}{C_1} + Q/C_2 + Q/C_3$

$\frac{1}{C_s} = 1/C_1 + 1/C_2 + 1/C_3.$

8 Parallel



Voltage across each capacitor is equal to battery Voltage.

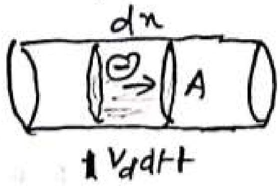
$Q = Q_1 + Q_2 + Q_3$

$Q = CV$

$C_pV = C_1V + C_2V + C_3V$

$C_p = C_1 + C_2 + C_3.$

35 (a) Microscopic Model of current:



$V_d = \frac{dx}{dt}$, $dx = V_d\, dt$

No. of electron in the volume of length $dx = A\, dx \times n$

$= A\, V_d\, dt\, n$

$dQ = e\, A\, V_d\, dt\, n$

$I = \frac{dQ}{dt} = neAV_d$

$J = \frac{I}{A} = \frac{neAV_d}{A} = neV_d$

W.k.t $V_d = -\frac{e\tau}{m}\vec{E}$

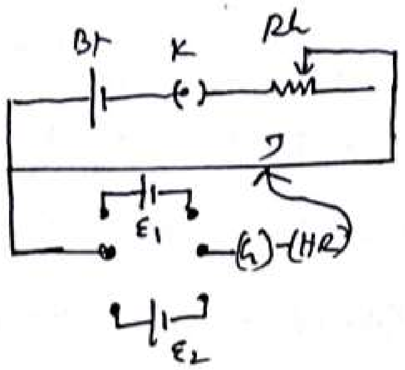
$\vec{J} = -\frac{ne^2\tau}{m}\vec{E}$

$\vec{J} = -\sigma\vec{E}$

$\vec{J} = \sigma\vec{E}$

$\sigma = \frac{ne^2\tau}{m}$

35 (b)



Introduction –

Explanation –

$\mathcal{E}_1 = I r l_1$

$\mathcal{E}_2 = I r l_2$

$$\frac{\mathcal{E}_1}{\mathcal{E}_2} = \frac{l_1}{l_2}$$

Force acting on each electron

$\vec{F} = -en\,A\,dl\,(\vec{V}_d \times \vec{B})$

But $I\vec{dl} = -enA\vec{V}_d\,dl$

Force on small elemental section

$d\vec{F} = (I\vec{dl} \times \vec{B})$

$\vec{F} = I\vec{l} \times \vec{B}$

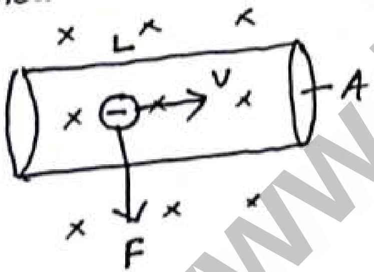
In magnitude

$F = BIl \sin\theta$

If $\theta = 0$, $F = 0$

If $\theta = 90$ $F = BIl$

36 a) Force on a current carrying Conductor:



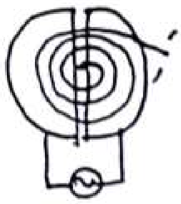
$I = nAV_d e$

$\vec{f} = -e(\vec{V}_d \times \vec{B})$

n is no. of electron per unit volume : $n = \frac{N}{V}$

N is no. of free electron in the small volume $V = A\,dl$.

36 (b) cyclotron.

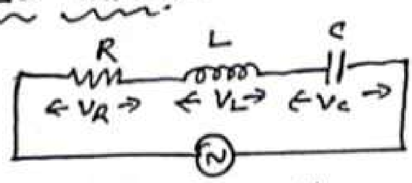


1. Diagram –
2. construction –
3. working.
4. $\frac{mv^2}{r} = Bqv \quad \therefore r = \frac{mv}{qB}$

$r \propto v$

5. $f_{osc} = \frac{qB}{2\pi m}$, $T = \frac{2\pi m}{Bq}$
6. $KE = \frac{1}{2}mv^2 = \frac{q^2B^2r^2}{2m}$

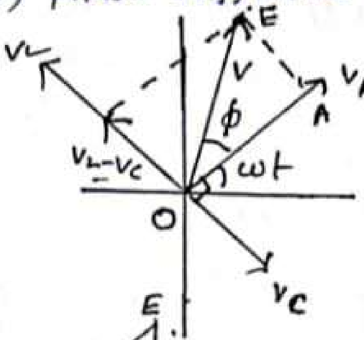
37 a) RLC circuit:

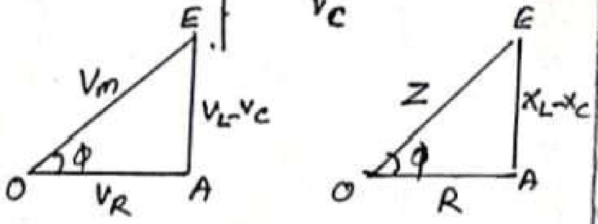


$V = V_m \sin \omega t$

1) Introduction

2) phase difference Explanation.





$$V_m^2 = V_R^2 + (V_L - V_C)^2$$

$$V_m = \sqrt{(I_m R)^2 + (I_m X_L - I_m X_C)^2}$$

$$V_m = I_m \sqrt{R^2 + (X_L - X_C)^2}$$

$$I_m = \frac{V_m}{\sqrt{R^2 + (X_L - X_C)^2}}$$

$$I_m = \frac{V_m}{Z}, \quad Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\tan\phi = \frac{V_L - V_C}{V_R} = \frac{X_L - X_C}{R}.$$

Spl. case:

1) If $X_L > X_C$ – Voltage leads the current by ϕ

Circuit is Inductive, ϕ is positive

$V = V_m \sin \omega t$, $I = I_m \sin(\omega t - \phi)$

2) If $X_L < X_C$, current leads the Voltage by ϕ

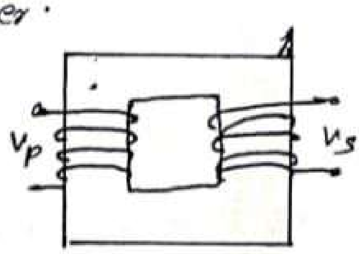
Circuit is capacitive, ϕ is negative

$V = V_m \sin \omega t$, $I = I_m \sin(\omega t + \phi)$

3) If $X_L = X_C$, $\phi = 0$, circuit is resistive.

$V = V_m \sin \omega t$, $I = I_m \sin \omega t$

37(b) Transformer.



1. Diagram –

2. Construction –

3. Working –

4. $\varepsilon_p = -N_p \cdot \frac{d\phi_B}{dt}$; $V_p = -N_p \cdot \frac{d\phi_B}{dt}$

5. $\varepsilon_s = -N_s \cdot \frac{d\phi_B}{dt}$; $V_s = -N_s \cdot \frac{d\phi_B}{dt}$

6. $\frac{V_s}{V_p} = \frac{N_s}{N_p} = K.$

7. For Ideal transformer: $V_p i_p = V_s i_s$

$\therefore \frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s} = K$

8. Step up: $K > 1$, $V_s > V_p$, $N_s > N_p$, $I_p > I_s$

9. Step down: $K < 1$, $V_p > V_s$, $N_p > N_s$, $I_s > I_p$

10. $\eta = \frac{\text{Output power}}{\text{Input power}} \times 100\%$.

38 (a) Maxwells Equation:-

1) $\oint \vec{E}\cdot d\vec{A} = \frac{Q_{enclosed}}{\varepsilon_0}$

2) $\oint \vec{B}\cdot d\vec{A} = 0$

3) $\oint \vec{E}\cdot d\vec{l} = -\frac{d\phi_B}{dt}$

4) $\oint \vec{B}\cdot d\vec{l} = \mu_0 I_c + \mu_0\varepsilon_0 \frac{d}{dt}\oint \vec{E}\cdot d\vec{A}$

38 (b) Emission spectrum! -

* when the spectrum of self luminous source is taken, we get emission spectrum. Each source has its own characteristic emission spectrum.

Continuous Emission spectrum! -

- light from incandescent lamp is allowed to pass through the prism it split in to seven colours. violet to red.
- Eg. Spectrum obtained from Carbon arc, incandescent solid.

Line Emission spectrum: -

- light from hot gas is allowed to pass through the prism.
- It consist of sharp lines of definite wavelength.
- arises due to excited atoms of element and shows its character.
- Eg: Spectra of atomic H_2 and helium.

Band Emission Spectrum: -

- several no. of closely spaced spectral line overlap. forms specific band separated by dark space.
- sharp edge at one end and fading at other end.
- arises due to excited of molecules. - Used to study the structure of molecule.
- Eg: Spectra of Ammonia gas in the discharge tube.