

II PUC PHYSICS



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Passing Package 2025

(Department Of Pre-University)

MOST IMPORTANT 5 MARKS NUMERICAL PROBLEMS

PART – D

10 Marks

Out of 4 any 2 Numericals to be solved.

To Solve any 2, do Numericals on

01.	Electric Charges & Field (10) or Electric Potential & Capacitance (12)
02.	Current Electricity (13)
03.	AC – Alternating Current (12)
04.	Ray Optics +

1. ELECTRIC CHARGES & FIELD :

- Two point charges $q_A = 3\mu\text{C}$ and $q_B = -3\mu\text{C}$ are located 20cm apart in vacuum.
 - What is the electric field at the midpoint O on the line AB joining the two charges?
 - If a negative test charge of magnitude $1.5 \times 10^{-9} \text{ C}$ is placed at this point, what is the force experienced by the test charge?

(March-17)
- Three charges each equal to $+4\text{nC}$ are placed at the three corners of a square of side 2cm. find the electric field at the fourth corner.

(March-18)
- Two point charges $q_A = 5\mu\text{C}$ and $q_B = -5\mu\text{C}$ are located at A and B 0.2m apart in vacuum.
 - What is the electric field at the midpoint O of the line joining the two charges?

- b) If a negative test charge of magnitude 2nC is placed at point O, what is the force experienced by the test charge? **(March-2020)**
4. Two point charges of $2\mu\text{C}$ and $8\mu\text{C}$ are separated by a distance of 4cm . Calculate the electrostatic force between them. If the distance between the charges is halved, and a medium of dielectric constant 2 is placed between them, find new electrostatic force. Also find the change in force. (Given: $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{Nm}^2\text{C}^{-2}$) **(MQP -2022)**
5. Three-point charges $+3\text{nC}$, -3nC and $+2\text{nC}$ are placed at corners of an equilateral triangle ABC of side 0.3 m in air. Find resultant force acting on $+2\text{nC}$.
6. Four-point charges $2\mu\text{C}$, $-5\mu\text{C}$, $2\mu\text{C}$ and $-5\mu\text{C}$ are placed at corners of square ABCD of side 10 cm respectively. Find force on $1\mu\text{C}$ charge placed at the center of square.
7. Two-point charges $10\mu\text{C}$ and $20\mu\text{C}$ are placed at corners of hypotenuse BC of right angled triangle ABC of side $AB = 3\text{ cm}$, $AC = 4\text{ cm}$. Calculate resultant electric field at point A.
8. Three charges each equal to $+4\text{nC}$ are placed at 3 corners of a square of side 2 cm . Find resultant electric field at 4th corner.
9. Two-point charges 5nC and 20nC are separated by a distance of 2 m . Find point on the line joining them where electric field is zero.
10. A spherical conductor of radius 12 cm has charge of $1.6 \times 10^{-7}\text{ C}$ distributed uniformly on its surface. Find electric field. i) at a point 18 cm from center of sphere ii) Just outside the sphere iii) Inside the sphere

2. ELECTRIC POTENTIAL & CAPACITANCE:

1. In a parallel plate capacitor with air between the plates, each plate has an area of $6 \times 10^{-3}\text{ m}^2$ and the distance between the plates is 3mm . calculate the capacitance of the capacitor. If this capacitor is connected to a 100 V supply, what is the charge on each plate of capacitor? (absolute permittivity of free space $= 8.85 \times 10^{-12}\text{Fm}^{-1}$). **(March-14)**
2. Two charges $3 \times 10^{-8}\text{ C}$ and $-2 \times 10^{-8}\text{ C}$ are located 15cm apart. At what points on the line joining the two charges is the electric potential is zero. Take the potential at infinity to be zero. **(J-14)**
3. Two point charges 1microC & -4 Micro C are 1m apart in air. Find the positions along the line joining the two charges at which the resultant potential is zero. **(M-15)**
4. ABCD is a square of side 2m . Charges 5microC , 10microC and 5microC are placed at the corners A B and C respectively. What is the work done in transferring a charge of 5microC from D to the point of intersection of diagonals? **(J-15)**

5. When two capacitors are connected in series and connected across a 4kV line, the energy stored in the system is 8J. If the same capacitors are connected in parallel across the same line, the energy stored is 36J. Find the individual capacitances. **(March-16)**

6. Charges 2microC , 4 microC, and 6 microC are placed at three corners ABC respectively of a square ABCD of side x m. Find what charge must be placed at the corner D such that the potential at the centre of the square is zero. **(J-16)**

7. In a parallel plate capacitor with air between the plates each plate has an area $8 \times 10^{-3} \text{m}^2$ and distance between the plates is 2mm. calculate the capacitance of the capacitor. If these capacitors is connected to a 50V supply. What is the charge on each plate of the capacitor? **(J-17)**

8. The plates of a parallel plate capacitor have an area of 100cm^2 each and are separated by 3mm. The capacitor is charged by connecting it to a 400V supply. Calculate (a) the electrostatic energy stored in the capacitor, (b) if a dielectric of constant 2.5 is introduced between the plates of the capacitor, then find electrostatic energy stored and also change in the energy stored. **(J-18)**

9. In a circular parallel plate capacitor radius of each plate is 5cm and they are separated by a distance of 2mm. Calculate the capacitance and the energy stored, when it is charged by connecting the battery of 200V. **(March 2019)**

10. A B C D is a square of side 1m. charges of +3nC, -5nC and +3nC are placed at the corners A, B and C respectively/ Calculate the work done in transferring a charge of 12microC from D to the point of intersection of the diagonals. **(June-19)**

11. In a parallel plate capacitor with air between the plates, each plate has an area of $6 \times 10^{-3} \text{m}^2$ and the distance between the plates is 3mm. calculate the capacitance of the capacitor. If this capacitor is connected to a 100 V supply, what is the charge on each plate of capacitor? (absolute permittivity of free space= $8.85 \times 10^{-12} \text{Fm}^{-1}$). **(June-2020)**

12. A parallel plate capacitor consists of two circular metal plates, each of radius 1.38cm. A coating of Teflon $40 \mu\text{m}$ thick is applied to the inner surface of one plate to provide a dielectric layer, and then the plates are pressed together. Find the voltage to be applied between the plates of this capacitor to establish a charge of 0.5nC on each plate (Given: Dielectric of Teflon = 2) **(MQP-2022)**

3. CURRENT ELECTRICITY :

1. A battery of internal resistance 3Ω is connected to 20Ω resistor and potential difference across the resistor is 10V. If another resistor of 30Ω is connected in series with the first resistor and battery is again connected to the combination, calculate the emf and terminal potential difference across the combination. **(March-14)**

2. Two cells of emf 2V and 4V and internal resistance 1Ω and 2Ω respectively are connected in parallel so as to send the current in the same direction through an external

resistance of 10Ω . find the potential difference across the 10Ω resistance.

(March-15)

3. Two identical cells either in series or parallel in combination give the same current of $0.5A$ through an external resistance of 4Ω . Find the emf and internal resistance of each cell.

(June-15)

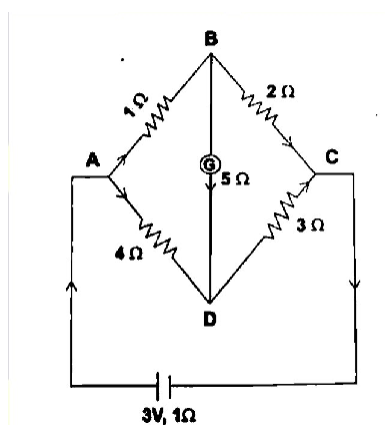
4. A wire having length $0.2m$, diameter $1.0mm$ and resistivity $1.963 \times 10^{-8} \Omega m$ is connected in series with a battery of emf $3V$ and internal resistance 1Ω . Calculate the resistance of a wire and current in the circuit.

(June-16)

5. $100mg$ mass of Nichrome metal is drawn into a wire of area of cross section $0.05mm^2$. Calculate the resistance of this wire. Given density of nichrome is $8.4 \times 10^3 kgm^{-3}$ and the resistivity of the material is $1.2 \times 10^{-6} \Omega m$.

(March-18)

6. In the given circuit, Calculate the current through the galvanometer(Ig) (June-20)

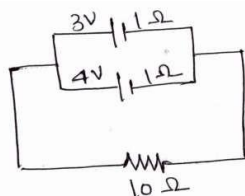


7. Two cells of emf $3V$ and $4V$ and internal resistance 1Ω and 2Ω respectively are connected in parallel so as to send the current in the same direction through an external resistance of 5Ω . Find the potential difference across 5Ω resistor.

(MQP 2022)

8. A uniform wire of resistance 12Ω is cut into 3 pieces in the ratio $1 : 2 : 3$ and are connected to form a triangle. A cell of emf $8V$, internal resistance 1Ω is connected across highest of three resistors. Calculate current in each part of the circuit.

9. Calculate power dissipated across 10Ω resistor.



10. Two cells of emf $1.5V$ and $2V$ having internal resistance 1Ω and 2Ω respectively are connected in parallel to an external resistance of 5Ω . Calculate current in each branch of circuit.

11. Two identical cells either in series or parallel combination give same current of 0.5 A through external resistance of $4\ \Omega$. Find emf and internal resistance of each cell.
12. An electric bulb is marked 100 W, 230 V. If it is connected to a supply of 115 V calculate
 - i) Current flowing through bulb.
 - ii) Heat and light energy produced in 20 min.
13. Two electric bulbs rated 60 W, 110 V and 100 W and 110 V are connected in series with a 220 V supply. Will any bulb fuse?

4. ALTERNATING CURRENT (AC) :

1. Calculate resonant frequency of & factor of series LCR circuit containing a pure inductor of inductance 3H, capacitor of capacitance $27\mu\text{F}$ and the resistor of resistance 7.4Ω . **(March-14)**
2. A pure inductor of 25mH is connected to source of 220V; 50 Hz. Find the inductive reactance, rms value of current and peak current in the circuit. **(J-14)**
3. A sinusoidal voltage of peak value 283V and frequency 50Hz is applied to a series LCR circuit in which $R = 3\ \Omega$, $L = 25.48\text{mH}$ and $C = 786\mu\text{F}$. Find
 - a) impedance of the circuit, b) the phase difference between the voltage across the source and the current c) the power factor. **(March-15)**
4. A resistor of 100Ω , a pure inductance coil of $L = 0.5\text{H}$ and capacitor are in series in a circuit containing an AC source of 200V; 50Hz. In the circuit current is ahead of voltage by 30° . Find the value of capacitance. **(J-15)**
5. Calculate the resonant frequency and Q factor of a series LCR circuit containing a pure inductor of inductance 4H, capacitor of capacitance $27\mu\text{F}$ and resistor of resistance 8.4Ω . **(March-16)**
6. An inductor and bulb are connected in series to an ac source of 220V; 50Hz. A current of 11A flows in the circuit and phase angle between voltage and current $\pi/4$ radians. Calculate the impedance and inductance of the circuit. **(J-16)**
7. A source of alternating emf of 220V; 50Hz is connected in series with a resistance of 200Ω , an inductance of 100mH and a capacitance of $30\mu\text{F}$. Does the current lead or lag the voltage and by what angle? **(March-17)**
8. A sinusoidal voltage of peak value 285V is applied to a series LCR circuit in which resistor of resistance 5Ω , pure inductor of inductance 28.5mH and capacitor of capacitance $800\mu\text{F}$ are connected. Find the resonant frequency and also calculate the impedance, current and power dissipated at resonance. **(J-17)**
9. A 20Ω resistor, 1.5 H inductor and $35\mu\text{F}$ capacitor are connected in series with a 220V; 50 Hz ac supply. Calculate the impedance of the circuit and also find the current through the circuit. **(J-18)**
10. A sinusoidal voltage of peak value 283V and frequency 50Hz is applied to a series LCR circuit in which $R = 3\Omega$, $L=25.48\text{mH}$ and $C = 796\mu\text{F}$, Find

- a) Impedance of the circuit
- b) The phase difference between the voltage across the source and the current. **(June-19)**

11. A series LCR circuit contains a pure inductor of inductance 5.0 H, a capacitor of capacitance $20\mu\text{F}$ and a resistor of resistance 40Ω

- a) Find the resonant frequency of the circuit
- b) Calculate the Quality Factor(Q.Factor) of the circuit.
- c) What is the impedance at resonant condition ?

(March-2020)

12. An AC source of 200V, 50Hz is applied to a series LCR circuit in which $R = 3\Omega$, $L=25\text{mH}$ and $C = 790\mu\text{F}$, Find

- a) Impedance of the circuit
- b) Current in the circuit

(June-2020)

5. RAY OPTICS:

1. Two lenses of focal lengths 0.20m and 0.30m are kept in contact. Find the focal length of the combination. Calculate the powers of two lenses and combination.

(March-14)

2. A prism of angle 60° produces angle of minimum deviation of 40° . What is its refractive index? Calculate the angle of incidence. **(July 2014)**

3. An object is placed at 10cm in front of a concave mirror of radius of curvature 15cm. Find the position and the magnification of the image. Write the nature of the image

(MQP 2022)