TNPSC | CTSE | DIPLOMA | ITI | 2026

Circuit Theory Fundamentals

Subject Code: 446

50 Most Important Expected Numerical MCQs

Part I-A — Competitive Exam Preparation | Previous Year + Expected Questions

Detailed Step-by-Step Explanations for Self Study

Topics: Electrostatics · Ohm's Law · KVL/KCL · Network Theorems · AC Circuits · Resonance

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Prepared by: Er Balakrishnan

🌐 Website: **https://erbalakrishnan.online/** | 📺 YouTube: **Er Balakrishnan**

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TOPIC 1: Electrostatics & Basic Electricity Concepts

Er Balakrishnan

Questions 1 to 6 | Charge, Coulomb's Law, Electric Field, Potential, Capacitors

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Q.1 — Electrostatics (Coulomb's Law)

Previous Year Type

Two point charges of +4 μC and +9 μC are placed 3 m apart in air. Find the force of repulsion between them. (Given: k = 9 × 10⁹ N·m²/C²)

(A) 0.036 N

(B) 0.036 N — 36 mN

(C) 0.004 N

(D) 0.360 N

✅ **CORRECT ANSWER: (B) 36 MN = 0.036 N**

Coulomb's Law: $F = k \cdot q_1 \cdot q_2 / r^2$

```
F = (9×10⁹ × 4×10⁻⁶ × 9×10⁻⁶) / (3)²
```

Step 1: Numerator = $9\times10^{9} \times 36\times10^{-12} = 9 \times 36 \times 10^{-3} = 324 \times 10^{-3} = 0.324$

Step 2: Denominator = $r^2 = 3^2 = 9$

Step 3: F = 0.324 / 9 = 0.036 N = 36 mN

📌 *Key: Both charges same sign → Repulsion. Different sign → Attraction. Unit of charge: Coulomb (C). 1 μC = 10^{-6} C.*

Q.2 — Electric Field Intensity

Expected 2026

A charge of 5 μC is placed in air. What is the electric field intensity at a point 2 m away from it? (k = 9 × 10^9 N·m^2/C^2)

(A) 4500 V/m

(B) 11250 V/m

(C) 22500 V/m

(D) 900 V/m

✓ **CORRECT ANSWER: (B) 11250 V/M**

Formula: $E = k \cdot Q / r^2$

```
E = (9×10⁹ × 5×10⁻⁶) / (2)² = 45000 / 4 = 11250 V/m
```

Step 1: $k \cdot Q = 9 \times 10^9 \times 5 \times 10^{-6} = 45{,}000$ N·m/C

Step 2: $r^2 = 4$ m^2

Step 3: $E = 45000 / 4 = 11{,}250$ V/m

📌 *Electric field (E) is force per unit charge. Unit: N/C or V/m. E is a vector — it points away from positive charges.*

Q.3 — Capacitance & Energy Stored

Previous Year Type

A capacitor of 50 μF is charged to a voltage of 200 V. Find the energy stored in the capacitor.

(A) 0.5 J

(B) 2 J

(C) 1 J

(D) 4 J

✓ **CORRECT ANSWER: (C) 1 J**

Energy stored in capacitor:

```
W = ½·C·V² = ½ × 50×10⁻⁶ × (200)² = ½ × 50×10⁻⁶ × 40000 = ½ × 2 = 1 J
```

Step 1: C = 50 μF = 50 × 10^{-6} F, V = 200 V

Step 2: $V^2 = 200^2 = 40{,}000$

Step 3: $W = ½ \times 50 \times 10^{-6} \times 40{,}000 = ½ \times 2 = 1$ J

📌 *Also: $W = Q^2/(2C) = ½QV$. Capacitor stores energy in electric field. Unit: Joule (J).*

Q.4 — Capacitors in Series
Expected 2026

Three capacitors of 6 μF, 4 μF, and 12 μF are connected in series. Find the equivalent capacitance.

(A) 22 μF

(B) 2 μF

(C) 4 μF

(D) 3 μF

✅ **CORRECT ANSWER: (B) 2 MF**

Series Capacitance: $1/C_{eq} = 1/C_1 + 1/C_2 + 1/C_3$

```
1/C_eq = 1/6 + 1/4 + 1/12 = 2/12 + 3/12 + 1/12 = 6/12 = 1/2
```

Step 1: 1/6 = 2/12, 1/4 = 3/12, 1/12 = 1/12

Step 2: Sum = (2+3+1)/12 = 6/12 = 1/2

Step 3: C_{eq} = 2 μF

📌 *Series capacitors — total capacitance decreases (like parallel resistors). Parallel capacitors — total capacitance increases (like series resistors).*

Q.5 — Electric Potential
Expected 2026

Find the work done in moving a charge of 2 C through a potential difference of 100 V.

(A) 50 J

(B) 200 J

(C) 100 J

(D) 0.02 J

✅ **CORRECT ANSWER: (B) 200 J**

Formula: $W = Q \times V$

```
W = 2 C × 100 V = 200 J
```

Concept: Potential difference (V) = Work done per unit charge. So $W = Q \times V$.

📌 *1 Volt = 1 Joule/Coulomb. This is the fundamental definition of electric potential.*