TNPSC | CTSE DIPLOMA ITI EXAM 2026 | SUBJECT CODE: 446

PART I-A: CIRCUIT THEORY FUNDAMENTALS

200 Most Important One-Line Q&A | Self-Study Material

Prepared for: All TNPSC CTSE Diploma & ITI Aspirants | Tamil Nadu

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TOPIC 1: ELECTROSTATICS & BASIC ELECTRICITY CONCEPTS

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KEY CONCEPTS AT A GLANCE

- **Electrostatics** deals with electric charges at rest and the forces between them.
- **Coulomb's Law:** Force between two charges = $k \cdot Q_1 \cdot Q_2 / r^2$ ($k = 9 \times 10^9$ N·m²/C²)
- **Electric Field (E):** Force per unit positive charge. E = F/Q (V/m or N/C)
- **Electric Potential (V):** Work done per unit charge. V = W/Q (Volts)
- **Capacitance (C):** Ability to store charge. C = Q/V (Farads)
- **Dielectric:** Insulating material between capacitor plates that increases capacitance.
- **Energy in capacitor:** $E = \frac{1}{2}CV^2 = \frac{1}{2}QV = Q^2/2C$
- **Current (I):** Rate of flow of charge. I = Q/t (Amperes)
- **EMF:** Energy per unit charge provided by a source. Unit: Volt
- **Resistance (R):** Opposition to current flow. R = ρL/A (Ohms)

$C = \varepsilon_0 \cdot \varepsilon_r \cdot A/d$ | $F = k \cdot Q_1 Q_2 / r^2$ | $E = \frac{1}{2}CV^2$

E = Easy | **M = Moderate** | **H = Hard**

Q.NO	QUESTION	ANSWER	LEVEL	EXPLANATION
1	What is the SI unit of electric charge?	**Coulomb (C)**	E	One Coulomb = charge of 6.24×10^{18} electrons.
2	What is the charge of one electron?	**1.6×10^{-19} C**	E	This is the fundamental unit of negative electric charge.
3	What law states the force between two point charges?	**Coulomb's Law**	E	$F = kQ_1Q_2/r^2$. Force is directly proportional to product of charges and inversely to square of distance.
4	What is the value of Coulomb's constant (k)?	**9×10^9 N·m²/C²**	E	$k = 1/(4\pi\varepsilon_0)$. This constant appears in Coulomb's law.
5	What is electric field intensity?	**Force per unit positive charge (E = F/Q)**	E	Unit is V/m or N/C. It shows direction and strength of electric force at a point.
6	What is electric potential?	**Work done per unit positive charge (V = W/Q)**	E	Unit is Volt. It is a scalar quantity unlike electric field.

7	What is capacitance?	**Ability to store electric charge (C = Q/V)**	**E**	Unit is Farad (F). Larger capacitance = more charge stored per volt.
8	What is the SI unit of capacitance?	**Farad (F)**	**E**	Practical units: μF (microfarad) and pF (picofarad) are commonly used.
9	What is a dielectric material?	**Insulating material placed between capacitor plates**	**E**	It increases capacitance by reducing the electric field inside the capacitor.
10	What is the formula for energy stored in a capacitor?	**$E = \frac{1}{2}CV^2$**	**M**	Energy stored in joules. Also written as $E = Q^2/2C = \frac{1}{2}QV$.
11	What is the permittivity of free space (ε_0)?	**8.854×10^{-12} F/m**	**M**	It appears in Coulomb's law as $k = 1/(4\pi\varepsilon_0)$.
12	How does capacitance change when plate area is doubled?	**Capacitance doubles**	**M**	$C = \varepsilon_0\varepsilon_r A/d$. Capacitance is directly proportional to plate area (A).
13	How does capacitance change when plate separation is doubled?	**Capacitance is halved**	**M**	$C = \varepsilon_0\varepsilon_r A/d$. Capacitance is inversely proportional to plate distance (d).
14	What is electric flux?	**Total number of electric field lines passing through a surface ($\Phi = E \cdot A \cdot \cos\theta$)**	**M**	Unit is $N \cdot m^2/C$ or $V \cdot m$. Represents total electric field through a surface.
15	What does Gauss's Law state?	**Total electric flux through a closed surface = enclosed charge / ε_0**	**H**	$\Phi = Q_{enc}/\varepsilon_0$. Useful to find E for symmetric charge distributions.
16	What is electric current?	**Rate of flow of electric charge (I = Q/t)**	**E**	Unit is Ampere (A). 1A = 1 Coulomb per second.
17	What is EMF (Electromotive Force)?	**Energy supplied per unit charge by a source**	**E**	Unit: Volt. EMF drives current through a circuit. Not a real force but an energy concept.
18	What is the formula for resistance?	**$R = \rho L/A$**	**E**	ρ = resistivity, L = length, A = cross-sectional area. Unit: Ohm (Ω).
19	How does resistance change with temperature for conductors?	**Resistance increases with temperature**	**E**	$R_t = R_0(1 + \alpha t)$. α is positive for conductors (metals).
20	What is dielectric strength?	**Maximum electric field a dielectric can withstand without breaking down**	**H**	Unit: V/m or kV/mm. If exceeded, the insulator conducts (breakdown occurs).

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TOPIC 2: OHM'S LAW & KIRCHHOFF'S LAWS

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KEY CONCEPTS AT A GLANCE

- **Ohm's Law:** V = IR. Current is proportional to voltage at constant temperature.
- **KCL (Kirchhoff's Current Law):** Sum of currents entering a node = Sum of currents leaving (ΣI = 0).
- **KVL (Kirchhoff's Voltage Law):** Sum of all voltages around any closed loop = 0 (ΣV = 0).
- **Power:** P = VI = I^2R = V^2/R (Watts)
- **Energy:** W = Pt = VIt (Joules or kWh)
- **Conductance (G):** Reciprocal of resistance. G = 1/R (Siemens, S)

`V = IR | ΣI = 0 (KCL) | ΣV = 0 (KVL) | P = I²R`

Q.NO	QUESTION	ANSWER	LEVEL	EXPLANATION
21	State Ohm's Law.	**V = IR (Voltage = Current × Resistance)**	**E**	Valid only at constant temperature. V is directly proportional to I.
22	What is the unit of resistance?	**Ohm (Ω)**	**E**	1 Ohm = resistance when 1V causes 1A to flow.
23	State Kirchhoff's Current Law (KCL).	**Sum of currents at a node = 0 (currents in = currents out)**	**E**	Based on conservation of charge. No charge can accumulate at a node.
24	State Kirchhoff's Voltage Law (KVL).	**Sum of all voltages in a closed loop = 0**	**E**	Based on conservation of energy. Voltage rises = Voltage drops in a loop.
25	What is conductance?	**Reciprocal of resistance (G = 1/R)**	**E**	Unit is Siemens (S). Higher conductance means easier current flow.
26	What is the power formula in terms of current and resistance?	**$P = I^2R$**	**E**	This form is used when current and resistance are known.
27	What is the power formula in terms of voltage and resistance?	**$P = V^2/R$**	**E**	This form is used when voltage and resistance are known.
28	What is 1 kWh in joules?	**3.6×10^6 Joules**	**M**	1 kWh = 1000 W × 3600 s = 3,600,000 J. Used for electrical energy billing.
29	On what condition does Ohm's Law hold?	**Constant temperature (linear/ohmic conductors only)**	**M**	Non-ohmic devices like diodes and bulbs do not obey Ohm's Law strictly.
30	KCL is based on which conservation principle?	**Conservation of charge**	**M**	Charge cannot be created or destroyed at any junction in a circuit.
31	KVL is based on which conservation principle?	**Conservation of energy**	**M**	Energy supplied by sources equals energy consumed by resistors in a loop.
32	If R = 10Ω and V = 50V, find the current.	**I = 5A**	**E**	I = V/R = 50/10 = 5A. Direct application of Ohm's Law.
33	What is the unit of power?	**Watt (W)**	**E**	1 Watt = 1 Joule per second = 1 Volt × 1 Ampere.