

Class 12 Electrostatics Formula Sheet

NCERT Chapter 1 (Electric Charges and Fields) and Chapter 2 (Electrostatic Potential and Capacitance) · CBSE 2026-27

Constants

Constant	Value
Elementary charge e	$1.6 \times 10^{-19} \text{ C}$
$k = 1/4\pi\epsilon_0$	$9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$
ϵ_0 (permittivity of free space)	$8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$

Chapter 1: Electric Charges and Fields

Quantity	Formula	Note
Quantisation of charge	$q = ne$	n is an integer
Coulomb's law	$F = kq_1q_2/r^2$	Add forces as vectors (superposition)
Field of a point charge	$E = kq/r^2$	Away from $+q$, towards $-q$
Dipole moment	$p = q \times 2a$	Direction: $-q$ to $+q$
Dipole field, axial line	$E = 2kp/r^3$	$r \gg a$; along p
Dipole field, equatorial line	$E = kp/r^3$	$r \gg a$; opposite to p
Torque on a dipole	$\tau = p \times E$; $\tau = pE \sin \theta$	Net force in uniform field = 0
Electric flux	$\Phi = E \cdot A = EA \cos \theta$	Unit: $\text{N m}^2 \text{ C}^{-1}$
Gauss's law	$\Phi = q_{\text{enc}}/\epsilon_0$	Depends only on enclosed charge
Infinite line charge	$E = \lambda/2\pi\epsilon_0 r$	λ = charge per unit length
Infinite plane sheet	$E = \sigma/2\epsilon_0$	Independent of distance
Thin spherical shell	Outside: $E = kq/r^2$; inside: $E = 0$	On surface: $E = kq/R^2$

Chapter 2: Electrostatic Potential and Capacitance

Quantity	Formula	Note
Potential of a point charge	$V = kq/r$	Scalar: add with signs
Potential of a dipole	$V = kp \cos \theta / r^2$	Zero on equatorial line
Field from potential	$E = -dV/dr$	Field points to falling V
Work done	$W = q(V_B - V_A)$	Zero along an equipotential
PE of two charges	$U = kq_1q_2/r$	Keep the signs
Dipole in uniform field	$U = -pE \cos \theta$	Stable at $\theta = 0$
Work to rotate a dipole	$W = pE(\cos \theta_1 - \cos \theta_2)$	
Capacitance	$C = Q/V$	Unit: farad (F)
Isolated sphere	$C = 4\pi\epsilon_0 R$	
Parallel plate capacitor	$C = \epsilon_0 A/d$	
Filled with dielectric	$C = K\epsilon_0 A/d$	K = dielectric constant
Dielectric slab, thickness t	$C = \epsilon_0 A/[d - t(1 - 1/K)]$	$t < d$
Series	$1/C = 1/C_1 + 1/C_2 + \dots$	Same charge on each
Parallel	$C = C_1 + C_2 + \dots$	Same voltage across each
Energy stored	$U = \frac{1}{2}CV^2 = Q^2/2C = \frac{1}{2}QV$	
Energy density	$u = \frac{1}{2}\epsilon_0 E^2$	Energy per unit volume

Inserting a dielectric (K): what changes?

Quantity	Battery connected (V fixed)	Battery disconnected (Q fixed)
Capacitance	KC	KC
Voltage	V	V/K
Charge	KQ	Q
Energy	KU	U/K

Remember: convert $\mu C \rightarrow C (\times 10^{-6})$, $cm \rightarrow m$ and $cm^2 \rightarrow m^2$ before substituting. State directions for every vector.