

Electrostatics Derivations Checklist

Write each derivation three times: 1) with the NCERT textbook open, 2) from memory, 3) from memory under a time limit. Tick each attempt and note the step you got stuck on.

#	Derivation	Key steps to show	Final result	1	2	3
1	Dipole field on the axial line	Diagram; fields of +q and -q at P; subtract; $r \gg a$	$E = 2kp/r^3$	☐	☐	☐
2	Dipole field on the equatorial line	Diagram; resolve both fields; vertical parts cancel	$E = kp/r^3$, opposite to p	☐	☐	☐
3	Torque on a dipole in uniform field	Forces qE and -qE; couple; perpendicular distance $2a \sin \theta$	$\tau = pE \sin \theta$	☐	☐	☐
4	Field of infinite line charge (Gauss)	Cylindrical Gaussian surface; flux only through curved face	$E = \lambda/2\pi\epsilon_0 r$	☐	☐	☐
5	Field of infinite plane sheet (Gauss)	Cylinder through sheet; flux through two flat faces	$E = \sigma/2\epsilon_0$	☐	☐	☐
6	Field of thin spherical shell (Gauss)	Spherical Gaussian surfaces inside and outside	Out: kq/r^2 ; in: 0	☐	☐	☐
7	Potential due to a point charge	Work done bringing unit charge from infinity; integrate	$V = kq/r$	☐	☐	☐
8	Potential due to a dipole	Sum of potentials of $\pm q$; $r \gg a$ approximation	$V = kp \cos \theta/r^2$	☐	☐	☐
9	PE of dipole in uniform field	Work to rotate from θ_1 to θ_2 ; choose zero at 90°	$U = -pE \cos \theta$	☐	☐	☐
10	Parallel plate capacitor (air)	Field σ/ϵ_0 between plates; $V = Ed$; $C = Q/V$	$C = \epsilon_0 A/d$	☐	☐	☐
11	Parallel plate with dielectric	Field reduced by K inside slab; add potential drops	$C = K\epsilon_0 A/d$	☐	☐	☐
12	Capacitors in series and parallel	Same Q (series) / same V (parallel); add	$1/C = \Sigma 1/C_i$; $C = \Sigma C_i$	☐	☐	☐
13	Energy stored in a capacitor	Work $dW = (q/C)dq$; integrate 0 to Q	$U = Q^2/2C = \frac{1}{2}CV^2$	☐	☐	☐

Checklist for every derivation

- ☐ Labelled diagram (charges, distances, Gaussian surface, directions)
- ☐ Starting principle stated in words (Coulomb's law, Gauss's law, definition of potential)
- ☐ Each algebra step on its own line — CBSE awards marks step by step
- ☐ Final result boxed, with direction for vectors and the approximation used (e.g. $r \gg a$)

Stuck-point notes

Derivation #	Where I got stuck	Fix