



EXAM-DAY · 90-MIN REVISION CARD

Electric Charges and Fields

Print this · Fold it · Carry to the exam-hall gate · Revise once · Then walk in.

FORMULAS & KEY RESULTS

Coulomb's law (vacuum): $F = (1/4\pi\epsilon_0) \cdot q_1q_2 / r^2$; $k = 1/4\pi\epsilon_0 = 9 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$

In medium of dielectric K: $F_{\text{medium}} = F_{\text{vacuum}} / K$

Electric field: $E = F / q_{\text{test}} = kq/r^2$
(from point charge q)

Dipole moment: $p = q(2a)$, directed from $-q$ to $+q$

E on axial line of dipole ($r \gg a$): $E_{\text{ax}} = (1/4\pi\epsilon_0) \cdot (2p / r^3)$, along $p \rightarrow$

E on equatorial line of dipole ($r \gg a$):
 $E_{\text{eq}} = (1/4\pi\epsilon_0) \cdot (p / r^3)$, opposite to $p \rightarrow$

Torque on dipole in uniform field: $\tau = p \times E$; $|\tau| = pE \sin\theta$

Electric flux: $\Phi = \int E \cdot dA \rightarrow$; SI unit: $\text{N}\cdot\text{m}^2/\text{C}$ or $\text{V}\cdot\text{m}$

Gauss's law: $\int E \cdot dA \rightarrow = q_{\text{enclosed}} / \epsilon_0$ (over any closed surface)

E from infinite line ($\lambda \text{ C/m}$): $E = \lambda / (2\pi\epsilon_0 r)$ — radial, $1/r$ falloff

E from infinite plane ($\sigma \text{ C/m}^2$): $E = \sigma / (2\epsilon_0)$ — uniform, perpendicular to plane

E inside a uniformly charged thin shell: $E = 0$ (Gauss with no enclosed charge)

E outside the shell ($r > R$): $E = kQ/r^2$, same as a point charge at centre

TOP 5 PYQ PATTERNS

- 1 Derive E for infinite line/plane via Gauss's law**
5 marks · 95% of years
Use the 5-step template above. State law, draw, symmetry, flux, enclosed charge, solve.
- 2 Coulomb's law numerical with 3 charges in triangle/square**
3 marks · 85% of years
Find each pairwise force, resolve, use vector/parallelogram law.
- 3 Dipole field on axial OR equatorial line**
3 marks · 70% of years
Set up geometry, use Coulomb's law on each charge, superpose, take $r \gg a$ limit.
- 4 Define flux + find flux through closed surface**
2 marks · 80% of years
Gauss's law directly: $\Phi = q_{\text{enclosed}}/\epsilon_0$, regardless of surface shape.
- 5 Find null point on line joining two charges ($E = 0$)**
3 marks · 50% of years
Set E from $+q = E$ from $-q$ on the line; closer to the smaller charge for like, between the two for unlike.

90-MIN REVISION FLOW

- 0–15 min**
Recite Coulomb's law (statement + vector form + medium correction). Write SI units of E, q, ϵ_0 , p.
- 15–30 min**
Derive (from memory!) the field of an infinite line charge using Gauss's law. Aim for ≤ 5 minutes — this is the most reliable 5-marker.
- 30–45 min**
Derive E on the axial line of a dipole. Take the $r \gg a$ limit. Then redo for the equatorial line.
- 45–60 min**
Do 5 numerical problems: 2 Coulomb-law triangles, 2 dipole-field, 1 Gauss-law cube-flux.
- 60–75 min**
Take the 15-MCQ Quick Drill under timer. Target $\geq 12/15$.
- 75–90 min**
Review wrong answers. Re-derive the rust equation — wait, wrong chapter — re-derive infinite plane E and uniformly-charged-shell E. Done.

Confidence, not anxiety. You've practised this all year. Trust your steps. Don't change strategy on exam morning. Helpline: +91 70330 05444 · readyforboards.com