LOGIC BLOOM · JEE MAIN PHYSICS

Electrostatics *L1 + L2 Practice*

Class 12 Physics · **Foundation to Rank-Decider**

20 questions across two tiers: 10 formula-recall (Level 1) and 10 multi-concept, vector & distribution problems (Level 2), all with detailed solutions.

10 Level 1 | 10 Level 2 | Diagrams | Detailed Solutions

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Understand through games.
Score through practice.

PART I · QUESTIONS

Electrostatics – 20 MCQs in Two Tiers

Single correct answer. Level 1 builds speed on core formulas; Level 2 mixes in mechanics, vectors and charge distributions.

LEVEL 1 Speed & Formula Recall

single-step, under 90 s each

Q1 to Q10. Direct application of the core electrostatics formulas. Aim for speed and accuracy.

Q1 LEVEL 1 COULOMB'S LAW

Two point charges of 2 μC and 3 μC are placed 30 cm apart in vacuum. The magnitude of the electrostatic force between them is:

(A) 0.06 N

(B) 0.6 N

(C) 6 N

(D) 0.3 N

Q2 LEVEL 1 ELECTRIC FIELD

The electric field at a distance of 3 m from a point charge of 4 μC is:

(A) 4000 N/C

(B) 3600 N/C

(C) 1200 N/C

(D) 400 N/C

Q3 LEVEL 1 DIPOLE

An electric dipole consists of charges ±2 μC separated by 3 cm. Its dipole moment is:

A) 2×10^{-8} C·m

B) 6×10^{-6} C·m

C) 6×10^{-8} C·m

D) 3×10^{-8} C·m

Q4 LEVEL 1 DIPOLE

For a short dipole, the ratio of the axial field to the equatorial field at equal distances is:

A) 1 : 1

B) 2 : 1

C) 1 : 2

D) 4 : 1

Q5 LEVEL 1 POTENTIAL

The electric potential at 0.2 m from a point charge of 5 μC is:

A) 2.25×10^{5} V

B) 1.125×10^{5} V

C) 4.5×10^{5} V

D) 2.25×10^{4} V

Q6 LEVEL 1 POTENTIAL

The work done in moving a charge of 2 μC through a potential difference of 100 V is:

(A) 200 J

(B) 2×10^{-2} J

(C) 2×10^{-6} J

(D) 2×10^{-4} J

Q7 LEVEL 1 GAUSS'S LAW

A charge Q is at the centre of a cube. The electric flux through one face is:

(A) $Q/6\varepsilon_0$

(B) $Q/8\varepsilon_0$

(C) Q/ε_0

(D) $6Q/\varepsilon_0$

Q8 LEVEL 1 CAPACITORS

A parallel-plate capacitor has plates of area 100 cm^2 separated by 1 mm in air. Its capacitance is ($\varepsilon_0 = 8.85 \times 10^{-12}$ F/m):

(A) 8.85 pF

(B) 44.25 pF

(C) 88.5 pF

(D) 885 pF

Q9 LEVEL 1 CAPACITORS

Two capacitors of 2 μF and 3 μF are connected in series. Their equivalent capacitance is:

(A) 0.6 μF

(B) 5 μF

(C) 6 μF

(D) 1.2 μF

Q10 LEVEL 1 CAPACITORS

A capacitor of 2 μF is charged to a potential difference of 100 V. The energy stored is:

(A) 1 J

(B) 0.02 J

(C) 0.1 J

(D) 0.01 J

LEVEL 2 Multi-concept & Rank-Deciders

multi-step, vectors, distributions

Q11 to Q20. These integrate mechanics and work-energy, use vector notation, cover continuous charge distributions, and include assertion-reason. Weighted toward multi-concept integration.

Q11 LEVEL 2 MULTI-CONCEPT

An electron (mass 9.1×10^{-31} kg, charge 1.6×10^{-19} C) is placed in a uniform electric field of 1×10^{4} N/C. Its acceleration is:

(A) 1.76×10^{12} m/s^2

(B) 5.7×10^{5} m/s^2

(C) 1.76×10^{15} m/s^2

(D) 1.6×10^{15} m/s^2

Q12 LEVEL 2 MULTI-CONCEPT

A proton (mass 1.67×10^{-27} kg) starts from rest and is accelerated through a potential difference of 100 V. Its final speed is (use energy conservation):

(A) 1.0×10^{5} m/s

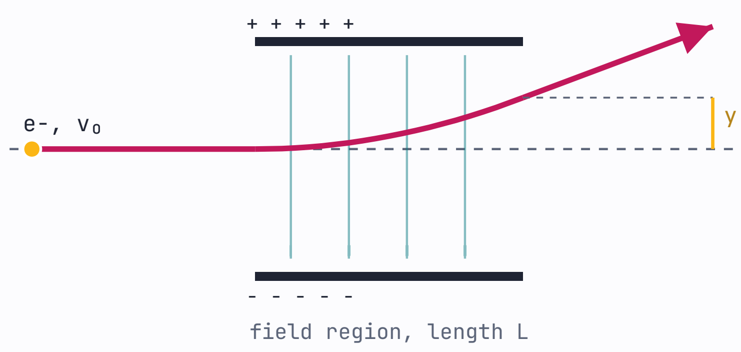
(B) 1.4×10^{5} m/s

(C) 1.4×10^{6} m/s

(D) 1.4×10^{4} m/s

Q13 LEVEL 2 MULTI-CONCEPT

An electron enters mid-way between two horizontal plates moving horizontally at $v_0 = 1\times10^7$ m/s. The field between the plates is 1×10^3 N/C and the plate length is 0.1 m. The vertical deflection as it leaves the plates is about:



(A) 1.8×10^{-3} m

(B) 8.8×10^{-3} m

(C) 8.8×10^{-2} m

(D) 4.4×10^{-3} m

Q14 LEVEL 2 MULTI-CONCEPT

A charged particle of charge q and mass m is held in equilibrium between two horizontal plates by the electric field balancing gravity. If the field is E, the charge equals:

(A) mgE

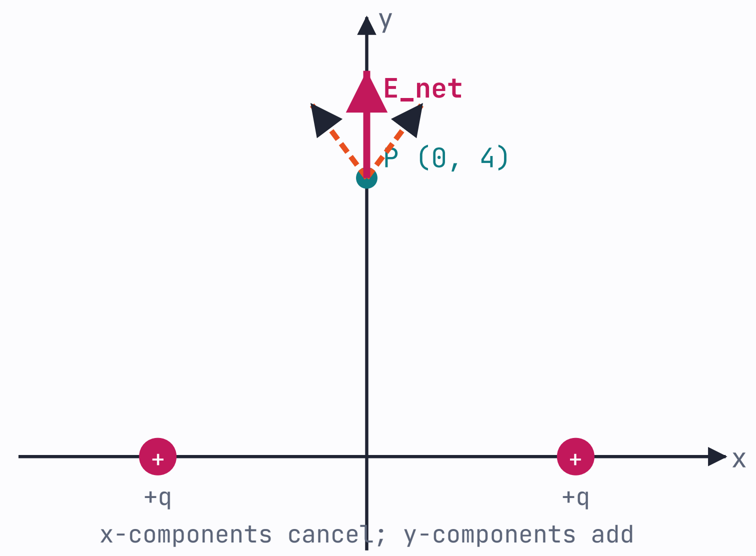
(B) mg/E

(C) qE/m

(D) E/mg

Q15 LEVEL 2 VECTOR SUPERPOSITION

Two equal charges of +2 μC are placed at (−3, 0) m and (3, 0) m. The net electric field at the point (0, 4) m is:



(A) 1152 N/C along +y

(B) 0

(C) 576 N/C along +y

(D) 720 N/C along +y

Q16 LEVEL 2 VECTOR SUPERPOSITION

A charge of +1 μC is at the origin. The electric field at the point (3, 4) m, in vector form, is closest to:

(A) (216 î + 288 ĵ) N/C

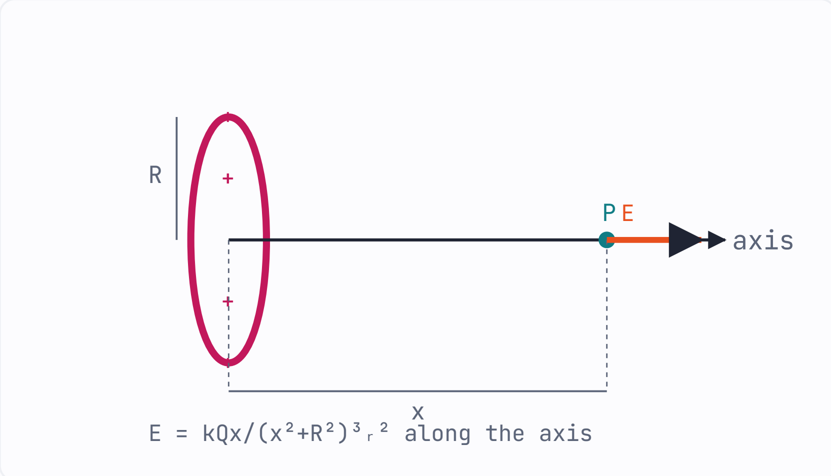
(B) (288 î + 216 ĵ) N/C

(C) (180 î + 240 ĵ) N/C

(D) (360 î) N/C

Q17 LEVEL 2 CONTINUOUS DISTRIBUTION

A ring of radius 0.3 m carries a total charge of 1 μC. The electric field on its axis at a distance of 0.4 m from the centre is:



(A) 9000 N/C

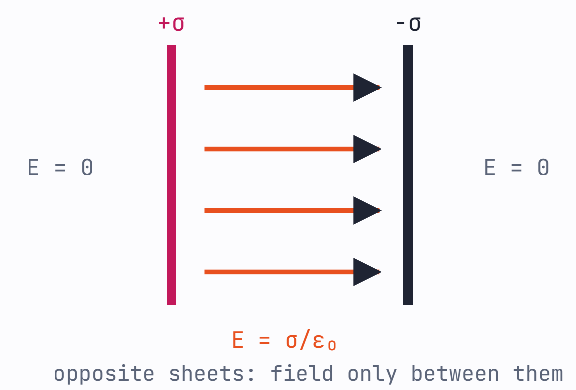
(B) 28800 N/C

(C) 36000 N/C

(D) 14400 N/C

Q18 LEVEL 2 CONTINUOUS DISTRIBUTION

Two large parallel sheets carry equal and opposite surface charge densities $+\sigma$ and $-\sigma$, with $\sigma = 8.85\times10^{-6}$ C/m^2. The electric field in the region between the sheets is:



(A) 5×10^5 N/C

(B) 2.5×10^5 N/C

(C) 1×10^6 N/C

(D) zero

Q19 LEVEL 2 ASSERTION-REASON

Assertion (A): The electric field inside a conductor is always zero in electrostatic equilibrium.
Reason (R): The free charges in a conductor redistribute on its surface until the interior field vanishes.
Choose the correct option:

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

Q20 LEVEL 2 ASSERTION-REASON

Assertion (A): Electric field lines can never intersect each other.
Reason (R): At the point of intersection there would be two directions of the field, which is impossible.
Choose the correct option:

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

PART II · ANSWER KEY & SOLUTIONS

Detailed Solutions

Quick-check grid first (Level 2 answers shown in teal), then full working for every question.

Q1 B | Q2 A | Q3 C | Q4 B | Q5 A | Q6 D | Q7 A | Q8 C | Q9 D | Q10 D | Q11 C | Q12 D

Q13 B | Q14 B | Q15 A | Q16 A | Q17 B | Q18 C | Q19 A | Q20 A

Q1 Correct: B *0.6 N*

By Coulomb's law $F = kq_1q_2/r^2$ with $k = 9\times10^9$. $F = (9\times10^9)(2\times10^{-6})(3\times10^{-6})/(0.30)^2 = (54\times10^{-3})/0.09 =$ **0.6 N**. Convert cm to m before squaring.

Q2 Correct: A *4000 N/C*

$E = kQ/r^2 = (9\times10^9)(4\times10^{-6})/9 =$ **4000 N/C**, directed radially outward. Field falls off as $1/r^2$.

Q3 Correct: C *6×10^{-8} C·m*

Dipole moment $p = q\times(2a) = (2\times10^{-6})(3\times10^{-2}) =$ **6×10^{-8} C·m**, directed from the negative to the positive charge. Use the full separation, not half.

Q4 Correct: B *2 : 1*

$E_{axial} = 2kp/r^3$ and $E_{equatorial} = kp/r^3$, so the ratio is **2 : 1**. Both fall as $1/r^3$, but the axial field is always twice the equatorial field at the same distance.

Q5 Correct: A *2.25×10^5 V*

$V = kQ/r = (9\times10^9)(5\times10^{-6})/0.2 =$ **2.25×10^5 V**. Potential is a scalar and falls off as $1/r$.

Q6 Correct: D *2×10^{-4} J*

$W = q\Delta V = (2\times10^{-6})(100) =$ **2×10^{-4} J**. Potential difference is work per unit charge, and this is independent of the path.

Q7 Correct: A *$Q/6\varepsilon_0$*

Total flux through the cube is Q/ε_0 (Gauss's law). By symmetry it divides equally among the 6 faces, so each face gets $\mathbf{Q/6\varepsilon_0}$. A frequent JEE symmetry shortcut.

Q8 Correct: C *88.5 pF*

$C = \varepsilon_0 A/d$ with $A = 10^{-2}$ m^2, $d = 10^{-3}$ m: $C = (8.85\times10^{-12})(10^{-2})/(10^{-3})$ = **88.5 pF**. Convert 1 cm^2 = 10^{-4} m^2 carefully.

Q9 Correct: D *1.2 μF*

$1/C_{eq} = 1/2 + 1/3 = 5/6$, so C_{eq} = **1.2 μF**. Series capacitance is always less than the smallest capacitor. In parallel these would give 5 μF.

Q10 Correct: D *0.01 J*

$U = ½CV^2 = ½(2\times10^{-6})(100)^2$ = **0.01 J**. Equivalent forms: $U = ½QV = Q^2/2C$.

Q11 Correct: C *1.76×10^{15} m/s^2*

The force is $F = eE$, so acceleration $a = eE/m = (1.6\times10^{-19})(10^4)/(9.1\times10^{-31})$ = **1.76×10^{15} m/s^2**. This links electrostatics to Newton's second law, the core Level 2 move: field gives force, force gives acceleration.

Q12 Correct: D *1.4×10^4 m/s*

The work done by the field becomes kinetic energy: $qV = ½mv^2$, so $v = \sqrt{(2qV/m)} = \sqrt{[2(1.6\times10^{-19})(100)/(1.67\times10^{-27})]}$ ≈ **1.4×10^5 m/s**. This is the work-energy theorem applied to a charge, a staple rank-decider setup.

Q13 Correct: B *8.8×10^{-3} m*

This is projectile motion. Time in field $t = L/v_0 = 0.1/10^7 = 10^{-8}$ s. Vertical acceleration $a = eE/m = (1.6\times10^{-19})(10^3)/(9.1\times10^{-31}) \approx 1.76\times10^{12}$ m/s^2. Deflection $y = ½at^2 = ½(1.76\times10^{12})(10^{-8})^2 \approx$ **8.8×10^{-3} m**. Horizontal and vertical motions are independent, exactly like a ball thrown horizontally.

Q14 Correct: B *mg/E*

For equilibrium the upward electric force balances the downward weight: $qE = mg$, so $q =$ **mg/E**. This is the principle behind Millikan's oil-drop experiment, and it combines electrostatics with mechanics (force balance).

Q15 Correct: A *1152 N/C along +y*

Each charge is a distance $r = \sqrt{(3^2+4^2)} = 5$ m from the point. Each field magnitude is $E = kq/r^2 = (9\times10^9)(2\times10^{-6})/25 = 720$ N/C. By symmetry the x-components cancel and the y-components add: $E_{net} = 2\times720\times(4/5) =$ **1152 N/C along +y**. Always resolve into components; never add magnitudes directly.

Q16 Correct: A *$(216\,\hat{\imath} + 288\,\hat{\jmath})$ N/C*

Distance $r = \sqrt{(3^2+4^2)} = 5$ m, so $|E| = kq/r^2 = (9\times10^9)(10^{-6})/25 = 360$ N/C. The unit vector from origin to (3,4) is $(3\hat{\imath}+4\hat{\jmath})/5$. So $E = 360\times(3\hat{\imath}+4\hat{\jmath})/5 =$ **$(216\,\hat{\imath} + 288\,\hat{\jmath})$ N/C**. The field points along the line from the charge to the point.

Q17 Correct: B *28800 N/C*

On the axis of a ring, $E = kQx/(x^2+R^2)^{3}{}_{r}{}^{2}$. Here $x^2+R^2 = 0.16+0.09 = 0.25$, and $(0.25)^{3}{}_{r}{}^{2} = 0.125$. So $E = (9\times10^9)(10^{-6})(0.4)/0.125 =$ **28800 N/C**. Note the field is zero at the centre ($x = 0$) and maximum at $x = R/\sqrt{2}$.

Q18 Correct: C *1×10^6 N/C*

A single infinite sheet gives $\sigma/2\varepsilon_0$. Between opposite sheets the two fields add: $E = \sigma/\varepsilon_0 = (8.85\times10^{-6})/(8.85\times10^{-12}) =$ **1×10^6 N/C**. Outside the pair the fields cancel to zero. This is exactly the parallel-plate capacitor field.

Q19 Correct: A *Both A and R are true and R is the correct explanation of A*

In equilibrium, any interior field would push the free charges around; they keep moving until the field inside becomes zero, settling on the surface. So both statements are true, and R precisely explains A. **Answer: option A.** This is the reasoning behind electrostatic shielding.

Q20 Correct: A *Both A and R are true and R is the correct explanation of A*

The field at any point has one unique direction (the tangent to the field line there). If two lines crossed, the field would have two directions at that point, which is impossible. So both are true and R correctly explains A. **Answer: option A.**

KEEP GOING · ON THE APP

From Level 1 to Level 2, *track every step.*

You've worked both tiers on paper. On the Logic Bloom app, every question you attempt is tracked, so you see exactly where Level 2 trips you up, the vector step, the force balance, the wrong distribution formula, and you fix it before the exam.

- **Mistake Book** – every wrong answer auto-saved with the concept you missed, so revision is targeted, not random.
- **In-depth analysis** – Level 1 vs Level 2 accuracy and speed, so you know which tier needs work.
- **Play the chapter** – Electrostatics turned into games that make fields and potentials stick.
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