

AP Physics C: Electricity and Magnetism Practice Test 3

60 original multiple-choice questions covering all 6 AP Physics C: Electricity and Magnetism units (Units 8–13). All questions are calculus-based. Choose one answer for each question. The full answer key is on the last page — worked explanations for every question are free on the test page at QuaidianPoint.com.

Name: _____ Class: _____ Score: _____ / 60

Unit 8: Electric Charges, Fields, and Gauss's Law

Q1. A particle of mass 2 mg and charge 3 μC is placed in a uniform electric field of 4895 N/C. Ignoring gravity, what is the magnitude of its initial acceleration?

- (A) $3.67 \times 10^3 \text{ m/s}^2$
- (B) $1.47 \times 10^4 \text{ m/s}^2$
- (C) $1.84 \times 10^3 \text{ m/s}^2$
- (D) $7.34 \times 10^3 \text{ m/s}^2$

Q2. An electric dipole consists of charges +13 μC and -13 μC separated by 24 mm. Estimate the magnitude of the electric field on the dipole axis 35 cm from its centre, where the distance is much larger than the separation.

- (A) $6.54 \times 10^4 \text{ N/C}$
- (B) $1.31 \times 10^5 \text{ N/C}$
- (C) $2.62 \times 10^5 \text{ N/C}$
- (D) $5.23 \times 10^5 \text{ N/C}$

Q3. A thin rod of length 48 cm carries a uniform linear charge density λ . Which integral gives the magnitude of the electric field at a point on the rod's axis 13 cm beyond one end, where x is the distance from a charge element dq to the point?

- (A) $\int k\lambda \, dx / x$
- (B) $\int k\lambda \, dx / x^3$
- (C) $\int k\lambda \, dx / x^2$
- (D) $\int \lambda \, dx / x^2$

Q4. Two point charges carry charges 2 μC and 3 μC and are 42 cm apart in vacuum. What is the magnitude of the electrostatic force between them?

- (A) 0.153 N
- (B) 0.306 N
- (C) 0.612 N
- (D) 0.0764 N

Q5. A point charge of 30 μC is fixed in vacuum. What is the magnitude of the electric field at a point 39 cm from the charge?

- (A) $1.77 \times 10^6 \text{ N/C}$
- (B) $8.87 \times 10^5 \text{ N/C}$
- (C) $3.55 \times 10^6 \text{ N/C}$
- (D) $7.09 \times 10^6 \text{ N/C}$

Q6. Two positive point charges $20\ \mu\text{C}$ and $14\ \mu\text{C}$ lie on the x-axis 23 cm apart. A point P lies on the x-axis 20 cm beyond the second charge, on the side away from the first. What is the magnitude of the net electric field at P?

- (A) $4.12 \times 10^6\ \text{N/C}$
- (B) $2.06 \times 10^6\ \text{N/C}$
- (C) $8.24 \times 10^6\ \text{N/C}$
- (D) $1.03 \times 10^6\ \text{N/C}$

Q7. An infinitely long straight wire carries a uniform linear charge density of $59\ \text{nC/m}$. What is the magnitude of the electric field 14 cm from the wire?

- (A) $3.79 \times 10^3\ \text{N/C}$
- (B) $7.58 \times 10^3\ \text{N/C}$
- (C) $1.52 \times 10^4\ \text{N/C}$
- (D) $3.03 \times 10^4\ \text{N/C}$

Q8. A very large flat sheet carries a uniform surface charge density of $35\ \mu\text{C/m}^2$. What is the magnitude of the electric field near the sheet, away from its edges?

- (A) $1.98 \times 10^6\ \text{N/C}$
- (B) $9.89 \times 10^5\ \text{N/C}$
- (C) $3.95 \times 10^6\ \text{N/C}$
- (D) $4.94 \times 10^5\ \text{N/C}$

Q9. A solid insulating sphere of radius 27 cm carries a total charge of $6\ \mu\text{C}$ uniformly distributed through its volume. What is the magnitude of the electric field at a point 38 cm from its centre?

- (A) $1.87 \times 10^5\ \text{N/C}$
- (B) $7.47 \times 10^5\ \text{N/C}$
- (C) $1.49 \times 10^6\ \text{N/C}$
- (D) $3.74 \times 10^5\ \text{N/C}$

Q10. A thin ring of radius 10 cm carries a total charge of $13\ \mu\text{C}$ uniformly around its circumference. What is the magnitude of the electric field on the ring's axis 36 cm from its centre?

- (A) $4.03 \times 10^5\ \text{N/C}$
- (B) $1.61 \times 10^6\ \text{N/C}$
- (C) $8.07 \times 10^5\ \text{N/C}$
- (D) $2.02 \times 10^5\ \text{N/C}$

Q11. A thin rod of length 23 cm carries a total charge of $25\ \text{nC}$ uniformly along its length. What is the magnitude of the electric field on the rod's axis 9 cm beyond one end?

- (A) $3.9 \times 10^3\ \text{N/C}$
- (B) $1.56 \times 10^4\ \text{N/C}$
- (C) $3.12 \times 10^4\ \text{N/C}$
- (D) $7.8 \times 10^3\ \text{N/C}$

Q12. A closed surface encloses a net charge of $22\ \mu\text{C}$. What is the net electric flux through the surface?

- (A) $1.24 \times 10^6\ \text{N}\cdot\text{m}^2/\text{C}$
- (B) $4.97 \times 10^6\ \text{N}\cdot\text{m}^2/\text{C}$
- (C) $2.49 \times 10^6\ \text{N}\cdot\text{m}^2/\text{C}$
- (D) $6.21 \times 10^5\ \text{N}\cdot\text{m}^2/\text{C}$

Unit 9: Electric Potential

Q13. Two point charges $13\ \mu\text{C}$ and $-4\ \mu\text{C}$ are held $21\ \text{cm}$ apart. What is the electric potential energy of this pair?

- (A) $-2.23\ \text{J}$
- (B) $-1.11\ \text{J}$
- (C) $-4.45\ \text{J}$
- (D) $2.23\ \text{J}$

Q14. In a region, the electric potential varies with position as $V(x) = 14x^2 + (-28)x + 20$, where V is in volts and x is in metres. What is the x -component of the electric field at $x = 2.0\ \text{m}$?

- (A) $-14\ \text{N/C}$
- (B) $-28\ \text{N/C}$
- (C) $-56\ \text{N/C}$
- (D) $28\ \text{N/C}$

Q15. A thin ring of radius $16\ \text{cm}$ carries a total charge of $23\ \mu\text{C}$ uniformly around its circumference. What is the electric potential on the ring's axis $38\ \text{cm}$ from its centre, with zero potential at infinity?

- (A) $2.51 \times 10^5\ \text{V}$
- (B) $1 \times 10^6\ \text{V}$
- (C) $1.25 \times 10^5\ \text{V}$
- (D) $5.01 \times 10^5\ \text{V}$

Q16. A thin spherical shell of radius $25\ \text{cm}$ carries a total charge of $29\ \mu\text{C}$ uniformly on its surface. What is the electric potential at a point $5\ \text{cm}$ from its centre, with zero potential at infinity?

- (A) $5.21 \times 10^5\ \text{V}$
- (B) $1.04 \times 10^6\ \text{V}$
- (C) $2.09 \times 10^6\ \text{V}$
- (D) $4.17 \times 10^6\ \text{V}$

Q17. A particle of mass $42\ \mu\text{g}$ and charge $27\ \text{nC}$ starts from rest and accelerates through a potential drop of $272\ \text{V}$. What is its final speed, ignoring gravity and other forces?

- (A) $18.7\ \text{m/s}$
- (B) $9.35\ \text{m/s}$
- (C) $37.4\ \text{m/s}$
- (D) $4.68\ \text{m/s}$

Q18. Point charges $10\ \mu\text{C}$ and $11\ \mu\text{C}$ are fixed in vacuum. At a certain point P , the distances to the two charges are $42\ \text{cm}$ and $23\ \text{cm}$ respectively. What is the electric potential at P , with zero potential at infinity?

- (A) $6.44 \times 10^5\ \text{V}$
- (B) $3.22 \times 10^5\ \text{V}$
- (C) $1.29 \times 10^6\ \text{V}$
- (D) $-6.44 \times 10^5\ \text{V}$

Q19. A charge is moved slowly along an equipotential surface held at 270 V, from one point to another on the same surface. How much work is done by the electric field during this move?

- (A) 270 J
- (B) 135 J
- (C) 540 J
- (D) 0 J

Q20. A point charge of 28 μC is fixed in vacuum, with zero potential at infinity. What is the electric potential 34 cm from the charge?

- (A) $3.7 \times 10^5 \text{ V}$
- (B) $1.48 \times 10^6 \text{ V}$
- (C) $-7.4 \times 10^5 \text{ V}$
- (D) $7.4 \times 10^5 \text{ V}$

Q21. A charge of 16 μC is moved slowly from a point at potential 147 V to a point at potential 247 V. How much work is done by an external agent, ignoring any change in kinetic energy?

- (A) 0.0008 J
- (B) 0.0032 J
- (C) 0.0004 J
- (D) 0.0016 J

Unit 10: Conductors and Capacitors

Q22. A 12 μF capacitor is connected across a 18 V battery. What charge is stored on each plate?

- (A) 0.000108 C
- (B) 0.000432 C
- (C) 0.000864 C
- (D) 0.000216 C

Q23. A spherical capacitor consists of two concentric conducting shells of radii 9 cm and 20 cm. What is its capacitance?

- (A) $9.1 \times 10^{-12} \text{ F}$
- (B) $1.82 \times 10^{-11} \text{ F}$
- (C) $3.64 \times 10^{-11} \text{ F}$
- (D) $4.55 \times 10^{-12} \text{ F}$

Q24. The voltage across a parallel-plate capacitor is 191 V and the plate separation is 5 mm. What is the magnitude of the uniform electric field between the plates?

- (A) $3.82 \times 10^4 \text{ N/C}$
- (B) $1.91 \times 10^4 \text{ N/C}$
- (C) $7.64 \times 10^4 \text{ N/C}$
- (D) $1.53 \times 10^5 \text{ N/C}$

Q25. A parallel-plate capacitor has plates of area 41 cm^2 separated by 5 mm in vacuum. What is its capacitance?

- (A) $3.63 \times 10^{-12} \text{ F}$
- (B) $7.26 \times 10^{-12} \text{ F}$
- (C) $1.45 \times 10^{-11} \text{ F}$
- (D) $2.9 \times 10^{-11} \text{ F}$

Q26. A parallel-plate capacitor has capacitance 45 pF in vacuum. The gap is then completely filled with a dielectric of constant 5 while the plates remain isolated. What is the new capacitance?

- (A) 112 pF
- (B) 225 pF
- (C) 450 pF
- (D) 56.2 pF

Q27. Capacitors of $3 \mu\text{F}$ and $10 \mu\text{F}$ are connected in series. What is their equivalent capacitance?

- (A) $1.15 \mu\text{F}$
- (B) $2.31 \mu\text{F}$
- (C) $4.62 \mu\text{F}$
- (D) $9.23 \mu\text{F}$

Q28. Capacitors of $18 \mu\text{F}$, $9 \mu\text{F}$ and $4 \mu\text{F}$ are connected in parallel. What is their equivalent capacitance?

- (A) $15.5 \mu\text{F}$
- (B) $62 \mu\text{F}$
- (C) $31 \mu\text{F}$
- (D) $23.2 \mu\text{F}$

Q29. A $18 \mu\text{F}$ capacitor is charged to 147 V. How much energy is stored in the capacitor?

- (A) 0.0972 J
- (B) 0.389 J
- (C) 0.194 J
- (D) 0.0486 J

Unit 11: Electric Circuits

Q30. A resistor of 82Ω is connected across a 99 V source. How much power is dissipated in the resistor?

- (A) 59.8 W
- (B) 120 W
- (C) 239 W
- (D) 29.9 W

Q31. A battery of emf 31 V and internal resistance 2Ω is connected to an external resistor of 36Ω . What is the terminal voltage of the battery?

- (A) 14.7 V
- (B) 58.7 V
- (C) 7.34 V
- (D) 29.4 V

Q32. A resistor of $40\text{ k}\Omega$ and a capacitor of $44\text{ }\mu\text{F}$ are connected in series. What is the time constant of this RC circuit?

- (A) 0.88 s
- (B) 3.52 s
- (C) 0.44 s
- (D) 1.76 s

Q33. An initially uncharged capacitor is connected in series with a $38\text{ k}\Omega$ resistor to a battery. The RC time constant is not given directly. How long after connection will the capacitor reach 90% of its maximum charge? The capacitance is $42\text{ }\mu\text{F}$.

- (A) 1.84 s
- (B) 3.67 s
- (C) 7.35 s
- (D) 0.919 s

Q34. A capacitor charged to 32 V discharges through a resistor. The RC time constant is 2.5 s . What is the voltage across the capacitor 2 s after discharge begins?

- (A) 7.19 V
- (B) 28.8 V
- (C) 14.4 V
- (D) 3.59 V

Q35. An uncharged capacitor is connected to a 20 V battery through a resistor. The RC time constant is 0.8 s . What is the voltage across the capacitor 1.5 s after connection?

- (A) 8.47 V
- (B) 33.9 V
- (C) 4.23 V
- (D) 16.9 V

Q36. A current of 1 A flows in a wire of cross-sectional area 1 mm^2 . The free-electron density is $10 \times 10^{28}\text{ m}^{-3}$. What is the drift speed of the electrons?

- (A) $3.13 \times 10^{-5}\text{ m/s}$
- (B) 0.000125 m/s
- (C) $6.25 \times 10^{-5}\text{ m/s}$
- (D) 0.00025 m/s

Q37. Resistors of $25\text{ }\Omega$ and $85\text{ }\Omega$ are connected in series across a 14 V battery. What is the voltage across the $85\text{ }\Omega$ resistor?

- (A) 5.41 V
- (B) 21.6 V
- (C) 10.8 V
- (D) 2.7 V

Q38. A current of 0.5 A flows uniformly through a wire of cross-sectional area 0.5 mm^2 . What is the current density in the wire?

- (A) $5 \times 10^5\text{ A/m}^2$
- (B) $2 \times 10^6\text{ A/m}^2$
- (C) $2.5 \times 10^5\text{ A/m}^2$
- (D) $1 \times 10^6\text{ A/m}^2$

Q39. A wire of resistivity $16.0 \times 10^{-8} \Omega \cdot \text{m}$ has length 2 m and cross-sectional area 0.8 mm^2 . What is its resistance?

- (A) 0.2Ω
- (B) 0.8Ω
- (C) 0.4Ω
- (D) 0.1Ω

Q40. Resistors of 14Ω , 13Ω and 48Ω are connected in series. What is their equivalent resistance?

- (A) 37.5Ω
- (B) 150Ω
- (C) 75Ω
- (D) 56.2Ω

Q41. Resistors of 25Ω and 50Ω are connected in parallel. What is their equivalent resistance?

- (A) 16.7Ω
- (B) 8.33Ω
- (C) 33.3Ω
- (D) 25Ω

Unit 12: Magnetic Fields and Electromagnetism

Q42. A long solid cylindrical wire of radius 11 cm carries a current of 20 A uniformly distributed over its cross-section. What is the magnitude of the magnetic field inside the wire at a distance 8 cm from its axis?

- (A) $1.32 \times 10^{-5} \text{ T}$
- (B) $2.64 \times 10^{-5} \text{ T}$
- (C) $5.29 \times 10^{-5} \text{ T}$
- (D) 0.000106 T

Q43. A long straight wire carries a current of 21 A. What is the magnitude of the magnetic field 3 cm from the wire?

- (A) 0.00014 T
- (B) $7 \times 10^{-5} \text{ T}$
- (C) 0.00028 T
- (D) 0.00056 T

Q44. A circular loop of radius 13 cm has 5 turns and carries a current of 6 A. What is the magnitude of the magnetic field at the centre of the loop?

- (A) 0.000145 T
- (B) $7.25 \times 10^{-5} \text{ T}$
- (C) 0.00029 T
- (D) $3.62 \times 10^{-5} \text{ T}$

Q45. A solenoid of length 22 cm has 278 turns and carries a current of 2 A. What is the magnitude of the magnetic field inside the solenoid, away from its ends?

- (A) 0.00159 T
- (B) 0.00635 T
- (C) 0.0127 T
- (D) 0.00318 T

Q46. A straight wire of length 27 cm carries a current of 17 A in a uniform magnetic field of 74 mT. The angle between the wire and the field is 60° . What is the magnitude of the magnetic force on the wire?

- (A) 0.147 N
- (B) 0.588 N
- (C) 0.0735 N
- (D) 0.294 N

Q47. A proton (mass 1.67×10^{-27} kg, charge 1.60×10^{-19} C) moves at 2×10^5 m/s perpendicular to a uniform magnetic field of 55 mT. What is the radius of its circular path?

- (A) 0.038 m
- (B) 0.019 m
- (C) 0.0759 m
- (D) 0.152 m

Q48. An electron (mass 9.11×10^{-31} kg, charge 1.60×10^{-19} C) moves perpendicular to a uniform magnetic field of 16 mT. What is the period of its circular motion?

- (A) 1.12×10^{-9} s
- (B) 4.47×10^{-9} s
- (C) 5.59×10^{-10} s
- (D) 2.24×10^{-9} s

Q49. Two long parallel wires 6 cm apart carry currents of 11 A and 19 A in the same direction. What is the magnitude of the magnetic force per unit length on either wire?

- (A) 0.000348 N/m
- (B) 0.000697 N/m
- (C) 0.00139 N/m
- (D) 0.00279 N/m

Q50. A rectangular loop of area 20 cm^2 has 1 turns and carries a current of 1 A in a uniform magnetic field of 36 mT. The angle between the loop's normal and the field is 60° . What is the magnitude of the torque on the loop?

- (A) 3.12×10^{-5} N·m
- (B) 0.000125 N·m
- (C) 6.24×10^{-5} N·m
- (D) 1.56×10^{-5} N·m

Unit 13: Electromagnetic Induction

Q51. An LC circuit consists of an inductor of 26 mH and a capacitor of 49 μF . What is the frequency of oscillation of the circuit?

- (A) 70.5 Hz
- (B) 141 Hz
- (C) 282 Hz
- (D) 35.3 Hz

Q52. A flat loop of area 139 cm^2 is placed in a uniform magnetic field of 120 mT. The angle between the field and the normal to the loop is 60° . What is the magnetic flux through the loop?

- (A) 0.000834 Wb
- (B) 0.000417 Wb
- (C) 0.00167 Wb
- (D) 0.000209 Wb

Q53. A coil of 250 turns and area 30 cm^2 is perpendicular to a magnetic field that increases uniformly from 17 mT to 71 mT in 104 ms. What is the magnitude of the induced emf in the coil?

- (A) 0.389 V
- (B) 0.195 V
- (C) 0.779 V
- (D) 0.0974 V

Q54. A conducting rod of length 29 cm moves at 4 m/s perpendicular to a uniform magnetic field of 47 mT, with its length perpendicular to both the velocity and the field. What is the motional emf between its ends?

- (A) 0.0273 V
- (B) 0.109 V
- (C) 0.0545 V
- (D) 0.218 V

Q55. An emf of 4 V is induced in a rectangular loop of resistance 5Ω . What is the induced current in the loop?

- (A) 0.8 A
- (B) 0.4 A
- (C) 1.6 A
- (D) 0.2 A

Q56. A solenoid has 812 turns, a cross-sectional area of 50 cm^2 and a length of 54 cm. What is its self-inductance?

- (A) 0.00384 H
- (B) 0.00767 H
- (C) 0.0153 H
- (D) 0.00192 H

Q57. An inductor of 189 mH carries a current of 2 A. How much energy is stored in its magnetic field?

- (A) 0.189 J
- (B) 0.756 J
- (C) 0.378 J
- (D) 1.51 J

Q58. An inductor of 179 mH is connected in series with a resistor of 5Ω . What is the time constant of this LR circuit?

- (A) 0.0358 s
- (B) 0.0179 s
- (C) 0.0716 s
- (D) 0.00895 s

Q59. An LR circuit with time constant 0.5 s is connected to a 46 V battery through a 31 Ω resistor. What is the current 1 s after the switch is closed, starting from zero current?

- (A) 0.642 A
- (B) 2.57 A
- (C) 1.28 A
- (D) 0.321 A

Q60. An inductor carrying an initial current of 4 A is disconnected from its battery and discharges through a resistor. The LR time constant is 2 s. What is the current 1 s after discharge begins?

- (A) 1.21 A
- (B) 4.85 A
- (C) 2.43 A
- (D) 9.7 A

Answer Key

Q1: D	Q11: D	Q21: D	Q31: D	Q41: A	Q51: B
Q2: B	Q12: C	Q22: D	Q32: D	Q42: B	Q52: A
Q3: C	Q13: A	Q23: B	Q33: B	Q43: A	Q53: A
Q4: B	Q14: B	Q24: A	Q34: C	Q44: A	Q54: C
Q5: A	Q15: D	Q25: B	Q35: D	Q45: D	Q55: A
Q6: A	Q16: B	Q26: B	Q36: C	Q46: D	Q56: B
Q7: B	Q17: A	Q27: B	Q37: C	Q47: A	Q57: C
Q8: A	Q18: A	Q28: C	Q38: D	Q48: D	Q58: A
Q9: D	Q19: D	Q29: C	Q39: C	Q49: B	Q59: C
Q10: C	Q20: D	Q30: B	Q40: C	Q50: C	Q60: C

Worked explanations for all 60 questions:

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