

AP Physics C: Electricity and Magnetism Practice Test 1

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. An infinitely long straight wire carries a uniform linear charge density of 82 nC/m. What is the magnitude of the electric field 16 cm from the wire?

- (A) 9.21×10^3 N/C
- (B) 4.61×10^3 N/C
- (C) 1.84×10^4 N/C
- (D) 3.69×10^4 N/C

Q2. A very large flat sheet carries a uniform surface charge density of $28 \mu\text{C}/\text{m}^2$. What is the magnitude of the electric field near the sheet, away from its edges?

- (A) 1.58×10^6 N/C
- (B) 7.91×10^5 N/C
- (C) 3.16×10^6 N/C
- (D) 3.95×10^5 N/C

Q3. A solid insulating sphere of radius 26 cm carries a total charge of $11 \mu\text{C}$ uniformly distributed through its volume. What is the magnitude of the electric field at a point 53 cm from its centre?

- (A) 1.76×10^5 N/C
- (B) 7.04×10^5 N/C
- (C) 3.52×10^5 N/C
- (D) 1.41×10^6 N/C

Q4. A thin ring of radius 24 cm carries a total charge of $12 \mu\text{C}$ uniformly around its circumference. What is the magnitude of the electric field on the ring's axis 37 cm from its centre?

- (A) 2.33×10^5 N/C
- (B) 9.31×10^5 N/C
- (C) 1.16×10^5 N/C
- (D) 4.65×10^5 N/C

Q5. A thin rod of length 36 cm carries a total charge of 12 nC uniformly along its length. What is the magnitude of the electric field on the rod's axis 11 cm beyond one end?

- (A) 2.09×10^3 N/C
- (B) 1.04×10^3 N/C
- (C) 4.17×10^3 N/C
- (D) 8.35×10^3 N/C

Q6. A closed surface encloses a net charge of $26\ \mu\text{C}$. What is the net electric flux through the surface?

- (A) $1.47 \times 10^6\ \text{N}\cdot\text{m}^2/\text{C}$
- (B) $2.94 \times 10^6\ \text{N}\cdot\text{m}^2/\text{C}$
- (C) $5.88 \times 10^6\ \text{N}\cdot\text{m}^2/\text{C}$
- (D) $7.34 \times 10^5\ \text{N}\cdot\text{m}^2/\text{C}$

Q7. A particle of mass $15\ \text{mg}$ and charge $7\ \mu\text{C}$ is placed in a uniform electric field of $5302\ \text{N/C}$. Ignoring gravity, what is the magnitude of its initial acceleration?

- (A) $1.24 \times 10^3\ \text{m/s}^2$
- (B) $4.95 \times 10^3\ \text{m/s}^2$
- (C) $619\ \text{m/s}^2$
- (D) $2.47 \times 10^3\ \text{m/s}^2$

Q8. An electric dipole consists of charges $+16\ \mu\text{C}$ and $-16\ \mu\text{C}$ separated by $17\ \text{mm}$. Estimate the magnitude of the electric field on the dipole axis $35\ \text{cm}$ from its centre, where the distance is much larger than the separation.

- (A) $1.14 \times 10^5\ \text{N/C}$
- (B) $5.7 \times 10^4\ \text{N/C}$
- (C) $2.28 \times 10^5\ \text{N/C}$
- (D) $4.56 \times 10^5\ \text{N/C}$

Q9. A thin rod of length $36\ \text{cm}$ carries a uniform linear charge density λ . Which integral gives the magnitude of the electric field at a point on the rod's axis $32\ \text{cm}$ 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) $\int \lambda\ dx / x^2$
- (D) $\int k\lambda\ dx / x^2$

Q10. Two point charges carry charges $14\ \mu\text{C}$ and $22\ \mu\text{C}$ and are $23\ \text{cm}$ apart in vacuum. What is the magnitude of the electrostatic force between them?

- (A) $26.2\ \text{N}$
- (B) $52.3\ \text{N}$
- (C) $105\ \text{N}$
- (D) $13.1\ \text{N}$

Q11. A point charge of $10\ \mu\text{C}$ is fixed in vacuum. What is the magnitude of the electric field at a point $36\ \text{cm}$ from the charge?

- (A) $6.94 \times 10^5\ \text{N/C}$
- (B) $3.47 \times 10^5\ \text{N/C}$
- (C) $1.39 \times 10^6\ \text{N/C}$
- (D) $2.77 \times 10^6\ \text{N/C}$

Q12. Two positive point charges $5\ \mu\text{C}$ and $10\ \mu\text{C}$ lie on the x -axis $44\ \text{cm}$ apart. A point P lies on the x -axis $22\ \text{cm}$ beyond the second charge, on the side away from the first. What is the magnitude of the net electric field at P ?

- (A) $1.96 \times 10^6\ \text{N/C}$
- (B) $9.8 \times 10^5\ \text{N/C}$
- (C) $3.92 \times 10^6\ \text{N/C}$
- (D) $4.9 \times 10^5\ \text{N/C}$

Unit 9: Electric Potential

Q13. A thin spherical shell of radius 32 cm carries a total charge of $15\ \mu\text{C}$ uniformly on its surface. What is the electric potential at a point 44 cm from its centre, with zero potential at infinity?

- (A) $1.53 \times 10^5\ \text{V}$
- (B) $6.13 \times 10^5\ \text{V}$
- (C) $3.06 \times 10^5\ \text{V}$
- (D) $1.23 \times 10^6\ \text{V}$

Q14. A particle of mass $58\ \mu\text{g}$ and charge $169\ \text{nC}$ starts from rest and accelerates through a potential drop of $748\ \text{V}$. What is its final speed, ignoring gravity and other forces?

- (A) 66 m/s
- (B) 33 m/s
- (C) 132 m/s
- (D) 16.5 m/s

Q15. Point charges $17\ \mu\text{C}$ and $-19\ \mu\text{C}$ are fixed in vacuum. At a certain point P, the distances to the two charges are 23 cm and 25 cm respectively. What is the electric potential at P, with zero potential at infinity?

- (A) $-9.38 \times 10^3\ \text{V}$
- (B) $-3.75 \times 10^4\ \text{V}$
- (C) $1.88 \times 10^4\ \text{V}$
- (D) $-1.88 \times 10^4\ \text{V}$

Q16. A charge is moved slowly along an equipotential surface held at $159\ \text{V}$, from one point to another on the same surface. How much work is done by the electric field during this move?

- (A) 159 J
- (B) 79.5 J
- (C) 318 J
- (D) 0 J

Q17. A point charge of $-21\ \mu\text{C}$ is fixed in vacuum, with zero potential at infinity. What is the electric potential 32 cm from the charge?

- (A) $-2.95 \times 10^5\ \text{V}$
- (B) $-1.18 \times 10^6\ \text{V}$
- (C) $-5.9 \times 10^5\ \text{V}$
- (D) $5.9 \times 10^5\ \text{V}$

Q18. A charge of $12\ \mu\text{C}$ is moved slowly from a point at potential $200\ \text{V}$ to a point at potential $450\ \text{V}$. How much work is done by an external agent, ignoring any change in kinetic energy?

- (A) 0.0015 J
- (B) 0.003 J
- (C) 0.006 J
- (D) 0.00075 J

Q19. Two point charges $5\ \mu\text{C}$ and $14\ \mu\text{C}$ are held $54\ \text{cm}$ apart. What is the electric potential energy of this pair?

- (A) $0.583\ \text{J}$
- (B) $1.17\ \text{J}$
- (C) $2.33\ \text{J}$
- (D) $-1.17\ \text{J}$

Q20. In a region, the electric potential varies with position as $V(x) = 15x^2 + (-27)x + 20$, where V is in volts and x is in metres. What is the x -component of the electric field at $x = 2.5\ \text{m}$?

- (A) $-24\ \text{N/C}$
- (B) $-96\ \text{N/C}$
- (C) $-48\ \text{N/C}$
- (D) $48\ \text{N/C}$

Q21. A thin ring of radius $23\ \text{cm}$ carries a total charge of $19\ \mu\text{C}$ uniformly around its circumference. What is the electric potential on the ring's axis $20\ \text{cm}$ from its centre, with zero potential at infinity?

- (A) $5.6 \times 10^5\ \text{V}$
- (B) $2.8 \times 10^5\ \text{V}$
- (C) $1.12 \times 10^6\ \text{V}$
- (D) $1.4 \times 10^5\ \text{V}$

Unit 10: Conductors and Capacitors

Q22. The voltage across a parallel-plate capacitor is $207\ \text{V}$ and the plate separation is $4\ \text{mm}$. What is the magnitude of the uniform electric field between the plates?

- (A) $2.59 \times 10^4\ \text{N/C}$
- (B) $1.04 \times 10^5\ \text{N/C}$
- (C) $2.07 \times 10^5\ \text{N/C}$
- (D) $5.18 \times 10^4\ \text{N/C}$

Q23. A parallel-plate capacitor has plates of area $194\ \text{cm}^2$ separated by $1\ \text{mm}$ in vacuum. What is its capacitance?

- (A) $8.58 \times 10^{-11}\ \text{F}$
- (B) $1.72 \times 10^{-10}\ \text{F}$
- (C) $3.43 \times 10^{-10}\ \text{F}$
- (D) $6.87 \times 10^{-10}\ \text{F}$

Q24. An isolated parallel-plate capacitor is charged to $33\ \text{V}$ in vacuum. The gap is then completely filled with a dielectric of constant 4 without changing the charge on the plates. What is the new voltage across the capacitor?

- (A) $4.12\ \text{V}$
- (B) $16.5\ \text{V}$
- (C) $8.25\ \text{V}$
- (D) $33\ \text{V}$

Q25. Capacitors of $9\ \mu\text{F}$ and $7\ \mu\text{F}$ are connected in series. What is their equivalent capacitance?

- (A) $1.97\ \mu\text{F}$
- (B) $7.88\ \mu\text{F}$
- (C) $3.94\ \mu\text{F}$
- (D) $15.8\ \mu\text{F}$

Q26. Capacitors of $6\ \mu\text{F}$, $13\ \mu\text{F}$ and $9\ \mu\text{F}$ are connected in parallel. What is their equivalent capacitance?

- (A) $14\ \mu\text{F}$
- (B) $56\ \mu\text{F}$
- (C) $21\ \mu\text{F}$
- (D) $28\ \mu\text{F}$

Q27. A $36\ \mu\text{F}$ capacitor is charged to $62\ \text{V}$. How much energy is stored in the capacitor?

- (A) $0.0346\ \text{J}$
- (B) $0.138\ \text{J}$
- (C) $0.0692\ \text{J}$
- (D) $0.0173\ \text{J}$

Q28. A $34\ \mu\text{F}$ capacitor is connected across a $55\ \text{V}$ battery. What charge is stored on each plate?

- (A) $0.000935\ \text{C}$
- (B) $0.00374\ \text{C}$
- (C) $0.00748\ \text{C}$
- (D) $0.00187\ \text{C}$

Q29. A spherical capacitor consists of two concentric conducting shells of radii $15\ \text{cm}$ and $22\ \text{cm}$. What is its capacitance?

- (A) $2.62 \times 10^{-11}\ \text{F}$
- (B) $5.24 \times 10^{-11}\ \text{F}$
- (C) $1.05 \times 10^{-10}\ \text{F}$
- (D) $1.31 \times 10^{-11}\ \text{F}$

Unit 11: Electric Circuits

Q30. A current of $4\ \text{A}$ flows in a wire of cross-sectional area $1\ \text{mm}^2$. The free-electron density is $8.5 \times 10^{28}\ \text{m}^{-3}$. What is the drift speed of the electrons?

- (A) $0.000147\ \text{m/s}$
- (B) $0.000588\ \text{m/s}$
- (C) $0.00118\ \text{m/s}$
- (D) $0.000294\ \text{m/s}$

Q31. Resistors of $72\ \Omega$ and $53\ \Omega$ are connected in series across a $30\ \text{V}$ battery. What is the voltage across the $53\ \Omega$ resistor?

- (A) $6.36\ \text{V}$
- (B) $12.7\ \text{V}$
- (C) $25.4\ \text{V}$
- (D) $3.18\ \text{V}$

Q32. A current of 2 A flows uniformly through a wire of cross-sectional area 2 mm². What is the current density in the wire?

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

Q33. A wire of resistivity $2.8 \times 10^{-8} \Omega \cdot \text{m}$ has length 1 m and cross-sectional area 0.5 mm². What is its resistance?

- (A) 0.028 Ω
- (B) 0.112 Ω
- (C) 0.056 Ω
- (D) 0.014 Ω

Q34. Resistors of 108 Ω , 119 Ω and 80 Ω are connected in series. What is their equivalent resistance?

- (A) 154 Ω
- (B) 614 Ω
- (C) 230 Ω
- (D) 307 Ω

Q35. Resistors of 30 Ω and 20 Ω are connected in parallel. What is their equivalent resistance?

- (A) 6 Ω
- (B) 24 Ω
- (C) 12 Ω
- (D) 48 Ω

Q36. A resistor of 22 Ω is connected across a 114 V source. How much power is dissipated in the resistor?

- (A) 295 W
- (B) $1.18 \times 10^3 \text{ W}$
- (C) 148 W
- (D) 591 W

Q37. A battery of emf 13 V and internal resistance 2 Ω is connected to an external resistor of 30 Ω . What is the terminal voltage of the battery?

- (A) 6.09 V
- (B) 12.2 V
- (C) 24.4 V
- (D) 3.05 V

Q38. A resistor of 44 k Ω and a capacitor of 81 μF are connected in series. What is the time constant of this RC circuit?

- (A) 3.56 s
- (B) 1.78 s
- (C) 7.13 s
- (D) 0.891 s

Q39. An initially uncharged capacitor is connected in series with a $29\text{ k}\Omega$ resistor to a battery. The RC time constant is not given directly. How long after connection will the capacitor reach 50% of its maximum charge? The capacitance is $115\text{ }\mu\text{F}$.

- (A) 2.31 s
- (B) 1.16 s
- (C) 4.62 s
- (D) 0.578 s

Q40. A capacitor charged to 86 V discharges through a resistor. The RC time constant is 2 s . What is the voltage across the capacitor 1 s after discharge begins?

- (A) 52.2 V
- (B) 26.1 V
- (C) 104 V
- (D) 13 V

Q41. An uncharged capacitor is connected to a 33 V battery through a resistor. The RC time constant is 2 s . What is the voltage across the capacitor 1.5 s after connection?

- (A) 17.4 V
- (B) 8.71 V
- (C) 34.8 V
- (D) 4.35 V

Unit 12: Magnetic Fields and Electromagnetism

Q42. A solenoid of length 57 cm has 314 turns and carries a current of 4 A . What is the magnitude of the magnetic field inside the solenoid, away from its ends?

- (A) 0.00138 T
- (B) 0.00277 T
- (C) 0.00554 T
- (D) 0.0111 T

Q43. A straight wire of length 23 cm carries a current of 17 A in a uniform magnetic field of 75 mT . The angle between the wire and the field is 30° . What is the magnitude of the magnetic force on the wire?

- (A) 0.0733 N
- (B) 0.293 N
- (C) 0.147 N
- (D) 0.0367 N

Q44. A proton (mass $1.67 \times 10^{-27}\text{ kg}$, charge $1.60 \times 10^{-19}\text{ C}$) moves at $2 \times 10^5\text{ m/s}$ perpendicular to a uniform magnetic field of 39 mT . What is the radius of its circular path?

- (A) 0.0535 m
- (B) 0.0268 m
- (C) 0.107 m
- (D) 0.214 m

Q45. An electron (mass 9.11×10^{-31} kg, charge 1.60×10^{-19} C) moves perpendicular to a uniform magnetic field of 37 mT. What is the period of its circular motion?

- (A) 4.83×10^{-10} s
- (B) 9.67×10^{-10} s
- (C) 1.93×10^{-9} s
- (D) 2.42×10^{-10} s

Q46. Two long parallel wires 23 cm apart carry currents of 10 A and 10 A in the same direction. What is the magnitude of the magnetic force per unit length on either wire?

- (A) 4.35×10^{-5} N/m
- (B) 8.7×10^{-5} N/m
- (C) 0.000174 N/m
- (D) 0.000348 N/m

Q47. A rectangular loop of area 92 cm^2 has 1 turns and carries a current of 5 A in a uniform magnetic field of 63 mT. The angle between the loop's normal and the field is 30° . What is the magnitude of the torque on the loop?

- (A) 0.00145 N·m
- (B) 0.000724 N·m
- (C) 0.0029 N·m
- (D) 0.000362 N·m

Q48. A long solid cylindrical wire of radius 15 cm carries a current of 24 A uniformly distributed over its cross-section. What is the magnitude of the magnetic field inside the wire at a distance 10 cm from its axis?

- (A) 1.07×10^{-5} T
- (B) 4.27×10^{-5} T
- (C) 8.53×10^{-5} T
- (D) 2.13×10^{-5} T

Q49. A long straight wire carries a current of 18 A. What is the magnitude of the magnetic field 5 cm from the wire?

- (A) 3.6×10^{-5} T
- (B) 0.000144 T
- (C) 7.2×10^{-5} T
- (D) 0.000288 T

Q50. A circular loop of radius 13 cm has 50 turns and carries a current of 2 A. What is the magnitude of the magnetic field at the centre of the loop?

- (A) 0.000242 T
- (B) 0.000967 T
- (C) 0.000121 T
- (D) 0.000483 T

Unit 13: Electromagnetic Induction

Q51. An emf of 2 V is induced in a circular loop of resistance $20\ \Omega$. What is the induced current in the loop?

- (A) 0.05 A
- (B) 0.2 A
- (C) 0.1 A
- (D) 0.025 A

Q52. A solenoid has 1200 turns, a cross-sectional area of 67 cm^2 and a length of 80 cm. What is its self-inductance?

- (A) 0.00758 H
- (B) 0.0152 H
- (C) 0.0303 H
- (D) 0.00379 H

Q53. An inductor of 55 mH carries a current of 4 A. How much energy is stored in its magnetic field?

- (A) 0.22 J
- (B) 0.44 J
- (C) 0.88 J
- (D) 1.76 J

Q54. An inductor of 153 mH is connected in series with a resistor of $49\ \Omega$. What is the time constant of this LR circuit?

- (A) 0.00156 s
- (B) 0.00624 s
- (C) 0.00312 s
- (D) 0.000781 s

Q55. An LR circuit with time constant 1 s is connected to a 25 V battery through a $27\ \Omega$ resistor. What is the current 1.5 s after the switch is closed, starting from zero current?

- (A) 0.36 A
- (B) 1.44 A
- (C) 0.719 A
- (D) 0.18 A

Q56. An inductor carrying an initial current of 1 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) 0.303 A
- (B) 1.21 A
- (C) 2.43 A
- (D) 0.607 A

Q57. An LC circuit consists of an inductor of 102 mH and a capacitor of $7\ \mu\text{F}$. What is the frequency of oscillation of the circuit?

- (A) 94.2 Hz
- (B) 377 Hz
- (C) 47.1 Hz
- (D) 188 Hz

Q58. A flat loop of area 110 cm^2 is placed in a uniform magnetic field of 91 mT. The angle between the field and the normal to the loop is 60° . What is the magnetic flux through the loop?

- (A) 0.00025 Wb
- (B) 0.000501 Wb
- (C) 0.001 Wb
- (D) 0.000125 Wb

Q59. A coil of 200 turns and area 63 cm^2 is perpendicular to a magnetic field that increases uniformly from 46 mT to 120 mT in 55 ms. What is the magnitude of the induced emf in the coil?

- (A) 0.848 V
- (B) 3.39 V
- (C) 1.7 V
- (D) 0.424 V

Q60. A conducting rod of length 20 cm moves at 1 m/s perpendicular to a uniform magnetic field of 105 mT, with its length perpendicular to both the velocity and the field. What is the motional emf between its ends?

- (A) 0.021 V
- (B) 0.0105 V
- (C) 0.042 V
- (D) 0.084 V

Answer Key

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

Worked explanations for all 60 questions:

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