

AP Physics C: Electricity and Magnetism Practice Test 4

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. Two point charges carry charges $24\ \mu\text{C}$ and $18\ \mu\text{C}$ and are $54\ \text{cm}$ apart in vacuum. What is the magnitude of the electrostatic force between them?

- (A) $6.66\ \text{N}$
- (B) $26.6\ \text{N}$
- (C) $13.3\ \text{N}$
- (D) $3.33\ \text{N}$

Q2. A point charge of $27\ \mu\text{C}$ is fixed in vacuum. What is the magnitude of the electric field at a point $75\ \text{cm}$ from the charge?

- (A) $2.16 \times 10^5\ \text{N/C}$
- (B) $8.63 \times 10^5\ \text{N/C}$
- (C) $4.32 \times 10^5\ \text{N/C}$
- (D) $1.73 \times 10^6\ \text{N/C}$

Q3. Two positive point charges $17\ \mu\text{C}$ and $17\ \mu\text{C}$ lie on the x-axis $22\ \text{cm}$ apart. A point P lies on the x-axis $25\ \text{cm}$ beyond the second charge, on the side away from the first. What is the magnitude of the net electric field at P?

- (A) $1.57 \times 10^6\ \text{N/C}$
- (B) $3.14 \times 10^6\ \text{N/C}$
- (C) $6.27 \times 10^6\ \text{N/C}$
- (D) $7.84 \times 10^5\ \text{N/C}$

Q4. An infinitely long straight wire carries a uniform linear charge density of $16\ \text{nC/m}$. What is the magnitude of the electric field $40\ \text{cm}$ from the wire?

- (A) $360\ \text{N/C}$
- (B) $1.44 \times 10^3\ \text{N/C}$
- (C) $2.88 \times 10^3\ \text{N/C}$
- (D) $719\ \text{N/C}$

Q5. A very large flat sheet carries a uniform surface charge density of $29\ \mu\text{C/m}^2$. What is the magnitude of the electric field near the sheet, away from its edges?

- (A) $8.19 \times 10^5\ \text{N/C}$
- (B) $3.28 \times 10^6\ \text{N/C}$
- (C) $1.64 \times 10^6\ \text{N/C}$
- (D) $2.46 \times 10^6\ \text{N/C}$

Q6. A solid insulating sphere of radius 24 cm carries a total charge of 35 μC uniformly distributed through its volume. What is the magnitude of the electric field at a point 17 cm from its centre?

- (A) $3.87 \times 10^6 \text{ N/C}$
- (B) $1.93 \times 10^6 \text{ N/C}$
- (C) $7.74 \times 10^6 \text{ N/C}$
- (D) $1.55 \times 10^7 \text{ N/C}$

Q7. A thin ring of radius 14 cm carries a total charge of 32 μC uniformly around its circumference. What is the magnitude of the electric field on the ring's axis 25 cm from its centre?

- (A) $3.06 \times 10^6 \text{ N/C}$
- (B) $1.53 \times 10^6 \text{ N/C}$
- (C) $6.11 \times 10^6 \text{ N/C}$
- (D) $7.64 \times 10^5 \text{ N/C}$

Q8. A thin rod of length 33 cm carries a total charge of 32 nC uniformly along its length. What is the magnitude of the electric field on the rod's axis 18 cm beyond one end?

- (A) $1.57 \times 10^3 \text{ N/C}$
- (B) $6.27 \times 10^3 \text{ N/C}$
- (C) $1.25 \times 10^4 \text{ N/C}$
- (D) $3.13 \times 10^3 \text{ N/C}$

Q9. A uniform electric field of 2959 N/C passes through a flat surface of area 0.04 m^2 . The angle between the field and the normal to the surface is 0° . What is the electric flux through the surface?

- (A) $59.2 \text{ N}\cdot\text{m}^2/\text{C}$
- (B) $237 \text{ N}\cdot\text{m}^2/\text{C}$
- (C) $118 \text{ N}\cdot\text{m}^2/\text{C}$
- (D) $473 \text{ N}\cdot\text{m}^2/\text{C}$

Q10. A particle of mass 17 mg and charge 7 μC is placed in a uniform electric field of 4429 N/C. Ignoring gravity, what is the magnitude of its initial acceleration?

- (A) 912 m/s^2
- (B) $3.65 \times 10^3 \text{ m/s}^2$
- (C) 456 m/s^2
- (D) $1.82 \times 10^3 \text{ m/s}^2$

Q11. An electric dipole consists of charges +15 μC and -15 μC separated by 28 mm. Estimate the magnitude of the electric field on the dipole axis 34 cm from its centre, where the distance is much larger than the separation.

- (A) $9.61 \times 10^4 \text{ N/C}$
- (B) $3.84 \times 10^5 \text{ N/C}$
- (C) $7.69 \times 10^5 \text{ N/C}$
- (D) $1.92 \times 10^5 \text{ N/C}$

Q12. A thin rod of length 31 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 29 cm beyond one end, where x is the distance from a charge element dq to the point?

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

Unit 9: Electric Potential

Q13. A thin spherical shell of radius 22 cm carries a total charge of 7 μC uniformly on its surface. What is the electric potential at a point 53 cm from its centre, with zero potential at infinity?

- (A) $1.19 \times 10^5 \text{ V}$
- (B) $5.94 \times 10^4 \text{ V}$
- (C) $2.37 \times 10^5 \text{ V}$
- (D) $4.75 \times 10^5 \text{ V}$

Q14. A particle of mass 8 μg and charge 74 nC starts from rest and accelerates through a potential drop of 642 V. What is its final speed, ignoring gravity and other forces?

- (A) 54.5 m/s
- (B) 218 m/s
- (C) 109 m/s
- (D) 27.2 m/s

Q15. Point charges 13 μC and -4 μC are fixed in vacuum. At a certain point P, the distances to the two charges are 21 cm and 28 cm respectively. What is the electric potential at P, with zero potential at infinity?

- (A) $2.14 \times 10^5 \text{ V}$
- (B) $8.56 \times 10^5 \text{ V}$
- (C) $4.28 \times 10^5 \text{ V}$
- (D) $-4.28 \times 10^5 \text{ V}$

Q16. A charge is moved slowly along an equipotential surface held at 200 V, from one point to another on the same surface. How much work is done by the electric field during this move?

- (A) 200 J
- (B) 100 J
- (C) 400 J
- (D) 0 J

Q17. A point charge of 14 μC is fixed in vacuum, with zero potential at infinity. What is the electric potential 50 cm from the charge?

- (A) $1.26 \times 10^5 \text{ V}$
- (B) $5.03 \times 10^5 \text{ V}$
- (C) $2.52 \times 10^5 \text{ V}$
- (D) $-2.52 \times 10^5 \text{ V}$

Q18. A charge of $16\ \mu\text{C}$ is moved slowly from a point at potential $157\ \text{V}$ to a point at potential $407\ \text{V}$. How much work is done by an external agent, ignoring any change in kinetic energy?

- (A) $0.004\ \text{J}$
- (B) $0.002\ \text{J}$
- (C) $0.008\ \text{J}$
- (D) $0.001\ \text{J}$

Q19. Two point charges $11\ \mu\text{C}$ and $-2\ \mu\text{C}$ are held $27\ \text{cm}$ apart. What is the electric potential energy of this pair?

- (A) $-0.733\ \text{J}$
- (B) $-0.366\ \text{J}$
- (C) $-1.47\ \text{J}$
- (D) $0.733\ \text{J}$

Q20. In a region, the electric potential varies with position as $V(x) = 9x^2 + (5)x + 20$, where V is in volts and x is in metres. What is the x -component of the electric field at $x = 0.5\ \text{m}$?

- (A) $-7\ \text{N/C}$
- (B) $-28\ \text{N/C}$
- (C) $14\ \text{N/C}$
- (D) $-14\ \text{N/C}$

Q21. A thin ring of radius $27\ \text{cm}$ carries a total charge of $13\ \mu\text{C}$ uniformly around its circumference. What is the electric potential on the ring's axis $26\ \text{cm}$ from its centre, with zero potential at infinity?

- (A) $1.56 \times 10^5\ \text{V}$
- (B) $3.12 \times 10^5\ \text{V}$
- (C) $6.24 \times 10^5\ \text{V}$
- (D) $7.79 \times 10^4\ \text{V}$

Unit 10: Conductors and Capacitors

Q22. A parallel-plate capacitor has plates of area $160\ \text{cm}^2$ separated by $8\ \text{mm}$ in vacuum. What is its capacitance?

- (A) $1.77 \times 10^{-11}\ \text{F}$
- (B) $8.85 \times 10^{-12}\ \text{F}$
- (C) $3.54 \times 10^{-11}\ \text{F}$
- (D) $7.08 \times 10^{-11}\ \text{F}$

Q23. An isolated parallel-plate capacitor is charged to $36\ \text{V}$ in vacuum. The gap is then completely filled with a dielectric of constant 2.5 without changing the charge on the plates. What is the new voltage across the capacitor?

- (A) $7.2\ \text{V}$
- (B) $28.8\ \text{V}$
- (C) $57.6\ \text{V}$
- (D) $14.4\ \text{V}$

Q24. Capacitors of $7\ \mu\text{F}$ and $2\ \mu\text{F}$ are connected in series. What is their equivalent capacitance?

- (A) $0.778\ \mu\text{F}$
- (B) $3.11\ \mu\text{F}$
- (C) $6.22\ \mu\text{F}$
- (D) $1.56\ \mu\text{F}$

Q25. Capacitors of $13\ \mu\text{F}$, $6\ \mu\text{F}$ and $3\ \mu\text{F}$ are connected in parallel. What is their equivalent capacitance?

- (A) $22\ \mu\text{F}$
- (B) $11\ \mu\text{F}$
- (C) $44\ \mu\text{F}$
- (D) $16.5\ \mu\text{F}$

Q26. A $37\ \mu\text{F}$ capacitor is charged to $200\ \text{V}$. How much energy is stored in the capacitor?

- (A) $0.74\ \text{J}$
- (B) $0.37\ \text{J}$
- (C) $1.48\ \text{J}$
- (D) $0.185\ \text{J}$

Q27. A $34\ \mu\text{F}$ capacitor is connected across a $115\ \text{V}$ battery. What charge is stored on each plate?

- (A) $0.00196\ \text{C}$
- (B) $0.00782\ \text{C}$
- (C) $0.00391\ \text{C}$
- (D) $0.0156\ \text{C}$

Q28. A spherical capacitor consists of two concentric conducting shells of radii $5\ \text{cm}$ and $15\ \text{cm}$. What is its capacitance?

- (A) $4.17 \times 10^{-12}\ \text{F}$
- (B) $8.34 \times 10^{-12}\ \text{F}$
- (C) $1.67 \times 10^{-11}\ \text{F}$
- (D) $2.09 \times 10^{-12}\ \text{F}$

Q29. The voltage across a parallel-plate capacitor is $290\ \text{V}$ and the plate separation is $10\ \text{mm}$. What is the magnitude of the uniform electric field between the plates?

- (A) $1.45 \times 10^4\ \text{N/C}$
- (B) $2.9 \times 10^4\ \text{N/C}$
- (C) $5.8 \times 10^4\ \text{N/C}$
- (D) $1.16 \times 10^5\ \text{N/C}$

Unit 11: Electric Circuits

Q30. An initially uncharged capacitor is connected in series with a $37\text{ k}\Omega$ 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 $18\text{ }\mu\text{F}$.

- (A) 0.231 s
- (B) 0.462 s
- (C) 0.923 s
- (D) 0.115 s

Q31. A capacitor charged to 88 V discharges through a resistor. The RC time constant is 4 s . What is the voltage across the capacitor 2 s after discharge begins?

- (A) 26.7 V
- (B) 107 V
- (C) 13.3 V
- (D) 53.4 V

Q32. An uncharged capacitor is connected to a 37 V battery through a resistor. The RC time constant is 0.8 s . What is the voltage across the capacitor 1 s after connection?

- (A) 13.2 V
- (B) 52.8 V
- (C) 6.6 V
- (D) 26.4 V

Q33. A current of 1 A flows in a wire of cross-sectional area 1 mm^2 . The free-electron density is $8.5 \times 10^{28}\text{ m}^{-3}$. What is the drift speed of the electrons?

- (A) $7.35 \times 10^{-5}\text{ m/s}$
- (B) $3.68 \times 10^{-5}\text{ m/s}$
- (C) 0.000147 m/s
- (D) 0.000294 m/s

Q34. Resistors of $13\text{ }\Omega$ and $16\text{ }\Omega$ are connected in series across a 47 V battery. What is the voltage across the $16\text{ }\Omega$ resistor?

- (A) 13 V
- (B) 25.9 V
- (C) 51.9 V
- (D) 6.48 V

Q35. A current of 1 A flows uniformly through a wire of cross-sectional area 2 mm^2 . What is the current density in the wire?

- (A) $2.5 \times 10^5\text{ A/m}^2$
- (B) $5 \times 10^5\text{ A/m}^2$
- (C) $1 \times 10^6\text{ A/m}^2$
- (D) $1.25 \times 10^5\text{ A/m}^2$

Q36. A wire of resistivity $5.6 \times 10^{-8}\text{ }\Omega\cdot\text{m}$ has length 1 m and cross-sectional area 0.2 mm^2 . What is its resistance?

- (A) $0.14\text{ }\Omega$
- (B) $0.56\text{ }\Omega$
- (C) $0.28\text{ }\Omega$
- (D) $0.07\text{ }\Omega$

Q37. Resistors of $19\ \Omega$, $120\ \Omega$ and $44\ \Omega$ are connected in series. What is their equivalent resistance?

- (A) $91.5\ \Omega$
- (B) $366\ \Omega$
- (C) $137\ \Omega$
- (D) $183\ \Omega$

Q38. Resistors of $40\ \Omega$ and $30\ \Omega$ are connected in parallel. What is their equivalent resistance?

- (A) $8.57\ \Omega$
- (B) $34.3\ \Omega$
- (C) $17.1\ \Omega$
- (D) $68.6\ \Omega$

Q39. A resistor of $40\ \Omega$ is connected across a $88\ \text{V}$ source. How much power is dissipated in the resistor?

- (A) $96.8\ \text{W}$
- (B) $194\ \text{W}$
- (C) $387\ \text{W}$
- (D) $48.4\ \text{W}$

Q40. A battery of emf $16\ \text{V}$ and internal resistance $1\ \Omega$ is connected to an external resistor of $11\ \Omega$. What is the current in the circuit?

- (A) $1.33\ \text{A}$
- (B) $0.667\ \text{A}$
- (C) $2.67\ \text{A}$
- (D) $5.33\ \text{A}$

Q41. A resistor of $26\ \text{k}\Omega$ and a capacitor of $10\ \mu\text{F}$ are connected in series. What is the time constant of this RC circuit?

- (A) $0.13\ \text{s}$
- (B) $0.52\ \text{s}$
- (C) $0.065\ \text{s}$
- (D) $0.26\ \text{s}$

Unit 12: Magnetic Fields and Electromagnetism

Q42. A solenoid of length $61\ \text{cm}$ has 631 turns and carries a current of $4\ \text{A}$. What is the magnitude of the magnetic field inside the solenoid, away from its ends?

- (A) $0.0026\ \text{T}$
- (B) $0.0104\ \text{T}$
- (C) $0.0052\ \text{T}$
- (D) $0.0208\ \text{T}$

Q43. A straight wire of length $68\ \text{cm}$ carries a current of $4\ \text{A}$ in a uniform magnetic field of $55\ \text{mT}$. The angle between the wire and the field is 90° . What is the magnitude of the magnetic force on the wire?

- (A) $0.15\ \text{N}$
- (B) $0.0748\ \text{N}$
- (C) $0.299\ \text{N}$
- (D) $0.0374\ \text{N}$

Q44. A proton (mass 1.67×10^{-27} kg, charge 1.60×10^{-19} C) moves at 3×10^5 m/s perpendicular to a uniform magnetic field of 11 mT. What is the radius of its circular path?

- (A) 0.142 m
- (B) 0.285 m
- (C) 0.569 m
- (D) 1.14 m

Q45. An electron (mass 9.11×10^{-31} kg, charge 1.60×10^{-19} C) moves perpendicular to a uniform magnetic field of 48 mT. What is the period of its circular motion?

- (A) 3.73×10^{-10} s
- (B) 1.49×10^{-9} s
- (C) 7.45×10^{-10} s
- (D) 1.86×10^{-10} s

Q46. Two long parallel wires 19 cm apart carry currents of 7 A and 12 A in the same direction. What is the magnitude of the magnetic force per unit length on either wire?

- (A) 8.84×10^{-5} N/m
- (B) 4.42×10^{-5} N/m
- (C) 0.000177 N/m
- (D) 0.000354 N/m

Q47. A rectangular loop of area 149 cm^2 has 1 turns and carries a current of 3 A in a uniform magnetic field of 25 mT. The angle between the loop's normal and the field is 60° . What is the magnitude of the torque on the loop?

- (A) 0.000968 N·m
- (B) 0.000484 N·m
- (C) 0.00194 N·m
- (D) 0.000242 N·m

Q48. A long solid cylindrical wire of radius 16 cm carries a current of 7 A uniformly distributed over its cross-section. What is the magnitude of the magnetic field inside the wire at a distance 13 cm from its axis?

- (A) 3.55×10^{-6} T
- (B) 7.11×10^{-6} T
- (C) 1.42×10^{-5} T
- (D) 2.84×10^{-5} T

Q49. A long straight wire carries a current of 10 A. What is the magnitude of the magnetic field 11 cm from the wire?

- (A) 9.09×10^{-6} T
- (B) 3.64×10^{-5} T
- (C) 7.27×10^{-5} T
- (D) 1.82×10^{-5} T

Q50. A circular loop of radius 8 cm has 10 turns and carries a current of 5 A. What is the magnitude of the magnetic field at the centre of the loop?

- (A) 0.000393 T
- (B) 0.000196 T
- (C) 0.000785 T
- (D) 9.82×10^{-5} T

Unit 13: Electromagnetic Induction

Q51. A conducting rod of length 37 cm moves at 4 m/s perpendicular to a uniform magnetic field of 83 mT, with its length perpendicular to both the velocity and the field. What is the motional emf between its ends?

- (A) 0.0614 V
- (B) 0.246 V
- (C) 0.123 V
- (D) 0.491 V

Q52. An emf of 2 V is induced in a coil of resistance 2 Ω . What is the induced current in the loop?

- (A) 0.5 A
- (B) 1 A
- (C) 2 A
- (D) 0.25 A

Q53. A solenoid has 1221 turns, a cross-sectional area of 12 cm² and a length of 26 cm. What is its self-inductance?

- (A) 0.00432 H
- (B) 0.0173 H
- (C) 0.00865 H
- (D) 0.00216 H

Q54. An inductor of 151 mH carries a current of 5 A. How much energy is stored in its magnetic field?

- (A) 0.944 J
- (B) 1.89 J
- (C) 3.77 J
- (D) 7.55 J

Q55. An inductor of 24 mH is connected in series with a resistor of 43 Ω . What is the time constant of this LR circuit?

- (A) 0.000279 s
- (B) 0.000558 s
- (C) 0.00112 s
- (D) 0.00014 s

Q56. An LR circuit with time constant 0.5 s is connected to a 40 V battery through a 14 Ω resistor. What is the current 0.5 s after the switch is closed, starting from zero current?

- (A) 0.903 A
- (B) 3.61 A
- (C) 0.452 A
- (D) 1.81 A

Q57. An inductor carrying an initial current of 4 A is disconnected from its battery and discharges through a resistor. The LR time constant is 1.5 s. What is the current 0.5 s after discharge begins?

- (A) 1.43 A
- (B) 2.87 A
- (C) 5.73 A
- (D) 11.5 A

Q58. An LC circuit consists of an inductor of 40 mH and a capacitor of 91 μ F. What is the period of oscillation of the circuit?

- (A) 0.00599 s
- (B) 0.012 s
- (C) 0.024 s
- (D) 0.048 s

Q59. A flat loop of area 45 cm² is placed in a uniform magnetic field of 109 mT. The angle between the field and the normal to the loop is 0°. What is the magnetic flux through the loop?

- (A) 0.000245 Wb
- (B) 0.000981 Wb
- (C) 0.000123 Wb
- (D) 0.000491 Wb

Q60. A coil of 250 turns and area 25 cm² is perpendicular to a magnetic field that increases uniformly from 37 mT to 95 mT in 104 ms. What is the magnitude of the induced emf in the coil?

- (A) 0.174 V
- (B) 0.697 V
- (C) 0.349 V
- (D) 0.0871 V

Answer Key

Q1: C	Q11: D	Q21: B	Q31: D	Q41: D	Q51: C
Q2: C	Q12: A	Q22: A	Q32: D	Q42: C	Q52: B
Q3: B	Q13: A	Q23: D	Q33: A	Q43: A	Q53: C
Q4: D	Q14: C	Q24: D	Q34: B	Q44: B	Q54: B
Q5: C	Q15: C	Q25: A	Q35: B	Q45: C	Q55: B
Q6: A	Q16: D	Q26: A	Q36: C	Q46: A	Q56: D

Q7: A	Q17: C	Q27: C	Q37: D	Q47: A	Q57: B
Q8: D	Q18: A	Q28: B	Q38: C	Q48: B	Q58: B
Q9: C	Q19: A	Q29: B	Q39: B	Q49: D	Q59: D
Q10: D	Q20: D	Q30: B	Q40: A	Q50: A	Q60: C

Worked explanations for all 60 questions:

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