

AP Physics C: Electricity and Magnetism Practice Test 19

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 of $7\ \mu\text{C}$ and $11\ \mu\text{C}$ and are held $0.3\ \text{m}$ apart in air. What is the magnitude of the electrostatic force between them?

- (A) $15.4\ \text{N}$
- (B) $3.85\ \text{N}$
- (C) $7.7\ \text{N}$
- (D) $11.6\ \text{N}$

Q2. A point charge of $2\ \mu\text{C}$ is fixed in vacuum. What is the magnitude of the electric field at a point $0.3\ \text{m}$ from the charge?

- (A) $400\ \text{kN/C}$
- (B) $100\ \text{kN/C}$
- (C) $300\ \text{kN/C}$
- (D) $200\ \text{kN/C}$

Q3. A closed Gaussian surface encloses a net charge of $7\ \text{nC}$. What is the net electric flux through the surface?

- (A) $791\ \text{N}\cdot\text{m}^2/\text{C}$
- (B) $1.58\times 10^3\ \text{N}\cdot\text{m}^2/\text{C}$
- (C) $395\ \text{N}\cdot\text{m}^2/\text{C}$
- (D) $1.19\times 10^3\ \text{N}\cdot\text{m}^2/\text{C}$

Q4. An infinitely long straight wire carries a uniform linear charge density of $1\ \mu\text{C/m}$. What is the magnitude of the electric field at a perpendicular distance of $0.3\ \text{m}$ from the wire?

- (A) $60\ \text{kN/C}$
- (B) $120\ \text{kN/C}$
- (C) $30\ \text{kN/C}$
- (D) $90\ \text{kN/C}$

Q5. A very large flat sheet carries a uniform surface charge density of $2\ \mu\text{C/m}^2$. What is the magnitude of the electric field just outside the sheet?

- (A) $226\ \text{kN/C}$
- (B) $56.5\ \text{kN/C}$
- (C) $169\ \text{kN/C}$
- (D) $113\ \text{kN/C}$

Q6. A solid insulating sphere of radius 0.3 m carries a total charge of $4\ \mu\text{C}$ uniformly distributed through its volume. What is the magnitude of the electric field at a distance of 0.05 m from its centre?

- (A) 133 kN/C
- (B) 33.3 kN/C
- (C) 100 kN/C
- (D) 66.7 kN/C

Q7. A thin spherical shell of radius 0.25 m carries a total charge of $4\ \mu\text{C}$ uniformly on its surface. What is the magnitude of the electric field at a distance of 0.4 m from the centre of the shell?

- (A) 450 kN/C
- (B) 225 kN/C
- (C) 112 kN/C
- (D) 337 kN/C

Q8. A thin rod of length 1 m carries a total charge of $6\ \mu\text{C}$ uniformly along its length. Using integration, what is the magnitude of the electric field at a point on the rod's axis at a distance of 0.25 m from its nearer end?

- (A) 346 kN/C
- (B) 86.4 kN/C
- (C) 173 kN/C
- (D) 259 kN/C

Q9. A thin ring of radius 0.1 m carries a total charge of $6\ \mu\text{C}$ uniformly around its circumference. What is the magnitude of the electric field on the ring's axis at a distance of 0.3 m from its centre?

- (A) 1.02×10^3 kN/C
- (B) 256 kN/C
- (C) 512 kN/C
- (D) 768 kN/C

Q10. An electric dipole consists of charges of $+6\ \mu\text{C}$ and $-6\ \mu\text{C}$ separated by 0.08 m. What is the approximate magnitude of the electric field on the dipole axis at a distance of 0.5 m from its centre, where the distance is much larger than the separation?

- (A) 69 kN/C
- (B) 34.5 kN/C
- (C) 138 kN/C
- (D) 104 kN/C

Q11. A closed surface contains only an electric dipole, with equal positive and negative charges inside and nothing else. What is the net electric flux through the surface, and why?

- (A) Zero, because the field is zero everywhere on the surface
- (B) Non-zero, because each charge produces flux
- (C) Non-zero, because the dipole field never cancels
- (D) Zero, because the enclosed net charge is zero

Q12. Two positive point charges of $2\ \mu\text{C}$ and $3\ \mu\text{C}$ lie on the x-axis. A point P lies on the same axis beyond both charges, $0.6\ \text{m}$ from the first charge and $0.25\ \text{m}$ from the second charge. What is the magnitude of the net electric field at P?

- (A) $964\ \text{kN/C}$
- (B) $241\ \text{kN/C}$
- (C) $723\ \text{kN/C}$
- (D) $482\ \text{kN/C}$

Unit 9: Electric Potential

Q13. A point charge of $3\ \mu\text{C}$ is fixed in vacuum. What is the electric potential at a distance of $0.4\ \text{m}$ from the charge, taking the potential at infinity to be zero?

- (A) $67.5\ \text{kV}$
- (B) $135\ \text{kV}$
- (C) $33.8\ \text{kV}$
- (D) $101\ \text{kV}$

Q14. Two point charges of $2\ \mu\text{C}$ and $3\ \mu\text{C}$ are held $0.5\ \text{m}$ apart. What is the electric potential energy of this pair, taking zero energy at infinite separation?

- (A) $0.216\ \text{J}$
- (B) $0.108\ \text{J}$
- (C) $0.054\ \text{J}$
- (D) $0.162\ \text{J}$

Q15. A thin ring of radius $0.15\ \text{m}$ carries a total charge of $6\ \mu\text{C}$ uniformly around its circumference. What is the electric potential on the ring's axis at a distance of $0.4\ \text{m}$ from its centre?

- (A) $253\ \text{kV}$
- (B) $63.2\ \text{kV}$
- (C) $190\ \text{kV}$
- (D) $126\ \text{kV}$

Q16. A thin rod of length $0.5\ \text{m}$ carries a uniform linear charge density of $1\ \mu\text{C/m}$. By integrating the contributions of its charge elements, what is the electric potential at a point on the rod's axis $0.1\ \text{m}$ from its nearer end, with zero potential at infinity?

- (A) $32.3\ \text{kV}$
- (B) $8.06\ \text{kV}$
- (C) $24.2\ \text{kV}$
- (D) $16.1\ \text{kV}$

Q17. A uniform electric field of $600\ \text{N/C}$ points in the $+x$ direction. A charge is moved $0.25\ \text{m}$ in the $+x$ direction. By how much does the electric potential change?

- (A) $-150\ \text{V}$
- (B) $-75\ \text{V}$
- (C) $-300\ \text{V}$
- (D) $-225\ \text{V}$

Q18. The electric potential along the x-axis is $V(x) = 50x^2 + 30x$ volts, where x is in metres. What is the x-component of the electric field at $x = 1$ m?

- (A) -130 V/m
- (B) 130 V/m
- (C) -260 V/m
- (D) -65 V/m

Q19. A charge of $6 \mu\text{C}$ is moved through a potential increase of 5000 V by an external agent at constant speed. How much work does the external agent do?

- (A) 60 mJ
- (B) 30 mJ
- (C) 15 mJ
- (D) 45 mJ

Q20. A conducting sphere of radius 0.25 m carries a total charge of $2 \mu\text{C}$. What is the electric potential at the surface of the sphere, with zero potential at infinity?

- (A) 144 kV
- (B) 36 kV
- (C) 108 kV
- (D) 72 kV

Q21. At a point where the electric potential equals zero, which statement about the electric field there is necessarily correct?

- (A) The field must be zero
- (B) The field may be zero or non-zero; zero potential does not fix the field
- (C) The field must be at its maximum value
- (D) The field must point toward the point

Unit 10: Conductors and Capacitors

Q22. A parallel-plate capacitor has plates of area 200 cm^2 separated by 2.5 mm of air. What is its capacitance?

- (A) 35.4 pF
- (B) 70.8 pF
- (C) 142 pF
- (D) 106 pF

Q23. An air-filled capacitor has capacitance 20 pF. It is completely filled with a dielectric of dielectric constant 2 while its geometry is unchanged. What is the new capacitance?

- (A) 80 pF
- (B) 20 pF
- (C) 60 pF
- (D) 40 pF

Q24. A capacitor of capacitance $10 \mu\text{F}$ is charged to 150 V. How much energy is stored in the capacitor?

- (A) 225 mJ
- (B) 56.2 mJ
- (C) 112 mJ
- (D) 169 mJ

Q25. Capacitors of $10\ \mu\text{F}$ and $5\ \mu\text{F}$ are connected in series. What is their equivalent capacitance?

- (A) $1.67 \times 10^6\ \mu\text{F}$
- (B) $3.33 \times 10^6\ \mu\text{F}$
- (C) $6.67 \times 10^6\ \mu\text{F}$
- (D) $5 \times 10^6\ \mu\text{F}$

Q26. Capacitors of $2\ \mu\text{F}$, $7\ \mu\text{F}$ and $1\ \mu\text{F}$ are connected in parallel. What is their equivalent capacitance?

- (A) $20\ \mu\text{F}$
- (B) $5\ \mu\text{F}$
- (C) $10\ \mu\text{F}$
- (D) $15\ \mu\text{F}$

Q27. A capacitor of capacitance $4\ \mu\text{F}$ is connected across a $50\ \text{V}$ battery. What charge is stored on each plate?

- (A) $400\ \mu\text{C}$
- (B) $100\ \mu\text{C}$
- (C) $300\ \mu\text{C}$
- (D) $200\ \mu\text{C}$

Q28. A parallel-plate capacitor has a potential difference of $100\ \text{V}$ across plates separated by $3\ \text{mm}$. What is the magnitude of the uniform electric field between the plates, ignoring edge effects?

- (A) $33.3\ \text{kV/m}$
- (B) $66.7\ \text{kV/m}$
- (C) $16.7\ \text{kV/m}$
- (D) $50\ \text{kV/m}$

Q29. A spherical capacitor consists of concentric conducting spheres of radii $0.06\ \text{m}$ and $0.1\ \text{m}$. What is its capacitance?

- (A) $16.7\ \text{pF}$
- (B) $33.4\ \text{pF}$
- (C) $8.34\ \text{pF}$
- (D) $25\ \text{pF}$

Unit 11: Electric Circuits

Q30. A resistor of $2\ \Omega$ is connected across a $20\ \text{V}$ battery of negligible internal resistance. What is the current through the resistor?

- (A) $20\ \text{A}$
- (B) $10\ \text{A}$
- (C) $5\ \text{A}$
- (D) $15\ \text{A}$

Q31. Resistors of $3\ \Omega$, $5\ \Omega$ and $4\ \Omega$ are connected in series across a $18\ \text{V}$ battery. What is the current in the circuit?

- (A) $3\ \text{A}$
- (B) $0.75\ \text{A}$
- (C) $1.5\ \text{A}$
- (D) $2.25\ \text{A}$

Q32. Resistors of $24\ \Omega$ and $8\ \Omega$ are connected in parallel. What is their equivalent resistance?

- (A) $6\ \Omega$
- (B) $3\ \Omega$
- (C) $12\ \Omega$
- (D) $9\ \Omega$

Q33. A $5\ \Omega$ resistor is connected across a $12\ \text{V}$ supply. At what rate is electrical energy converted to heat in the resistor?

- (A) $28.8\ \text{W}$
- (B) $57.6\ \text{W}$
- (C) $14.4\ \text{W}$
- (D) $43.2\ \text{W}$

Q34. In a single loop, two batteries of emf $15\ \text{V}$ and $4\ \text{V}$ oppose each other, and the total resistance in the loop is $5\ \Omega$. What is the current in the loop?

- (A) $2.2\ \text{A}$
- (B) $1.1\ \text{A}$
- (C) $4.4\ \text{A}$
- (D) $3.3\ \text{A}$

Q35. A battery of emf $15\ \text{V}$ and internal resistance $1\ \Omega$ is connected to an external resistor of $17\ \Omega$. What is the terminal voltage of the battery?

- (A) $28.3\ \text{V}$
- (B) $7.08\ \text{V}$
- (C) $21.2\ \text{V}$
- (D) $14.2\ \text{V}$

Q36. A resistor of $25\ \text{k}\Omega$ and a capacitor of $2\ \mu\text{F}$ are connected in series. What is the time constant of this RC circuit?

- (A) $100\ \text{ms}$
- (B) $50\ \text{ms}$
- (C) $25\ \text{ms}$
- (D) $75\ \text{ms}$

Q37. An uncharged capacitor is connected in series with a $3\ \text{k}\Omega$ resistor across a $9\ \text{V}$ battery. The time constant is τ . What is the current in the circuit at time $t = 1\tau$ after the connection is made?

- (A) $1.1\ \text{mA}$
- (B) $2.21\ \text{mA}$
- (C) $0.552\ \text{mA}$
- (D) $1.66\ \text{mA}$

Q38. A capacitor charged to $16\ \text{V}$ is discharged through a resistor. The time constant of the circuit is τ . What is the voltage across the capacitor at time $t = 1\tau$ after discharging begins?

- (A) $2.94\ \text{V}$
- (B) $11.8\ \text{V}$
- (C) $8.83\ \text{V}$
- (D) $5.89\ \text{V}$

Q39. A wire of length 4 m and cross-sectional area 1 mm² is made of a material of resistivity $1.1 \times 10^{-6} \Omega \cdot \text{m}$. What is the resistance of the wire?

- (A) 4.4 Ω
- (B) 8.8 Ω
- (C) 2.2 Ω
- (D) 6.6 Ω

Q40. A total current of 4 A splits between two parallel branches of resistance 3 Ω and 4 Ω . What is the current through the 3 Ω branch?

- (A) 4.57 A
- (B) 2.29 A
- (C) 1.14 A
- (D) 3.43 A

Q41. A current of 3 A flows through a 20 Ω resistor for 60 s. How much electrical energy is converted to heat in the resistor during this time?

- (A) 10.8 kJ
- (B) 21.6 kJ
- (C) 5.4 kJ
- (D) 16.2 kJ

Unit 12: Magnetic Fields and Electromagnetism

Q42. An electron moves at 2×10^6 m/s perpendicular to a uniform magnetic field of 0.04 T. What is the magnitude of the magnetic force on the electron?

- (A) 12.8×10^{-15} N
- (B) 6.4×10^{-15} N
- (C) 25.6×10^{-15} N
- (D) 19.2×10^{-15} N

Q43. A straight wire of length 0.2 m carries a current of 4 A perpendicular to a uniform magnetic field of 0.2 T. What is the magnitude of the magnetic force on the wire?

- (A) 0.32 N
- (B) 0.16 N
- (C) 0.08 N
- (D) 0.24 N

Q44. A long straight wire carries a current of 12 A. What is the magnitude of the magnetic field at a distance of 0.05 m from the wire?

- (A) 96 μT
- (B) 24 μT
- (C) 48 μT
- (D) 72 μT

Q45. A circular loop of radius 0.05 m carries a current of 5 A. What is the magnitude of the magnetic field at the centre of the loop?

- (A) 126 μT
- (B) 31.4 μT
- (C) 62.8 μT
- (D) 94.2 μT

Q46. A solenoid has 400 turns per metre and carries a current of 3 A. What is the magnitude of the magnetic field inside the solenoid, far from its ends?

- (A) 3.02 mT
- (B) 0.754 mT
- (C) 2.26 mT
- (D) 1.51 mT

Q47. A proton moves at 15×10^4 m/s perpendicular to a uniform magnetic field of 0.05 T. What is the radius of its circular path?

- (A) 6.26 cm
- (B) 3.13 cm
- (C) 1.57 cm
- (D) 4.7 cm

Q48. A rectangular coil of 20 turns, of sides 0.1 m by 0.1 m, carries a current of 3 A in a uniform magnetic field of 0.1 T. When the angle between the coil's normal and the field is 30° , what is the magnitude of the torque on the coil?

- (A) 60 mN·m
- (B) 15 mN·m
- (C) 30 mN·m
- (D) 45 mN·m

Q49. Two long parallel wires carry currents of 3 A and 6 A in the same direction and are 0.1 m apart. What is the magnitude of the magnetic force per unit length between the wires?

- (A) 0.072 mN/m
- (B) 0.018 mN/m
- (C) 0.054 mN/m
- (D) 0.036 mN/m

Q50. A long straight cylindrical wire of radius 0.05 m carries a uniformly distributed current of 10 A. What is the magnitude of the magnetic field at a distance of 0.01 m from the wire's axis, inside the wire?

- (A) 16 μ T
- (B) 4 μ T
- (C) 8 μ T
- (D) 12 μ T

Unit 13: Electromagnetic Induction

Q51. A flat loop of area 100 cm² is placed in a uniform magnetic field of 0.15 T. The angle between the field and the normal to the loop is 0° . What is the magnetic flux through the loop?

- (A) 3 mWb
- (B) 0.75 mWb
- (C) 1.5 mWb
- (D) 2.25 mWb

Q52. A coil of 40 turns and area 150 cm^2 is placed with its plane perpendicular to a magnetic field. The field strength increases uniformly at 3 T/s . What is the magnitude of the induced emf in the coil?

- (A) $0.9 \times 10^3 \text{ mV}$
- (B) $3.6 \times 10^3 \text{ mV}$
- (C) $1.8 \times 10^3 \text{ mV}$
- (D) $2.7 \times 10^3 \text{ mV}$

Q53. A conducting rod of length 1 m moves at 10 m/s perpendicular to its length and perpendicular to a uniform magnetic field of 0.1 T . What is the magnitude of the motional emf between the ends of the rod?

- (A) 2 V
- (B) 1 V
- (C) 0.5 V
- (D) 1.5 V

Q54. A coil with 1 turn, area 200 cm^2 and resistance 40Ω lies perpendicular to a magnetic field that changes at 0.5 T/s . What is the magnitude of the induced current in the coil?

- (A) 0.5 mA
- (B) 0.125 mA
- (C) 0.25 mA
- (D) 0.375 mA

Q55. An inductor of inductance 20 mH carries a current that changes at a rate of 20 A/s . What is the magnitude of the induced emf across the inductor?

- (A) 0.8 V
- (B) 0.2 V
- (C) 0.6 V
- (D) 0.4 V

Q56. An inductor of inductance 50 mH carries a steady current of 2 A . How much energy is stored in its magnetic field?

- (A) 200 mJ
- (B) 50 mJ
- (C) 100 mJ
- (D) 150 mJ

Q57. An inductor of inductance 100 mH is connected in series with a resistor of 10Ω . What is the time constant of this LR circuit?

- (A) 20 ms
- (B) 10 ms
- (C) 5 ms
- (D) 15 ms

Q58. A series LR circuit with a 9 V battery and a resistor of 10Ω is switched on at $t = 0$ with zero initial current. The time constant is τ . What is the current at $t = 1\tau$?

- (A) 1.14 A
- (B) 0.569 A
- (C) 0.284 A
- (D) 0.853 A

Q59. An LC circuit consists of an inductor of 10 mH and a capacitor of 2 μ F. What is the frequency of oscillation of the circuit?

- (A) 2.25 kHz
- (B) 0.563 kHz
- (C) 1.13 kHz
- (D) 1.69 kHz

Q60. An LC circuit has inductance 10 mH and capacitance 4 μ F. What is the angular frequency of its charge oscillations?

- (A) 10 krad/s
- (B) 5 krad/s
- (C) 2.5 krad/s
- (D) 7.5 krad/s

Answer Key

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

Worked explanations for all 60 questions:

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