

AP Physics C: Electricity and Magnetism Practice Test 16

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 $10\ \mu\text{C}$ and $2\ \mu\text{C}$ and are held $0.1\ \text{m}$ apart in air. What is the magnitude of the electrostatic force between them?

- (A) $36\ \text{N}$
- (B) $9\ \text{N}$
- (C) $27\ \text{N}$
- (D) $18\ \text{N}$

Q2. A point charge of $6\ \mu\text{C}$ is fixed in vacuum. What is the magnitude of the electric field at a point $0.8\ \text{m}$ from the charge?

- (A) $84.4\ \text{kN/C}$
- (B) $169\ \text{kN/C}$
- (C) $42.2\ \text{kN/C}$
- (D) $127\ \text{kN/C}$

Q3. A closed Gaussian surface encloses a net charge of $4\ \text{nC}$. What is the net electric flux through the surface?

- (A) $904\ \text{N}\cdot\text{m}^2/\text{C}$
- (B) $226\ \text{N}\cdot\text{m}^2/\text{C}$
- (C) $678\ \text{N}\cdot\text{m}^2/\text{C}$
- (D) $452\ \text{N}\cdot\text{m}^2/\text{C}$

Q4. An infinitely long straight wire carries a uniform linear charge density of $0.4\ \mu\text{C/m}$. What is the magnitude of the electric field at a perpendicular distance of $0.3\ \text{m}$ from the wire?

- (A) $48\ \text{kN/C}$
- (B) $12\ \text{kN/C}$
- (C) $36\ \text{kN/C}$
- (D) $24\ \text{kN/C}$

Q5. A very large flat sheet carries a uniform surface charge density of $4\ \mu\text{C/m}^2$. What is the magnitude of the electric field just outside the sheet?

- (A) $452\ \text{kN/C}$
- (B) $226\ \text{kN/C}$
- (C) $113\ \text{kN/C}$
- (D) $339\ \text{kN/C}$

Q6. A solid insulating sphere of radius 0.25 m carries a total charge of $3\text{ }\mu\text{C}$ uniformly distributed through its volume. What is the magnitude of the electric field at a distance of 0.15 m from its centre?

- (A) 518 kN/C
- (B) 130 kN/C
- (C) 259 kN/C
- (D) 389 kN/C

Q7. A thin spherical shell of radius 0.25 m carries a total charge of $2\text{ }\mu\text{C}$ uniformly on its surface. What is the magnitude of the electric field at a distance of 0.6 m from the centre of the shell?

- (A) 100 kN/C
- (B) 25 kN/C
- (C) 75 kN/C
- (D) 50 kN/C

Q8. A thin rod of length 0.5 m carries a total charge of $4\text{ }\mu\text{C}$ 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 0.1 m from its nearer end?

- (A) 1.2×10^3 kN/C
- (B) 600 kN/C
- (C) 300 kN/C
- (D) 900 kN/C

Q9. A thin ring of radius 0.15 m carries a total charge of $2\text{ }\mu\text{C}$ uniformly around its circumference. What is the magnitude of the electric field on the ring's axis at a distance of 0.5 m from its centre?

- (A) 127 kN/C
- (B) 63.3 kN/C
- (C) 31.6 kN/C
- (D) 94.9 kN/C

Q10. An electric dipole consists of charges of $+4\text{ }\mu\text{C}$ and $-4\text{ }\mu\text{C}$ separated by 0.08 m. What is the approximate magnitude of the electric field on the dipole axis at a distance of 0.4 m from its centre, where the distance is much larger than the separation?

- (A) 90 kN/C
- (B) 180 kN/C
- (C) 45 kN/C
- (D) 135 kN/C

Q11. A closed surface encloses a dipole consisting of equal and opposite charges, with no other charge inside. What is the net electric flux through the surface, and why?

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

Q12. Two positive point charges of $3\ \mu\text{C}$ and $1\ \mu\text{C}$ lie on the x-axis. A point P lies on the same axis beyond both charges, 0.6 m from the first charge and 0.3 m from the second charge. What is the magnitude of the net electric field at P?

- (A) 175 kN/C
- (B) 350 kN/C
- (C) 87.5 kN/C
- (D) 262 kN/C

Unit 9: Electric Potential

Q13. A point charge of $5\ \mu\text{C}$ is fixed in vacuum. What is the electric potential at a distance of 0.4 m from the charge, taking the potential at infinity to be zero?

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

Q14. Two point charges of $2\ \mu\text{C}$ and $6\ \mu\text{C}$ are held 0.2 m apart. What is the electric potential energy of this pair, taking zero energy at infinite separation?

- (A) 1.08 J
- (B) 0.27 J
- (C) 0.54 J
- (D) 0.81 J

Q15. A thin ring of radius 0.2 m carries a total charge of $5\ \mu\text{C}$ uniformly around its circumference. What is the electric potential on the ring's axis at a distance of 0.4 m from its centre?

- (A) 201 kV
- (B) 50.3 kV
- (C) 101 kV
- (D) 151 kV

Q16. A thin rod of length 0.5 m carries a uniform linear charge density of $1\ \mu\text{C}/\text{m}$. By integrating the contributions of its charge elements, what is the electric potential at a point on the rod's axis 0.2 m from its nearer end, with zero potential at infinity?

- (A) 22.5 kV
- (B) 11.3 kV
- (C) 5.64 kV
- (D) 16.9 kV

Q17. A uniform electric field of 400 N/C points in the +x direction. A charge is moved 0.1 m in the +x direction. By how much does the electric potential change?

- (A) 40 V
- (B) -80 V
- (C) -20 V
- (D) -40 V

Q18. The electric potential along the x-axis is $V(x) = 50x^2 + 20x$ volts, where x is in metres. What is the x-component of the electric field at $x = 2$ m?

- (A) 220 V/m
- (B) -440 V/m
- (C) -220 V/m
- (D) -110 V/m

Q19. A charge of $3 \mu\text{C}$ 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) 15 mJ
- (B) 30 mJ
- (C) 7.5 mJ
- (D) 22.5 mJ

Q20. A conducting sphere of radius 0.3 m carries a total charge of $1 \mu\text{C}$. What is the electric potential at the surface of the sphere, with zero potential at infinity?

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

Q21. At a certain point in space the electric potential is zero. Which statement about the electric field at that point is necessarily correct?

- (A) The field may be zero or non-zero; zero potential does not fix the field
- (B) The field must be zero
- (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 100 cm^2 separated by 2 mm of air. What is its capacitance?

- (A) 88.5 pF
- (B) 22.1 pF
- (C) 44.2 pF
- (D) 66.4 pF

Q23. An air-filled capacitor has capacitance 60 pF. It is completely filled with a dielectric of dielectric constant 5 while its geometry is unchanged. What is the new capacitance?

- (A) 600 pF
- (B) 300 pF
- (C) 150 pF
- (D) 450 pF

Q24. A capacitor of capacitance $4 \mu\text{F}$ is charged to 200 V. How much energy is stored in the capacitor?

- (A) 160 mJ
- (B) 40 mJ
- (C) 120 mJ
- (D) 80 mJ

Q25. Capacitors of $8\ \mu\text{F}$ and $4\ \mu\text{F}$ are connected in series. What is their equivalent capacitance?

- (A) $5.33\ \mu\text{F}$
- (B) $1.33\ \mu\text{F}$
- (C) $2.67\ \mu\text{F}$
- (D) $4\ \mu\text{F}$

Q26. Capacitors of $4\ \mu\text{F}$, $4\ \mu\text{F}$ and $2\ \mu\text{F}$ are connected in parallel. What is their equivalent capacitance?

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

Q27. A capacitor of capacitance $6\ \mu\text{F}$ is connected across a $20\ \text{V}$ battery. What charge is stored on each plate?

- (A) $240\ \mu\text{C}$
- (B) $60\ \mu\text{C}$
- (C) $180\ \mu\text{C}$
- (D) $120\ \mu\text{C}$

Q28. A parallel-plate capacitor has a potential difference of $500\ \text{V}$ across plates separated by $4\ \text{mm}$. What is the magnitude of the uniform electric field between the plates, ignoring edge effects?

- (A) $250\ \text{kV/m}$
- (B) $62.5\ \text{kV/m}$
- (C) $125\ \text{kV/m}$
- (D) $188\ \text{kV/m}$

Q29. A spherical capacitor consists of concentric conducting spheres of radii $0.08\ \text{m}$ and $0.12\ \text{m}$. What is its capacitance?

- (A) $26.7\ \text{pF}$
- (B) $53.4\ \text{pF}$
- (C) $13.3\ \text{pF}$
- (D) $40\ \text{pF}$

Unit 11: Electric Circuits

Q30. A resistor of $8\ \Omega$ is connected across a $9\ \text{V}$ battery of negligible internal resistance. What is the current through the resistor?

- (A) $2.25\ \text{A}$
- (B) $0.562\ \text{A}$
- (C) $1.69\ \text{A}$
- (D) $1.12\ \text{A}$

Q31. Resistors of $3\ \Omega$, $6\ \Omega$ and $5\ \Omega$ are connected in series across a $12\ \text{V}$ battery. What is the current in the circuit?

- (A) $1.71\ \text{A}$
- (B) $0.429\ \text{A}$
- (C) $1.29\ \text{A}$
- (D) $0.857\ \text{A}$

Q32. Resistors of $6\ \Omega$ and $4\ \Omega$ are connected in parallel. What is their equivalent resistance?

- (A) $4.8\ \Omega$
- (B) $1.2\ \Omega$
- (C) $3.6\ \Omega$
- (D) $2.4\ \Omega$

Q33. A $6\ \Omega$ resistor is connected across a $20\ \text{V}$ supply. At what rate is electrical energy converted to heat in the resistor?

- (A) $133\ \text{W}$
- (B) $33.3\ \text{W}$
- (C) $66.7\ \text{W}$
- (D) $100\ \text{W}$

Q34. In a single loop, two batteries of emf $18\ \text{V}$ and $9\ \text{V}$ oppose each other, and the total resistance in the loop is $9\ \Omega$. What is the current in the loop?

- (A) $2\ \text{A}$
- (B) $0.5\ \text{A}$
- (C) $1\ \text{A}$
- (D) $1.5\ \text{A}$

Q35. A battery of emf $15\ \text{V}$ and internal resistance $2\ \Omega$ is connected to an external resistor of $17\ \Omega$. What is the terminal voltage of the battery?

- (A) $26.8\ \text{V}$
- (B) $13.4\ \text{V}$
- (C) $6.71\ \text{V}$
- (D) $20.1\ \text{V}$

Q36. A resistor of $20\ \text{k}\Omega$ and a capacitor of $20\ \mu\text{F}$ are connected in series. What is the time constant of this RC circuit?

- (A) $400\ \text{ms}$
- (B) $800\ \text{ms}$
- (C) $200\ \text{ms}$
- (D) $600\ \text{ms}$

Q37. An uncharged capacitor is connected in series with a $2\ \text{k}\Omega$ resistor across a $15\ \text{V}$ battery. The time constant is τ . What is the current in the circuit at time $t = 1\tau$ after the connection is made?

- (A) $2.76\ \text{mA}$
- (B) $5.52\ \text{mA}$
- (C) $1.38\ \text{mA}$
- (D) $4.14\ \text{mA}$

Q38. A capacitor charged to $12\ \text{V}$ is discharged through a resistor. The time constant of the circuit is τ . What is the voltage across the capacitor at time $t = 2\tau$ after discharging begins?

- (A) $3.25\ \text{V}$
- (B) $1.62\ \text{V}$
- (C) $0.812\ \text{V}$
- (D) $2.44\ \text{V}$

Q39. A wire of length 3 m and cross-sectional area 2 mm^2 is made of a material of resistivity $0.8 \times 10^{-6} \Omega \cdot \text{m}$. What is the resistance of the wire?

- (A) 2.4Ω
- (B) 1.2Ω
- (C) 0.6Ω
- (D) 1.8Ω

Q40. A total current of 3 A splits between two parallel branches of resistance 2Ω and 3Ω . What is the current through the 2Ω branch?

- (A) 3.6 A
- (B) 0.9 A
- (C) 1.8 A
- (D) 2.7 A

Q41. A current of 5 A flows through a 5Ω resistor for 120 s. How much electrical energy is converted to heat in the resistor during this time?

- (A) 15 kJ
- (B) 30 kJ
- (C) 7.5 kJ
- (D) 22.5 kJ

Unit 12: Magnetic Fields and Electromagnetism

Q42. An electron moves at $2 \times 10^6 \text{ m/s}$ perpendicular to a uniform magnetic field of 0.01 T . What is the magnitude of the magnetic force on the electron?

- (A) $6.4 \times 10^{-15} \text{ N}$
- (B) $1.6 \times 10^{-15} \text{ N}$
- (C) $4.8 \times 10^{-15} \text{ N}$
- (D) $3.2 \times 10^{-15} \text{ N}$

Q43. A straight wire of length 1 m carries a current of 3 A perpendicular to a uniform magnetic field of 0.2 T . What is the magnitude of the magnetic force on the wire?

- (A) 1.2 N
- (B) 0.3 N
- (C) 0.9 N
- (D) 0.6 N

Q44. A long straight wire carries a current of 12 A. What is the magnitude of the magnetic field at a distance of 0.08 m from the wire?

- (A) $30 \mu\text{T}$
- (B) $60 \mu\text{T}$
- (C) $15 \mu\text{T}$
- (D) $45 \mu\text{T}$

Q45. A circular loop of radius 0.05 m carries a current of 8 A. What is the magnitude of the magnetic field at the centre of the loop?

- (A) $201 \mu\text{T}$
- (B) $50.3 \mu\text{T}$
- (C) $101 \mu\text{T}$
- (D) $151 \mu\text{T}$

Q46. A solenoid has 800 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) 6.03 mT
- (B) 1.51 mT
- (C) 4.52 mT
- (D) 3.02 mT

Q47. A proton moves at 5×10^4 m/s perpendicular to a uniform magnetic field of 0.02 T. What is the radius of its circular path?

- (A) 2.61 cm
- (B) 5.22 cm
- (C) 1.3 cm
- (D) 3.91 cm

Q48. A rectangular coil of 20 turns, of sides 0.1 m by 0.1 m, carries a current of 2 A in a uniform magnetic field of 0.3 T. When the angle between the coil's normal and the field is 90° , what is the magnitude of the torque on the coil?

- (A) 240 mN·m
- (B) 60 mN·m
- (C) 120 mN·m
- (D) 180 mN·m

Q49. Two long parallel wires carry currents of 6 A and 4 A in the same direction and are 0.2 m apart. What is the magnitude of the magnetic force per unit length between the wires?

- (A) 0.024 mN/m
- (B) 0.048 mN/m
- (C) 0.012 mN/m
- (D) 0.036 mN/m

Q50. A long straight cylindrical wire of radius 0.05 m carries a uniformly distributed current of 8 A. What is the magnitude of the magnetic field at a distance of 0.02 m from the wire's axis, inside the wire?

- (A) 25.6 μ T
- (B) 6.4 μ T
- (C) 12.8 μ T
- (D) 19.2 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 60° . What is the magnetic flux through the loop?

- (A) 1.5 mWb
- (B) 0.75 mWb
- (C) 0.375 mWb
- (D) 1.13 mWb

Q52. A coil of 20 turns and area 200 cm^2 is placed with its plane perpendicular to a magnetic field. The field strength increases uniformly at 0.5 T/s . What is the magnitude of the induced emf in the coil?

- (A) 400 mV
- (B) 100 mV
- (C) 300 mV
- (D) 200 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 0.5 T. What is the magnitude of the motional emf between the ends of the rod?

- (A) 10 V
- (B) 5 V
- (C) 2.5 V
- (D) 7.5 V

Q54. A coil with 5 turns, area 400 cm^2 and resistance 40Ω lies perpendicular to a magnetic field that changes at 2 T/s . What is the magnitude of the induced current in the coil?

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

Q55. An inductor of inductance 50 mH carries a current that changes at a rate of 25 A/s . What is the magnitude of the induced emf across the inductor?

- (A) 2.5 V
- (B) 1.25 V
- (C) 0.625 V
- (D) 1.88 V

Q56. An inductor of inductance 20 mH carries a steady current of 2 A. How much energy is stored in its magnetic field?

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

Q57. An inductor of inductance 100 mH is connected in series with a resistor of 20Ω . What is the time constant of this LR circuit?

- (A) 10 ms
- (B) 5 ms
- (C) 2.5 ms
- (D) 7.5 ms

Q58. A series LR circuit with a 6 V battery and a resistor of 5Ω is switched on at $t = 0$ with zero initial current. The time constant is τ . What is the current at $t = 2\tau$?

- (A) 2.08 A
- (B) 0.519 A
- (C) 1.04 A
- (D) 1.56 A

Q59. An LC circuit consists of an inductor of 10 mH and a capacitor of 5 μ F. What is the frequency of oscillation of the circuit?

- (A) 1.42 kHz
- (B) 0.712 kHz
- (C) 0.356 kHz
- (D) 1.07 kHz

Q60. An LC circuit has inductance 5 mH and capacitance 4 μ F. What is the angular frequency of its charge oscillations?

- (A) 14.1 krad/s
- (B) 3.54 krad/s
- (C) 10.6 krad/s
- (D) 7.07 krad/s

Answer Key

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

Worked explanations for all 60 questions:

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