

AP Physics C: Electricity and Magnetism Practice Test 17

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 $3\ \mu\text{C}$ and are held $0.2\ \text{m}$ apart in air. What is the magnitude of the electrostatic force between them?

- (A) $9.45\ \text{N}$
- (B) $2.36\ \text{N}$
- (C) $7.09\ \text{N}$
- (D) $4.72\ \text{N}$

Q2. A point charge of $6\ \mu\text{C}$ is fixed in vacuum. What is the magnitude of the electric field at a point $0.6\ \text{m}$ from the charge?

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

Q3. A closed Gaussian surface encloses a net charge of $6\ \text{nC}$. What is the net electric flux through the surface?

- (A) $1.36 \times 10^3\ \text{N}\cdot\text{m}^2/\text{C}$
- (B) $678\ \text{N}\cdot\text{m}^2/\text{C}$
- (C) $339\ \text{N}\cdot\text{m}^2/\text{C}$
- (D) $1.02 \times 10^3\ \text{N}\cdot\text{m}^2/\text{C}$

Q4. An infinitely long straight wire carries a uniform linear charge density of $1.5\ \mu\text{C/m}$. What is the magnitude of the electric field at a perpendicular distance of $0.3\ \text{m}$ from the wire?

- (A) $90\ \text{kN/C}$
- (B) $180\ \text{kN/C}$
- (C) $45\ \text{kN/C}$
- (D) $135\ \text{kN/C}$

Q5. A very large flat sheet carries a uniform surface charge density of $3\ \mu\text{C/m}^2$. What is the magnitude of the electric field just outside the sheet?

- (A) $339\ \text{kN/C}$
- (B) $169\ \text{kN/C}$
- (C) $84.7\ \text{kN/C}$
- (D) $254\ \text{kN/C}$

Q6. A solid insulating sphere of radius 0.2 m carries a total charge of 8 μC uniformly distributed through its volume. What is the magnitude of the electric field at a distance of 0.12 m from its centre?

- (A) $2.16 \times 10^3 \text{ kN/C}$
- (B) 540 kN/C
- (C) $1.08 \times 10^3 \text{ kN/C}$
- (D) $1.62 \times 10^3 \text{ kN/C}$

Q7. A thin spherical shell of radius 0.25 m carries a total charge of 2 μC uniformly on its surface. What is the magnitude of the electric field at a distance of 1 m from the centre of the shell?

- (A) 18 kN/C
- (B) 36 kN/C
- (C) 9 kN/C
- (D) 27 kN/C

Q8. A thin rod of length 0.4 m carries a total charge of 8 μC 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) $2.88 \times 10^3 \text{ kN/C}$
- (B) 720 kN/C
- (C) $1.44 \times 10^3 \text{ kN/C}$
- (D) $2.16 \times 10^3 \text{ kN/C}$

Q9. A thin ring of radius 0.25 m carries a total charge of 4 μC uniformly around its circumference. What is the magnitude of the electric field on the ring's axis at a distance of 0.2 m from its centre?

- (A) 439 kN/C
- (B) 110 kN/C
- (C) 219 kN/C
- (D) 329 kN/C

Q10. An electric dipole consists of charges of +4 μC and -4 μC separated by 0.06 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) 135 kN/C
- (B) 33.7 kN/C
- (C) 67.5 kN/C
- (D) 101 kN/C

Q11. A closed surface surrounds a dipole made of two equal and opposite charges, with no other charge enclosed. 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 $2\ \mu\text{C}$ and $1\ \mu\text{C}$ lie on the x-axis. A point P lies on the same axis beyond both charges, $0.6\ \text{m}$ from the first charge and $0.35\ \text{m}$ from the second charge. What is the magnitude of the net electric field at P?

- (A) $247\ \text{kN/C}$
- (B) $61.7\ \text{kN/C}$
- (C) $185\ \text{kN/C}$
- (D) $123\ \text{kN/C}$

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 $0.25\ \text{m}$ from the charge, taking the potential at infinity to be zero?

- (A) $180\ \text{kV}$
- (B) $360\ \text{kV}$
- (C) $90\ \text{kV}$
- (D) $270\ \text{kV}$

Q14. Two point charges of $6\ \mu\text{C}$ and $4\ \mu\text{C}$ are held $0.2\ \text{m}$ apart. What is the electric potential energy of this pair, taking zero energy at infinite separation?

- (A) $1.08\ \text{J}$
- (B) $2.16\ \text{J}$
- (C) $0.54\ \text{J}$
- (D) $1.62\ \text{J}$

Q15. A thin ring of radius $0.15\ \text{m}$ carries a total charge of $3\ \mu\text{C}$ uniformly around its circumference. What is the electric potential on the ring's axis at a distance of $0.2\ \text{m}$ from its centre?

- (A) $216\ \text{kV}$
- (B) $108\ \text{kV}$
- (C) $54\ \text{kV}$
- (D) $162\ \text{kV}$

Q16. A thin rod of length $0.5\ \text{m}$ carries a uniform linear charge density of $3\ \mu\text{C/m}$. 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) $96.8\ \text{kV}$
- (B) $24.2\ \text{kV}$
- (C) $48.4\ \text{kV}$
- (D) $72.6\ \text{kV}$

Q17. A uniform electric field of $600\ \text{N/C}$ points in the $+x$ direction. A charge is moved $0.1\ \text{m}$ in the $+x$ direction. By how much does the electric potential change?

- (A) $60\ \text{V}$
- (B) $-120\ \text{V}$
- (C) $-60\ \text{V}$
- (D) $-30\ \text{V}$

Q18. The electric potential along the x-axis is $V(x) = 60x^2 + 40x$ volts, where x is in metres. What is the x-component of the electric field at $x = 1$ m?

- (A) 160 V/m
- (B) -320 V/m
- (C) -80 V/m
- (D) -160 V/m

Q19. A charge of $6\ \mu\text{C}$ is moved through a potential increase of 2000 V by an external agent at constant speed. How much work does the external agent do?

- (A) 24 mJ
- (B) 12 mJ
- (C) 6 mJ
- (D) 18 mJ

Q20. A conducting sphere of radius 0.2 m carries a total charge of $3\ \mu\text{C}$. What is the electric potential at the surface of the sphere, with zero potential at infinity?

- (A) 135 kV
- (B) 270 kV
- (C) 67.5 kV
- (D) 202 kV

Q21. At one point in space the electric potential happens to be zero. Which statement about the electric field at that same 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 $200\ \text{cm}^2$ separated by 4 mm of air. What is its capacitance?

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

Q23. An air-filled capacitor has capacitance 80 pF. It is completely filled with a dielectric of dielectric constant 3 while its geometry is unchanged. What is the new capacitance?

- (A) 480 pF
- (B) 120 pF
- (C) 240 pF
- (D) 360 pF

Q24. A capacitor of capacitance $5\ \mu\text{F}$ is charged to 150 V. How much energy is stored in the capacitor?

- (A) 0.0281 mJ
- (B) 0.113 mJ
- (C) 0.0563 mJ
- (D) 0.0844 mJ

Q25. Capacitors of $8\ \mu\text{F}$ and $12\ \mu\text{F}$ are connected in series. What is their equivalent capacitance?

- (A) $4.8\ \mu\text{F}$
- (B) $9.6\ \mu\text{F}$
- (C) $2.4\ \mu\text{F}$
- (D) $7.2\ \mu\text{F}$

Q26. Capacitors of $5\ \mu\text{F}$, $4\ \mu\text{F}$ 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) $15\ \mu\text{F}$
- (D) $10\ \mu\text{F}$

Q27. A capacitor of capacitance $8\ \mu\text{F}$ is connected across a $25\ \text{V}$ battery. What charge is stored on each plate?

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

Q28. A parallel-plate capacitor has a potential difference of $300\ \text{V}$ across plates separated by $3\ \text{mm}$. What is the magnitude of the uniform electric field between the plates, ignoring edge effects?

- (A) $200\ \text{kV/m}$
- (B) $50\ \text{kV/m}$
- (C) $150\ \text{kV/m}$
- (D) $100\ \text{kV/m}$

Q29. A spherical capacitor consists of concentric conducting spheres of radii $0.06\ \text{m}$ and $0.15\ \text{m}$. What is its capacitance?

- (A) $11.1\ \text{pF}$
- (B) $22.2\ \text{pF}$
- (C) $5.56\ \text{pF}$
- (D) $16.7\ \text{pF}$

Unit 11: Electric Circuits

Q30. A resistor of $2\ \Omega$ is connected across a $9\ \text{V}$ battery of negligible internal resistance. What is the current through the resistor?

- (A) $9\ \text{A}$
- (B) $2.25\ \text{A}$
- (C) $4.5\ \text{A}$
- (D) $6.75\ \text{A}$

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

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

- Q32. Resistors of $6\ \Omega$ and $12\ \Omega$ are connected in parallel. What is their equivalent resistance?**
- (A) $2\ \Omega$
 - (B) $8\ \Omega$
 - (C) $4\ \Omega$
 - (D) $6\ \Omega$
- Q33. A $3\ \Omega$ resistor is connected across a $20\ \text{V}$ supply. At what rate is electrical energy converted to heat in the resistor?**
- (A) $267\ \text{W}$
 - (B) $133\ \text{W}$
 - (C) $66.7\ \text{W}$
 - (D) $200\ \text{W}$
- Q34. In a single loop, two batteries of emf $15\ \text{V}$ and $6\ \text{V}$ oppose each other, and the total resistance in the loop is $3\ \Omega$. What is the current in the loop?**
- (A) $6\ \text{A}$
 - (B) $3\ \text{A}$
 - (C) $1.5\ \text{A}$
 - (D) $4.5\ \text{A}$
- Q35. A battery of emf $18\ \text{V}$ and internal resistance $2\ \Omega$ is connected to an external resistor of $8\ \Omega$. What is the terminal voltage of the battery?**
- (A) $28.8\ \text{V}$
 - (B) $7.2\ \text{V}$
 - (C) $21.6\ \text{V}$
 - (D) $14.4\ \text{V}$
- Q36. A resistor of $20\ \text{k}\Omega$ and a capacitor of $10\ \mu\text{F}$ are connected in series. What is the time constant of this RC circuit?**
- (A) $400\ \text{ms}$
 - (B) $200\ \text{ms}$
 - (C) $100\ \text{ms}$
 - (D) $300\ \text{ms}$
- Q37. An uncharged capacitor is connected in series with a $3\ \text{k}\Omega$ resistor across a $6\ \text{V}$ battery. The time constant is τ . What is the current in the circuit at time $t = 1\tau$ after the connection is made?**
- (A) $1.47\ \text{mA}$
 - (B) $0.736\ \text{mA}$
 - (C) $0.368\ \text{mA}$
 - (D) $1.1\ \text{mA}$
- Q38. A capacitor charged to $20\ \text{V}$ 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) $14.7\ \text{V}$
 - (B) $7.36\ \text{V}$
 - (C) $3.68\ \text{V}$
 - (D) $11\ \text{V}$

Q39. A wire of length 4 m and cross-sectional area 0.5 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) 12.8Ω
- (B) 3.2Ω
- (C) 9.6Ω
- (D) 6.4Ω

Q40. A total current of 2 A splits between two parallel branches of resistance 2Ω and 12Ω . What is the current through the 2Ω branch?

- (A) 3.43 A
- (B) 0.857 A
- (C) 1.71 A
- (D) 2.57 A

Q41. A current of 5 A flows through a 10Ω resistor for 120 s. How much electrical energy is converted to heat in the resistor during this time?

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

Unit 12: Magnetic Fields and Electromagnetism

Q42. An electron moves at $3 \times 10^6 \text{ m/s}$ perpendicular to a uniform magnetic field of 0.05 T . What is the magnitude of the magnetic force on the electron?

- (A) $48 \times 10^{-15} \text{ N}$
- (B) $12 \times 10^{-15} \text{ N}$
- (C) $36 \times 10^{-15} \text{ N}$
- (D) $24 \times 10^{-15} \text{ N}$

Q43. A straight wire of length 0.5 m carries a current of 10 A perpendicular to a uniform magnetic field of 0.2 T . What is the magnitude of the magnetic force on the wire?

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

Q44. A long straight wire carries a current of 8 A. What is the magnitude of the magnetic field at a distance of 0.1 m from the wire?

- (A) $16 \mu\text{T}$
- (B) $32 \mu\text{T}$
- (C) $8 \mu\text{T}$
- (D) $24 \mu\text{T}$

Q45. A circular loop of radius 0.08 m carries a current of 6 A. What is the magnitude of the magnetic field at the centre of the loop?

- (A) $23.6 \mu\text{T}$
- (B) $94.2 \mu\text{T}$
- (C) $47.1 \mu\text{T}$
- (D) $70.7 \mu\text{T}$

Q46. A solenoid has 700 turns per metre and carries a current of 2 A. What is the magnetic field magnitude inside the solenoid, far from its ends?

- (A) 0.88 mT
- (B) 1.76 mT
- (C) 3.52 mT
- (D) 2.64 mT

Q47. A proton moves at 10×10^4 m/s perpendicular to a uniform magnetic field of 0.04 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 50 turns, of sides 0.1 m by 0.05 m, carries a current of 3 A in a uniform magnetic field of 0.3 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) 112 mN·m
- (B) 225 mN·m
- (C) 56.2 mN·m
- (D) 169 mN·m

Q49. Two long parallel wires carry currents of 6 A and 6 A in the same direction and are 0.05 m apart. What is the magnitude of the magnetic force per unit length between the wires?

- (A) 0.288 mN/m
- (B) 0.072 mN/m
- (C) 0.216 mN/m
- (D) 0.144 mN/m

Q50. A long straight cylindrical wire of radius 0.05 m carries a uniformly distributed current of 12 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) 19.2 μ T
- (B) 4.8 μ T
- (C) 9.6 μ T
- (D) 14.4 μ T

Unit 13: Electromagnetic Induction

Q51. A flat loop of area 300 cm² is placed in a uniform magnetic field of 0.1 T. The angle between the field and the normal to the loop is 0° . What is the magnetic flux through the loop?

- (A) 6 mWb
- (B) 1.5 mWb
- (C) 4.5 mWb
- (D) 3 mWb

Q52. A coil of 50 turns and area 200 cm^2 is placed with its plane perpendicular to a magnetic field. The field strength increases uniformly at 1 T/s . What is the magnitude of the induced emf in the coil?

- (A) $2 \times 10^3 \text{ mV}$
- (B) 500 mV
- (C) $1.5 \times 10^3 \text{ mV}$
- (D) $1 \times 10^3 \text{ mV}$

Q53. A conducting rod of length 0.4 m moves at 4 m/s perpendicular to its length and perpendicular to a uniform magnetic field of 0.4 T . What is the magnitude of the motional emf between the ends of the rod?

- (A) 1.28 V
- (B) 0.32 V
- (C) 0.96 V
- (D) 0.64 V

Q54. A coil with 2 turns, area 200 cm^2 and resistance 10Ω lies perpendicular to a magnetic field that changes at 2 T/s . What is the magnitude of the induced current in the coil?

- (A) 16 mA
- (B) 8 mA
- (C) 4 mA
- (D) 12 mA

Q55. An inductor of inductance 200 mH carries a current that changes at a rate of 50 A/s . What is the magnitude of the induced emf across the inductor?

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

Q56. An inductor of inductance 200 mH carries a steady current of 5 A . How much energy is stored in its magnetic field?

- (A) $5 \times 10^3 \text{ mJ}$
- (B) $2.5 \times 10^3 \text{ mJ}$
- (C) $1.25 \times 10^3 \text{ mJ}$
- (D) $3.75 \times 10^3 \text{ mJ}$

Q57. An inductor of inductance 250 mH is connected in series with a resistor of 50Ω . What is the time constant of this LR circuit?

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

Q58. A series LR circuit with a 6 V battery and a resistor of 4Ω is switched on at $t = 0$ with zero initial current. The time constant is τ . What is the current at $t = 2\tau$?

- (A) 2.59 A
- (B) 1.3 A
- (C) 0.648 A
- (D) 1.95 A

Q59. An LC circuit consists of an inductor of 5 mH and a capacitor of 2 μ F. What is the frequency of oscillation of the circuit?

- (A) 3.18 kHz
- (B) 0.796 kHz
- (C) 1.59 kHz
- (D) 2.39 kHz

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

- (A) 15.8 krad/s
- (B) 3.95 krad/s
- (C) 11.9 krad/s
- (D) 7.91 krad/s

Answer Key

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

Worked explanations for all 60 questions:

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