

AP Physics C: Electricity and Magnetism Practice Test 20

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 $5\ \mu\text{C}$ and $6\ \mu\text{C}$ and are held $0.4\ \text{m}$ apart in air. What is the magnitude of the electrostatic force between them?

- (A) $3.37\ \text{N}$
- (B) $0.844\ \text{N}$
- (C) $1.69\ \text{N}$
- (D) $2.53\ \text{N}$

Q2. A point charge of $1\ \mu\text{C}$ is fixed in vacuum. What is the magnitude of the electric field at a point $0.4\ \text{m}$ from the charge?

- (A) $112\ \text{kN/C}$
- (B) $28.1\ \text{kN/C}$
- (C) $56.2\ \text{kN/C}$
- (D) $84.4\ \text{kN/C}$

Q3. A closed Gaussian surface encloses a net charge of $3\ \text{nC}$. What is the net electric flux through the surface?

- (A) $339\ \text{N}\cdot\text{m}^2/\text{C}$
- (B) $678\ \text{N}\cdot\text{m}^2/\text{C}$
- (C) $169\ \text{N}\cdot\text{m}^2/\text{C}$
- (D) $508\ \text{N}\cdot\text{m}^2/\text{C}$

Q4. An infinitely long straight wire carries a uniform linear charge density of $0.6\ \mu\text{C/m}$. What is the magnitude of the electric field at a perpendicular distance of $0.3\ \text{m}$ from the wire?

- (A) $72\ \text{kN/C}$
- (B) $18\ \text{kN/C}$
- (C) $36\ \text{kN/C}$
- (D) $54\ \text{kN/C}$

Q5. A very large flat conducting sheet carries a uniform surface charge density of $7\ \mu\text{C/m}^2$. What is the magnitude of the electric field just outside the sheet?

- (A) $791\ \text{kN/C}$
- (B) $395\ \text{kN/C}$
- (C) $1580\ \text{kN/C}$
- (D) $1190\ \text{kN/C}$

Q6. A solid insulating sphere of radius 0.25 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 0.12 m from its centre?

- (A) 553 kN/C
- (B) 276 kN/C
- (C) 138 kN/C
- (D) 415 kN/C

Q7. A thin spherical shell of radius 0.25 m carries a total charge of $7\ \mu\text{C}$ 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) 126 kN/C
- (B) 31.5 kN/C
- (C) 63 kN/C
- (D) 94.5 kN/C

Q8. A thin rod of length 0.8 m carries a total charge of $3\ \mu\text{C}$ 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 0.15 m from its nearer end?

- (A) 189 kN/C
- (B) 379 kN/C
- (C) 94.7 kN/C
- (D) 284 kN/C

Q9. A thin ring of radius 0.2 m carries a total charge of $2\ \mu\text{C}$ uniformly around its circumference. What is the magnitude of the electric field on the ring's axis at a distance of 0.2 m from its centre?

- (A) 318 kN/C
- (B) 79.5 kN/C
- (C) 239 kN/C
- (D) 159 kN/C

Q10. An electric dipole consists of charges of $+2\ \mu\text{C}$ and $-2\ \mu\text{C}$ separated by 0.06 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) 34.6 kN/C
- (B) 17.3 kN/C
- (C) 8.64 kN/C
- (D) 25.9 kN/C

Q11. A surface encloses two charges of equal magnitude and opposite sign, with no additional charge inside. What is the net electric flux through it, and why?

- (A) Zero, because the field is zero everywhere on the surface
- (B) Zero, because the enclosed net charge is zero
- (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, $0.5\ \text{m}$ 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) $252\ \text{kN/C}$
- (B) $504\ \text{kN/C}$
- (C) $126\ \text{kN/C}$
- (D) $378\ \text{kN/C}$

Unit 9: Electric Potential

Q13. A point charge of $2\ \mu\text{C}$ 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) $72\ \text{kV}$
- (B) $144\ \text{kV}$
- (C) $36\ \text{kV}$
- (D) $108\ \text{kV}$

Q14. Two point charges of $5\ \mu\text{C}$ and $4\ \mu\text{C}$ are held $0.5\ \text{m}$ apart. What is the electric potential energy of this pair, taking zero energy at infinite separation?

- (A) $0.72\ \text{J}$
- (B) $0.36\ \text{J}$
- (C) $0.18\ \text{J}$
- (D) $0.54\ \text{J}$

Q15. A thin ring of radius $0.1\ \text{m}$ 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) $241\ \text{kV}$
- (B) $60.4\ \text{kV}$
- (C) $121\ \text{kV}$
- (D) $181\ \text{kV}$

Q16. A thin rod of length $0.5\ \text{m}$ carries a uniform linear charge density of $4\ \mu\text{C/m}$. 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) $64.5\ \text{kV}$
- (B) $129\ \text{kV}$
- (C) $32.3\ \text{kV}$
- (D) $96.8\ \text{kV}$

Q17. A uniform electric field of $500\ \text{N/C}$ points in the $+x$ direction. A charge is moved $0.15\ \text{m}$ in the $+x$ direction. By how much does the electric potential change?

- (A) $75\ \text{V}$
- (B) $-150\ \text{V}$
- (C) $-37.5\ \text{V}$
- (D) $-75\ \text{V}$

Q18. The electric potential along the x-axis is $V(x) = 40x^2 + 30x$ volts, where x is in metres. What is the x-component of the electric field at $x = 0.5$ m?

- (A) 70 V/m
- (B) -70 V/m
- (C) -140 V/m
- (D) -35 V/m

Q19. A charge of $4 \mu\text{C}$ is moved through a potential increase of 4000 V by an external agent at constant speed. How much work does the external agent do?

- (A) 0.008 mJ
- (B) 0.016 mJ
- (C) 0.032 mJ
- (D) 0.024 mJ

Q20. A conducting sphere of radius 0.5 m carries a total charge of $6 \mu\text{C}$. What is the electric potential at the surface of the sphere, with zero potential at infinity?

- (A) 5.39×10^4 kV
- (B) 2.16×10^5 kV
- (C) 1.62×10^5 kV
- (D) 1.08×10^5 kV

Q21. Suppose the electric potential at a point in space is zero. Which statement about the electric field at that point must hold?

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

Unit 10: Conductors and Capacitors

Q22. A parallel-plate capacitor has plates of area 300 cm^2 separated by 2 mm of air. What is its capacitance?

- (A) 266 pF
- (B) 66.4 pF
- (C) 199 pF
- (D) 133 pF

Q23. An air-filled capacitor has capacitance 90 pF. It is completely filled with a dielectric of dielectric constant 6 while its geometry is unchanged. What is the new capacitance?

- (A) 540 pF
- (B) 270 pF
- (C) 1.08×10^3 pF
- (D) 810 pF

Q24. A capacitor of capacitance $6 \mu\text{F}$ is charged to 150 V. How much energy is stored in the capacitor?

- (A) 135 mJ
- (B) 33.8 mJ
- (C) 101 mJ
- (D) 67.5 mJ

Q25. Capacitors of $6\ \mu\text{F}$ and $2\ \mu\text{F}$ are connected in series. What is their equivalent capacitance?

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

Q26. Capacitors of $6\ \mu\text{F}$, $5\ \mu\text{F}$ and $2\ \mu\text{F}$ are connected in parallel. What is their equivalent capacitance?

- (A) $26\ \mu\text{F}$
- (B) $6.5\ \mu\text{F}$
- (C) $13\ \mu\text{F}$
- (D) $19.5\ \mu\text{F}$

Q27. A capacitor of capacitance $2\ \mu\text{F}$ is connected across a $100\ \text{V}$ battery. What charge is stored on each plate?

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

Q28. A parallel-plate capacitor has a potential difference of $200\ \text{V}$ across plates separated by $3\ \text{mm}$. What is the magnitude of the uniform electric field between the plates, ignoring edge effects?

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

Q29. A spherical capacitor consists of concentric conducting spheres of radii $0.08\ \text{m}$ and $0.2\ \text{m}$. What is its capacitance?

- (A) $29.7\ \text{pF}$
- (B) $7.41\ \text{pF}$
- (C) $14.8\ \text{pF}$
- (D) $22.2\ \text{pF}$

Unit 11: Electric Circuits

Q30. A resistor of $3\ \Omega$ is connected across a $24\ \text{V}$ battery of negligible internal resistance. What is the current through the resistor?

- (A) $16\ \text{A}$
- (B) $4\ \text{A}$
- (C) $12\ \text{A}$
- (D) $8\ \text{A}$

Q31. Resistors of $3\ \Omega$, $5\ \Omega$ and $2\ \Omega$ are connected in series across a $30\ \text{V}$ battery. What is the current in the circuit?

- (A) $3\ \text{A}$
- (B) $6\ \text{A}$
- (C) $1.5\ \text{A}$
- (D) $4.5\ \text{A}$

Q32. Resistors of $4\ \Omega$ and $8\ \Omega$ are connected in parallel. What is their equivalent resistance?

- (A) $5.33\ \Omega$
- (B) $1.33\ \Omega$
- (C) $4\ \Omega$
- (D) $2.67\ \Omega$

Q33. A $10\ \Omega$ 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) $7.2\ \text{W}$
- (C) $14.4\ \text{W}$
- (D) $21.6\ \text{W}$

Q34. In a single loop, two batteries of emf $18\ \text{V}$ and $6\ \text{V}$ oppose each other, and the total resistance in the loop is $5\ \Omega$. What is the current in the loop?

- (A) $2.4\ \text{A}$
- (B) $4.8\ \text{A}$
- (C) $1.2\ \text{A}$
- (D) $3.6\ \text{A}$

Q35. A battery of emf $9\ \text{V}$ and internal resistance $1\ \Omega$ is connected to an external resistor of $10\ \Omega$. What is the terminal voltage of the battery?

- (A) $16.4\ \text{V}$
- (B) $4.09\ \text{V}$
- (C) $8.18\ \text{V}$
- (D) $12.3\ \text{V}$

Q36. A resistor of $50\ \text{k}\Omega$ and a capacitor of $20\ \mu\text{F}$ are connected in series. What is the time constant of this RC circuit?

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

Q37. An uncharged capacitor is connected in series with a $2\ \text{k}\Omega$ resistor across a $9\ \text{V}$ battery. The time constant is τ . What is the current in the circuit at time $t = 2\tau$ after the connection is made?

- (A) $0.609\ \text{mA}$
- (B) $1.22\ \text{mA}$
- (C) $0.305\ \text{mA}$
- (D) $0.914\ \text{mA}$

Q38. A capacitor charged to $18\ \text{V}$ 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) $2.44\ \text{V}$
- (B) $1.22\ \text{V}$
- (C) $4.87\ \text{V}$
- (D) $3.65\ \text{V}$

Q39. A wire of length 10 m and cross-sectional area 1 mm^2 is made of a material of resistivity $1.1 \times 10^{-6} \Omega \cdot \text{m}$. What is the resistance of the wire?

- (A) 22Ω
- (B) 11Ω
- (C) 5.5Ω
- (D) 16.5Ω

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

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

Q41. A current of 4 A flows through a 6Ω resistor for 90 s. How much electrical energy is converted to heat in the resistor during this time?

- (A) 8.64 kJ
- (B) 4.32 kJ
- (C) 17.3 kJ
- (D) 13 kJ

Unit 12: Magnetic Fields and Electromagnetism

Q42. An electron moves at $1 \times 10^6 \text{ m/s}$ perpendicular to a uniform magnetic field of 0.1 T. What is the magnitude of the magnetic force on the electron?

- (A) $16 \times 10^{-15} \text{ N}$
- (B) $32 \times 10^{-15} \text{ N}$
- (C) $8 \times 10^{-15} \text{ N}$
- (D) $24 \times 10^{-15} \text{ N}$

Q43. A straight wire of length 1 m carries a current of 8 A perpendicular to a uniform magnetic field of 0.1 T. What is the magnitude of the magnetic force on the wire?

- (A) 1.6 N
- (B) 0.4 N
- (C) 0.8 N
- (D) 1.2 N

Q44. A long straight wire carries a current of 8 A. What is the magnitude of the magnetic field at a distance of 0.08 m from the wire?

- (A) $40 \mu\text{T}$
- (B) $20 \mu\text{T}$
- (C) $10 \mu\text{T}$
- (D) $30 \mu\text{T}$

Q45. A circular loop of radius 0.08 m carries a current of 8 A. What is the magnitude of the magnetic field at the centre of the loop?

- (A) $126 \mu\text{T}$
- (B) $62.8 \mu\text{T}$
- (C) $31.4 \mu\text{T}$
- (D) $94.2 \mu\text{T}$

Q46. A solenoid has 1200 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) 2.26 mT
- (B) 9.05 mT
- (C) 6.79 mT
- (D) 4.52 mT

Q47. A proton moves at 20×10^4 m/s perpendicular to a uniform magnetic field of 0.1 T. What is the radius of its circular path?

- (A) 4.18 cm
- (B) 1.04 cm
- (C) 3.13 cm
- (D) 2.09 cm

Q48. A rectangular coil of 100 turns, of sides 0.1 m by 0.05 m, carries a current of 2 A in a uniform magnetic field of 0.2 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) 200 mN·m
- (B) 50 mN·m
- (C) 100 mN·m
- (D) 150 mN·m

Q49. Two long parallel wires carry currents of 8 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) 0.384 mN/m
- (B) 0.192 mN/m
- (C) 0.096 mN/m
- (D) 0.288 mN/m

Q50. A long straight cylindrical wire of radius 0.08 m carries a uniformly distributed current of 10 A. What is the magnitude of the magnetic field at a distance of 0.03 m from the wire's axis, inside the wire?

- (A) 4.69 μ T
- (B) 9.38 μ T
- (C) 18.8 μ T
- (D) 14.1 μ T

Unit 13: Electromagnetic Induction

Q51. A flat loop of area 100 cm² is placed in a uniform magnetic field of 0.1 T. The angle between the field and the normal to the loop is 30° . What is the magnetic flux through the loop?

- (A) 1.73 mWb
- (B) 0.433 mWb
- (C) 1.3 mWb
- (D) 0.866 mWb

Q52. A coil of 25 turns and area 100 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) 250 mV
- (B) 125 mV
- (C) 62.5 mV
- (D) 188 mV

Q53. A conducting rod of length 0.2 m moves at 3 m/s perpendicular to its length and perpendicular to a uniform magnetic field of 0.2 T. What is the magnitude of the motional emf between the ends of the rod?

- (A) 0.24 V
- (B) 0.06 V
- (C) 0.18 V
- (D) 0.12 V

Q54. A coil with 10 turns, area 200 cm^2 and resistance 5Ω lies perpendicular to a magnetic field that changes at 1 T/s . What is the magnitude of the induced current in the coil?

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

Q55. An inductor of inductance 50 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) 2.5 V
- (B) 5 V
- (C) 1.25 V
- (D) 3.75 V

Q56. An inductor of inductance 100 mH carries a steady current of 2 A. How much energy is stored in its magnetic field?

- (A) 400 mJ
- (B) 100 mJ
- (C) 300 mJ
- (D) 200 mJ

Q57. An inductor of inductance 200 mH is connected in series with a resistor of 40Ω . What is the time constant of this LR circuit?

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

Q58. A series LR circuit with a 15 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 $t = 2\tau$?

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

Q59. An LC circuit consists of an inductor of 4 mH and a capacitor of 2 μ F. What is the frequency of oscillation of the circuit?

- (A) 3.56 kHz
- (B) 0.89 kHz
- (C) 2.67 kHz
- (D) 1.78 kHz

Q60. An LC circuit has inductance 4 mH and capacitance 1 μ F. What is the angular frequency of its charge oscillations?

- (A) 31.6 krad/s
- (B) 7.91 krad/s
- (C) 15.8 krad/s
- (D) 23.7 krad/s

Answer Key

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

Worked explanations for all 60 questions:

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