

AP Physics C: Electricity and Magnetism Practice Test 11

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 small point charges of $3\ \mu\text{C}$ and $6\ \mu\text{C}$ are held $0.2\ \text{m}$ apart in a vacuum. What is the magnitude of the electrostatic force exerted on either charge?

- (A) $8.1\ \text{N}$
- (B) $4.05\ \text{N}$
- (C) $2.02\ \text{N}$
- (D) $16.2\ \text{N}$

Q2. A point charge of $2\ \mu\text{C}$ is fixed in a vacuum. What is the magnitude of the electric field at a point $0.4\ \text{m}$ from the charge?

- (A) $2.25 \times 10^5\ \text{N/C}$
- (B) $5.62 \times 10^4\ \text{N/C}$
- (C) $1.12 \times 10^6\ \text{N/C}$
- (D) $1.12 \times 10^5\ \text{N/C}$

Q3. Two point charges, $+8\ \mu\text{C}$ and $+4\ \mu\text{C}$, are fixed $0.6\ \text{m}$ apart. What is the magnitude of the net electric field at the midpoint between them?

- (A) $8.00 \times 10^5\ \text{N/C}$
- (B) $4.00 \times 10^5\ \text{N/C}$
- (C) $2.00 \times 10^5\ \text{N/C}$
- (D) $1.20 \times 10^6\ \text{N/C}$

Q4. A closed Gaussian surface encloses a net charge of $9\ \mu\text{C}$ and no other charge. What is the net electric flux through the surface?

- (A) $2.03 \times 10^6\ \text{N}\cdot\text{m}^2/\text{C}$
- (B) $5.08 \times 10^5\ \text{N}\cdot\text{m}^2/\text{C}$
- (C) $1.02 \times 10^7\ \text{N}\cdot\text{m}^2/\text{C}$
- (D) $1.02 \times 10^6\ \text{N}\cdot\text{m}^2/\text{C}$

Q5. A solid insulating sphere of radius $0.1\ \text{m}$ carries a total charge of $10\ \mu\text{C}$ uniformly distributed through its volume. What is the magnitude of the electric field at a distance $0.4\ \text{m}$ from the centre of the sphere?

- (A) $1.12 \times 10^6\ \text{N/C}$
- (B) $2.81 \times 10^5\ \text{N/C}$
- (C) $2.25 \times 10^6\ \text{N/C}$
- (D) $5.62 \times 10^5\ \text{N/C}$

Q6. A solid insulating sphere of radius 0.4 m carries a total charge of $10\ \mu\text{C}$ uniformly distributed through its volume. What is the magnitude of the electric field inside the sphere at a distance 0.1 m from its centre?

- (A) $1.41 \times 10^5\ \text{N/C}$
- (B) $2.81 \times 10^5\ \text{N/C}$
- (C) $7.03 \times 10^4\ \text{N/C}$
- (D) $5.62 \times 10^5\ \text{N/C}$

Q7. An infinitely long straight line of charge has a uniform linear charge density of $8\ \text{nC/m}$. What is the magnitude of the electric field at a perpendicular distance of 0.25 m from the line?

- (A) 576 N/C
- (B) 1150 N/C
- (C) 288 N/C
- (D) 2300 N/C

Q8. An infinite nonconducting sheet carries a uniform surface charge density of $2\ \mu\text{C/m}^2$. What is the magnitude of the electric field near the sheet, on either side of it?

- (A) 226 kN/C
- (B) 56.5 kN/C
- (C) 113 kN/C
- (D) 452 kN/C

Q9. A thin ring of radius 0.3 m carries a total charge of $4\ \mu\text{C}$ uniformly distributed around it. What is the magnitude of the electric field on the axis of the ring at a distance of 0.4 m from its centre?

- (A) $1.15 \times 10^5\ \text{N/C}$
- (B) $2.30 \times 10^5\ \text{N/C}$
- (C) $5.76 \times 10^4\ \text{N/C}$
- (D) $1.15 \times 10^6\ \text{N/C}$

Q10. A uniform electric field of 500 N/C passes through a flat surface of area $0.02\ \text{m}^2$. The angle between the field and the normal to the surface is 60° . What is the electric flux through the surface?

- (A) $5\ \text{N}\cdot\text{m}^2/\text{C}$
- (B) $10\ \text{N}\cdot\text{m}^2/\text{C}$
- (C) $2.5\ \text{N}\cdot\text{m}^2/\text{C}$
- (D) $20\ \text{N}\cdot\text{m}^2/\text{C}$

Q11. The electric field at the surface of a uniformly charged spherical shell has magnitude 3000 N/C, directed radially outward, and the shell has radius 0.1 m. What is the total charge on the shell?

- (A) $6.67 \times 10^{-3}\ \mu\text{C}$
- (B) $3.33 \times 10^{-3}\ \mu\text{C}$
- (C) $1.67 \times 10^{-3}\ \mu\text{C}$
- (D) $0.0133\ \mu\text{C}$

Q12. A thin rod of length 0.5 m carries a uniform linear charge density λ . A point P lies on the axis of the rod at a distance 0.1 m from its nearer end. Which integral gives the magnitude of the electric field at P?

- (A) $\int_0^{0.5} k\lambda \, dx / (0.1 + x)$
- (B) $\int_0^{0.5} k\lambda x \, dx / (0.1 + x)^2$
- (C) $k\lambda 0.5 / (0.1)^2$
- (D) $\int_0^{0.5} k\lambda \, dx / (0.1 + x)^2$

Unit 9: Electric Potential

Q13. A point charge of 6 μC is fixed in a vacuum. Taking the potential at infinity to be zero, what is the electric potential at a distance 0.3 m from the charge?

- (A) 360 kV
- (B) 180 kV
- (C) 90 kV
- (D) 720 kV

Q14. A charge of 2 μC is moved slowly from a point at potential 0 V to a point at potential 4000 V by an external agent. How much work is done by the external agent?

- (A) 8 mJ
- (B) 16 mJ
- (C) 4 mJ
- (D) 32 mJ

Q15. Two point charges of 5 μC and 6 μC are 0.5 m apart. What is the electric potential energy of this pair, taking zero energy at infinite separation?

- (A) 1080 mJ
- (B) 270 mJ
- (C) 540 mJ
- (D) 2160 mJ

Q16. A thin ring of radius 0.2 m carries a total charge of 6 μC uniformly distributed around it. What is the electric potential on the axis of the ring at a distance of 0.3 m from its centre, with zero potential at infinity?

- (A) 300 kV
- (B) 74.9 kV
- (C) 150 kV
- (D) 599 kV

Q17. A thin rod of length 0.4 m carries a uniform linear charge density λ . A point P lies on the axis of the rod at a distance 0.2 m from its nearer end. Which integral gives the electric potential at P, with zero potential at infinity?

- (A) $\int_0^{0.4} k\lambda \, dx / (0.2 + x)^2$
- (B) $\int_0^{0.4} k\lambda \, dx / (0.2 + x)$
- (C) $\int_0^{0.4} k\lambda x \, dx / (0.2 + x)$
- (D) $k\lambda 0.4 / (0.2)$

Q18. In a region, the electric potential varies with position as $V(x) = 3x^2 + 4x + 5$, where V is in volts and x is in metres. What is the x -component of the electric field at $x = 1$ m?

- (A) -20 V/m
- (B) -5 V/m
- (C) -10 V/m
- (D) 10 V/m

Q19. A conducting spherical shell of radius 0.1 m carries a total charge of $8\text{ }\mu\text{C}$. What is the electric potential at a point inside the shell, 0.05 m from its centre, with zero potential at infinity?

- (A) 720 kV
- (B) 1440 kV
- (C) 360 kV
- (D) 2880 kV

Q20. A particle of charge $2\text{ }\mu\text{C}$ is released from rest at a point where the potential is 1000 V higher than at a second point. If no non-electric forces act, what kinetic energy does it gain in moving to the second point?

- (A) 4 mJ
- (B) 2 mJ
- (C) 1 mJ
- (D) 8 mJ

Q21. An electric dipole consists of charges $+3\text{ }\mu\text{C}$ and $-3\text{ }\mu\text{C}$ separated by 0.02 m. Estimate the electric potential on the dipole axis at a distance 0.2 m from its centre, with zero potential at infinity, using the far-field dipole approximation.

- (A) 27 kV
- (B) 13.5 kV
- (C) 6.75 kV
- (D) 54 kV

Unit 10: Conductors and Capacitors

Q22. A parallel-plate capacitor has plates of area 0.02 m^2 separated by 2 mm in a vacuum. What is its capacitance?

- (A) 177 pF
- (B) 44.2 pF
- (C) 88.5 pF
- (D) 354 pF

Q23. A parallel-plate capacitor has capacitance 50 pF in air. A dielectric slab of dielectric constant 4 is inserted to fill the space between the plates completely, with the plates isolated so charge stays fixed. What is the new capacitance?

- (A) 200 pF
- (B) 400 pF
- (C) 100 pF
- (D) 800 pF

Q24. Capacitors of $15\ \mu\text{F}$ and $10\ \mu\text{F}$ are connected in series. What is their equivalent capacitance?

- (A) $12\ \mu\text{F}$
- (B) $6\ \mu\text{F}$
- (C) $3\ \mu\text{F}$
- (D) $18\ \mu\text{F}$

Q25. A capacitor of $2\ \mu\text{F}$ is charged to a potential difference of $200\ \text{V}$. How much energy is stored in it?

- (A) $40\ \text{mJ}$
- (B) $80\ \text{mJ}$
- (C) $20\ \text{mJ}$
- (D) $160\ \text{mJ}$

Q26. A capacitor of $5\ \mu\text{F}$ is connected across a $50\ \text{V}$ battery until fully charged. What charge is stored on either plate?

- (A) $500\ \mu\text{C}$
- (B) $125\ \mu\text{C}$
- (C) $1000\ \mu\text{C}$
- (D) $250\ \mu\text{C}$

Q27. A spherical capacitor consists of concentric conducting spheres of radii $0.08\ \text{m}$ and $0.25\ \text{m}$, with vacuum between them. What is its capacitance?

- (A) $26.2\ \text{pF}$
- (B) $6.54\ \text{pF}$
- (C) $13.1\ \text{pF}$
- (D) $52.3\ \text{pF}$

Q28. A hollow conducting sphere with an empty cavity is given a net charge and allowed to reach electrostatic equilibrium. Which statement is correct?

- (A) Charge resides on the inner wall of the cavity, and the field inside the cavity is uniform and nonzero.
- (B) No charge resides on the inner wall of the cavity, and the electric field inside the cavity is zero.
- (C) No charge resides on the inner wall, but the field inside the cavity equals the field outside the sphere.
- (D) Charge splits between the inner and outer walls, and the field inside the cavity points radially outward.

Q29. The electric field between the plates of a capacitor is $10000\ \text{N/C}$. What is the energy density stored in the field?

- (A) $0.885\ \text{mJ/m}^3$
- (B) $0.443\ \text{mJ/m}^3$
- (C) $0.221\ \text{mJ/m}^3$
- (D) $1.77\ \text{mJ/m}^3$

Unit 11: Electric Circuits

- Q30.** A wire of length 4 m and cross-sectional area 5 mm^2 is made of a material of resistivity $2.8 \times 10^{-8} \Omega \cdot \text{m}$. What is the resistance of the wire?
- (A) 0.0448Ω
 - (B) 0.0224Ω
 - (C) 0.0112Ω
 - (D) 0.0896Ω
- Q31.** Resistors of 10Ω and 10Ω are connected in parallel. What is their equivalent resistance?
- (A) 10Ω
 - (B) 5Ω
 - (C) 2.5Ω
 - (D) 15Ω
- Q32.** A 36 V battery with negligible internal resistance is connected across a 8Ω resistor. What current flows through the resistor?
- (A) 4.5 A
 - (B) 9 A
 - (C) 2.25 A
 - (D) 18 A
- Q33.** In a single loop, two batteries of emfs 12 V and 8 V oppose each other, and the total resistance in the loop is 3Ω . What is the current in the loop, in the direction of the larger emf?
- (A) 2.67 A
 - (B) 0.667 A
 - (C) 5.33 A
 - (D) 1.33 A
- Q34.** A current of 3 A flows through a 10Ω resistor. At what rate is energy dissipated as heat in the resistor?
- (A) 180 W
 - (B) 90 W
 - (C) 45 W
 - (D) 360 W
- Q35.** A capacitor of $10 \mu\text{F}$ is connected in series with a $10 \text{ k}\Omega$ resistor. What is the time constant of this RC circuit?
- (A) 0.2 s
 - (B) 0.05 s
 - (C) 0.1 s
 - (D) 0.4 s
- Q36.** A capacitor in an RC circuit charges toward a maximum charge of $100 \mu\text{C}$. After a time equal to 2 time constant(s), what charge is on the capacitor?
- (A) $86.5 \mu\text{C}$
 - (B) $173 \mu\text{C}$
 - (C) $43.2 \mu\text{C}$
 - (D) $346 \mu\text{C}$

Q37. A discharging RC circuit has an initial current of 15 mA. After a time equal to 2 time constant(s), what is the current?

- (A) 4.06 mA
- (B) 1.02 mA
- (C) 8.12 mA
- (D) 2.03 mA

Q38. An RC circuit with time constant 2 s is charging from zero charge. How long does it take for the charge to reach 50% of its maximum value?

- (A) 2.77 s
- (B) 0.693 s
- (C) 1.39 s
- (D) 5.54 s

Q39. A battery of emf 24 V and internal resistance 2 Ω delivers a current of 3 A to an external circuit. What is the terminal potential difference of the battery?

- (A) 36 V
- (B) 9 V
- (C) 18 V
- (D) 72 V

Q40. Resistors of 4 Ω and 12 Ω are connected in parallel across a 12 V battery. What is the current through the 4 Ω resistor?

- (A) 6 A
- (B) 1.5 A
- (C) 12 A
- (D) 3 A

Q41. In a series circuit, a 12 V battery is connected to a 6 Ω resistor in series with a 6 Ω resistor, and a capacitor is connected in parallel with the 6 Ω resistor. In steady state, what is the potential difference across the capacitor?

- (A) 12 V
- (B) 6 V
- (C) 3 V
- (D) 24 V

Unit 12: Magnetic Fields and Electromagnetism

Q42. A particle of charge 4 μC moves at 2×10^4 m/s perpendicular to a uniform magnetic field of 0.2 T. What is the magnitude of the magnetic force on the particle?

- (A) 32 mN
- (B) 8 mN
- (C) 16 mN
- (D) 64 mN

Q43. An alpha particle (mass 6.4×10^{-27} kg, charge 3.2×10^{-19} C) moves at 2×10^6 m/s perpendicular to a uniform magnetic field of 0.25 T. What is the radius of its circular path?

- (A) 32 cm
- (B) 8 cm
- (C) 16 cm
- (D) 64 cm

Q44. A straight wire of length 1 m carries a current of 4 A perpendicular to a uniform magnetic field of 50 mT. What is the magnitude of the magnetic force on the wire?

- (A) 400 mN
- (B) 100 mN
- (C) 800 mN
- (D) 200 mN

Q45. A long straight wire carries a current of 7 A. What is the magnitude of the magnetic field at a distance of 0.07 m from the wire?

- (A) 20 μ T
- (B) 10 μ T
- (C) 40 μ T
- (D) 30 μ T

Q46. A circular loop of radius 5 cm carries a current of 5 A. What is the magnitude of the magnetic field at the centre of the loop?

- (A) 62.8 μ T
- (B) 126 μ T
- (C) 31.4 μ T
- (D) 251 μ T

Q47. A long solenoid has 1500 turns per metre and carries a current of 2 A. What is the magnitude of the magnetic field inside the solenoid, far from its ends?

- (A) 7.54 mT
- (B) 3.77 mT
- (C) 1.88 mT
- (D) 15.1 mT

Q48. Two long parallel wires 10 cm apart carry currents of 4 A and 4 A in opposite directions. What is the magnitude of the net magnetic field at the midpoint between the wires?

- (A) 32 μ T
- (B) 64 μ T
- (C) 16 μ T
- (D) 128 μ T

Q49. A rectangular coil of 10 turns and area 0.04 m^2 carries a current of 3 A in a uniform magnetic field of 0.1 T. When the plane of the coil is parallel to the field, what is the magnitude of the torque on the coil?

- (A) 240 mN·m
- (B) 60 mN·m
- (C) 120 mN·m
- (D) 480 mN·m

Q50. In a velocity selector, a charged particle passes undeflected through crossed electric and magnetic fields of 4000 N/C and 50 mT. What is the speed of the particle?

- (A) 1.60×10^5 m/s
- (B) 4.00×10^4 m/s
- (C) 3.20×10^5 m/s
- (D) 8.00×10^4 m/s

Unit 13: Electromagnetic Induction

Q51. A flat loop of area 0.02 m^2 is placed in a uniform magnetic field of 200 mT. The angle between the field and the normal to the loop is 30° . What is the magnetic flux through the loop?

- (A) 3.46 mWb
- (B) 6.93 mWb
- (C) 1.73 mWb
- (D) 13.9 mWb

Q52. The magnetic field through a single loop of area 0.1 m^2 increases uniformly by 0.4 T in 0.2 s, with the field perpendicular to the loop. What is the magnitude of the induced emf in the loop?

- (A) 400 mV
- (B) 100 mV
- (C) 800 mV
- (D) 200 mV

Q53. A conducting rod of length 0.5 m moves at 2 m/s perpendicular to a uniform magnetic field of 0.2 T, with the rod perpendicular to both its velocity and the field. What is the motional emf between the ends of the rod?

- (A) 0.4 V
- (B) 0.1 V
- (C) 0.2 V
- (D) 0.8 V

Q54. A conducting loop lies in the plane of the page in a magnetic field directed into the page. The field strength decreases with time. Viewed from above the page, in which direction does the induced current flow?

- (A) Counterclockwise, because the induced field must point into the page to oppose the decreasing into-page flux.
- (B) Clockwise, because the induced field must point out of the page to speed the decrease.
- (C) Counterclockwise, because a decreasing field always induces a counterclockwise current.
- (D) Clockwise, because the induced field must point into the page to oppose the decreasing into-page flux.

Q55. A solenoid has 400 turns, a cross-sectional area of 10 cm^2 , and a length of 0.5 m. What is its self-inductance?

- (A) 0.804 mH
- (B) 0.201 mH
- (C) 1.61 mH
- (D) 0.402 mH

Q56. An inductor of 20 mH is connected in series with a 10 Ω resistor. What is the time constant of this LR circuit?

- (A) 4 ms
- (B) 1 ms
- (C) 2 ms
- (D) 8 ms

Q57. A series LR circuit with battery voltage 24 V and resistance 6 Ω is switched on at $t = 0$. After a time equal to 2 time constant(s), what is the current in the circuit?

- (A) 6.92 A
- (B) 1.73 A
- (C) 3.46 A
- (D) 13.8 A

Q58. An LC circuit consists of an inductor of 10 mH and a capacitor of 10 μ F. What is its natural frequency of oscillation?

- (A) 1010 Hz
- (B) 252 Hz
- (C) 2010 Hz
- (D) 503 Hz

Q59. In an ideal LC circuit, a capacitor of 40 μ F is initially charged to 10 V and then connected to an inductor of 40 mH. What is the maximum current in the circuit?

- (A) 0.316 A
- (B) 0.632 A
- (C) 0.158 A
- (D) 1.26 A

Q60. A coil of 50 turns and area 0.02 m² rotates in a uniform magnetic field of 0.2 T with angular speed 50 rad/s. What is the maximum induced emf in the coil?

- (A) 20 V
- (B) 5 V
- (C) 40 V
- (D) 10 V

Answer Key

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

Q9: A	Q19: A	Q29: B	Q39: C	Q49: C	Q59: A
Q10: A	Q20: B	Q30: B	Q40: D	Q50: D	Q60: D

Worked explanations for all 60 questions:

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