

PHY114 S09 Practice Final Exam

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1. A long thin wire, hundreds of meters long, carries a uniformly distributed charge of $-5.3\mu\text{C}$ per meter of length. Find the magnitude and direction of the electric field at a perpendicular distance 6.0 m from the center of the wire. Also at a point 2.0 m perpendicular from the center of the wire.
2. Two identical $+5.5\mu\text{C}$ point charges are initially spaced 6.5cm from each other. If they are released at the same instant from rest, how fast will they be moving when they are very far away from each other? Assume they have identical masses of 1.0mg.
3. A parallel-plate capacitor with plate area $A = 2.0 \text{ m}^2$ and plate separation $d = 3.0 \text{ mm}$ is connected to a $45 - \text{V}$ battery. Determine the capacitance. Determine the charge on the capacitor. Determine the electric field in the capacitor. Determine the energy stored in the capacitor.
4. A $8.0\mu\text{F}$ capacitor is charged by a 140 V battery and then is disconnected from the battery. When this capacitor (C_1) is then connected to a second (initially uncharged) capacitor, C_2 , the final voltage on each capacitor is 25 V. What is the value of C_2 ?
5. The peak value of an alternating current in a 1700 -W device is 5.4 A. What is the rms voltage across it? Assume that the device is a pure resistance.
6. A 3.1Ω wire is stretched uniformly to 1.20 times its original length. Its density remains the same and so does its resistivity. What is its resistance now?
7. Two $4.5\mu\text{F}$ capacitors, two $2.4\text{k}\Omega$ resistors, and a 12.8V source are connected in series. Starting from the uncharged state, how long does it take for the current to drop from its initial value to 1.58mA?
8. A 5.2MeV (kinetic energy) proton enters a 0.19T field, in a plane perpendicular to the field. What is the radius of its path? (An MeV is the amount of energy the proton would gain if it falls through a potential difference of one million Volts. It is commonly used as a unit of energy in particle physics.)

9. A 19.4cm-diameter circular loop of wire is placed with the plane of the loop parallel to the uniform magnetic field between the pole pieces of a large magnet. When 5.25A flows in the coil, the torque on it is $0.170\text{m} \cdot \text{N}$. What is the magnetic field strength?
10. A power line carries a current of 96 A west along the tops of 8.4 m-high poles. What is the magnitude of the magnetic field produced by this wire at the ground directly below? What is the direction of the magnetic field produced by this wire at the ground directly below?
11. A 18.0cm-diameter loop of wire is initially oriented perpendicular to a 1.5T magnetic field. The loop is rotated so that its plane is parallel to the field direction in 0.30s. What is the magnitude of the average induced emf in the loop?
12. A resonant circuit using a 290nF capacitor is to resonate at 19.4kHz. The air-core inductor is to be a circular solenoid with closely packed coils made from 11.0m of insulated wire 1.3mm in diameter. How many loops will the inductor contain?
13. A 53.8 mW laser puts out a narrow beam 2.00mm in diameter. What is the rms value of the electric field in the beam? What is the rms value of the magnetic field?
14. A dentist wants a small mirror that, when 2.10 cm from a tooth, will produce a $4.0\times$ upright image. What kind of mirror is needed (concave, convex or plane?) What must its radius of curvature be?
15. A 110 -mm-focal-length lens is used to focus an image on the sensor of a camera. The maximum distance allowed between the lens and the sensor plane is 140 mm. How far ahead of the sensor should the lens be if the object to be photographed is 10.0 m away? What is the closest object this lens could photograph sharply?
16. What is the speed of a beam of pi mesons if its average lifetime is measured to be $4.10 \times 10^{-8}\text{s}$? At rest, the average lifetime is $2.60 \times 10^{-8}\text{s}$.
17. What is the wavelength of radio waves emitted by a 102.7 MHz FM radio station? What is the energy (in joules) of a single photon of this frequency? What is its momentum ?
18. What wavelength photon would be required to ionize a hydrogen atom in the ground state and give the ejected electron a kinetic energy of 11.5 eV?