University Physics, PHYS 227/232 Midterm 3 Wed Apr 9, 2014

Your name and table number: _____

Please show your work, write neatly, write units, and box your answers.
There are a total of ? questions worth FIFTY points with ? bonus points.

Useful Equations/Concepts

Bar magnet magnetic field lines go from North to South (outside magnet)

Force on charged particle from magnetic field: $\vec{F} = q\vec{v} \times \vec{B}$

Force on current from magnetic field: $\vec{F} = I\vec{l} \times \vec{B}$

Cyclotron radius: $r = \frac{mv}{qB}$ Cyclotron frequency: $f = \frac{qB}{2\pi m}$

Biot-Savart Law: $d\vec{B} = \frac{\mu_0}{4\pi}\frac{Id\vec{l}\times\vec{r}}{r^2}$

Magnetic field of infinite line current: $B = \frac{\mu_0 I}{2\pi r}$ in right hand circles around current

Magnetic field at x along centerline of loop of radius a: $B = \frac{\mu_0 I a^2}{2x^3}$

Ampere's Law: $\int \vec{B} \cdot d\vec{r} = \mu_0 I_{\text{enclosed}}$

Magnetic field of a solenoid with n turns/unit length: $B = \mu_0 n I$

Faraday's Law: $\mathcal{E} = V = -\frac{d\Phi_B}{dt}$ Magnetic flux: $\Phi_B \equiv \int \vec{B} \cdot d\vec{A} = BA\cos\theta$

Ohm's Law: $V = IR$ Definition of Capacitance: $C \equiv \frac{Q}{V}$

Self-Inductance: $L \equiv \frac{\Phi_B}{I}$ Voltage/EMF across Inductor: $\mathcal{E}_L = -L\frac{dI}{dt}$

Self-Inductance of solenoid of length l, cross-section area A: $L = \mu_0 n^2 A l$

Useful Geometry Equations

Circle circumference: $2\pi r$ Circle area: πr^2

Sphere surface area: $4\pi r^2$ Sphere volume: $\frac{4}{3}\pi r^3$

Cylinder surface area: $2\pi r^2$ (ends) + $2\pi r L$ (side) Cylinder volume: $\pi r^2 L$

Useful Constants and Units

$\mu_0 = 4\pi \times 10^{-7}$ T-m/A Electron charge: $e = -1.6 \times 10^{-19}$ C

Electron mass: $m_e = 9.11 \times 10^{-31}$ kg Proton mass: $m_p = 1.67 \times 10^{-27}$ kg

Magnetic Field: Tesla [T, 1 T = 10^4 Gauss] Voltage/Electric Potential: Volt [V]

Electric Current: Ampere [A, 1 A = 1 C/s]

Inductance: Henry [H] Magnetic Flux: Weber [Wb, 1 Wb = 1 T m^2 = 1 V s]