Midterm #3

2. 1. a. into the page
b. to the left
c. out of the page

2. a. $F = (q\vec{v})(B)$

$F_B = qvB(\sin\theta) = qvB \sin 90° \rightarrow 1 = qvB$

$F_E = qE$

$Eq = qvB \Rightarrow E = vB$

b. $\Delta V = \dfrac{(1.33T)(0.02m)(10A)}{(2\times10^{-28}m^{-3})(10^{-6}m)(1.6\times10^{-19})} = \dfrac{0.266}{3200}$

$\boxed{\Delta V = 8.31\times10^{-5}V}$

3. $A = \pi r^2 = (\pi)(0.65\times10^{-15})^2 = 1.327\times10^{-30}m^2$

$\tau = NIABsin\theta$

$= (1.05\times10^{4}A)(1.27\times10^{-30}m^2)(2.50T)(\sin 90° \rightarrow 1)$

$\boxed{= 3.48\times10^{-26} \approx 3.50\times10^{-26}\ N/m}$

3. 1. a. $B = \mu_0 NI$

$= (4\pi\times10^{-7})(500)(0.3)$

$\boxed{= 1.88\times10^{-4} \approx 1.90\times10^{-4}\ T}$

b. $B = (4\pi\times10^{-7})(5000)(0.3)(500)$

$\boxed{= 0.942\ T}$

2. a. $F_{total} = F_{electrical} + F_{magnetic} = 0$

$F_{electrical} = q\vec{E}$ $\quad F_{magnetic} = q(\vec{v}\times\vec{B})$

$F_{total} = q\vec{E} + q(\vec{v}\times\vec{B}) = 0$

$|F_{total}| = qE - q(\vec{v}\times\vec{B}) = 0$

$qE = q(\vec{v}\times\vec{B})$

$E = \vec{v}\times\vec{B} \Rightarrow v = \dfrac{E}{B}$ if $F_{net} = 0$

b. $qvB = \dfrac{mv^2}{r}$

$r = \dfrac{mv}{qB}$ $\quad r = \dfrac{m\frac{E}{B}}{qB}$

$\boxed{r = \dfrac{mE}{qB^2}}$

c. $m = 16(1.7 \times 10^{-27})$

$= 2.7 \times 10^{-26}\ kg$

$r = \frac{(2.7 \times 10^{-26}\ kg)(10\ V/m)}{(16 \times 10^{-19}\ C)(0.01\ T)^2}$

$= 0.017\ m$

4. 1. a. $E = -N\left(\frac{d\phi}{dt}\right)$

$= (1)\left(\frac{d(BA)}{d(t)}\right)$ * $BA = \pi r^2$

$= \frac{B_0}{T_0}(\sin 2\pi f t)\pi r^2$

b. $t = 0 \longrightarrow \sin(2\pi f t)$

$emf = 0$

c. $E = \pi r^2 \times \frac{B_0}{T_0}(\sin(2\pi f t)$

$= \pi(0.1)^2 \times \left(\frac{0.1}{0.001}\right)(\sin 2\pi 10^{-3} \times (0.16 \times 10^{-3}))$

$= 0.055\ V$

d $V = IR$

$I = \frac{V}{R} = \frac{0.057\ V}{5\ \Omega} = 0.0114\ Amps$

5. 1. $emf = -M\left(\frac{dt}{dI}\right) \Longrightarrow \frac{emf}{-M} = \left|\frac{dI}{dt}\right| = \frac{0.150\ V}{0.50\ H} = 0.30\ A/s$

2 $\Delta t = \frac{L\,dI}{\mathcal{E}}$

$= \frac{0.002}{500}(0.1)$

$= 4 \times 10^{-7}\ s$