Midterm 3

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Phys 180
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2 Chapter 11

1) a: into the page
b: left
c: out of the page

2a) $F_E = F_B$ so, $qE = qvB\sin\theta$

since $\theta = 90°$, $qE = qvB$ (1)

$$v = \frac{qE}{qB} \Rightarrow \boxed{v = \frac{E}{B}}$$

2b) The E-field is constant.

$$E = \frac{\Delta V}{\Delta x} \Rightarrow \Delta V = E\Delta x$$

since $E = VB$, $\Delta V = vB\Delta x$

the drift velocity is $v_d = \frac{I}{nqeA}$ so, $V = v_d$

$$\boxed{\Delta v = \frac{B\Delta x I}{nqeA}}$$

$B = 1.33$
$\Delta x = 2cm = .02m$
$I = 10A$
$n = 2\times10^{28}\ m^{-3}$
$A = (1\times10^{-3})^2$

$$\Delta v = \frac{1.33\,(2\times10^{-2})\,10}{(2\times10^{28})\,(1.6\times10^{-19})\,(1\times10^{-3})^2}$$

$$\boxed{\Delta v = 8.3125\times10^{-5}\ V}$$

3) $\tau = NIAB\sin\theta$ (2.5)

$N = 1$
$I = 1.05\times10^{4}\,A$
$A = \pi(.65\times10^{-15})^2$
$B = 2.5$
$\theta = 90^\circ$

$\tau = (1)(1.05\times10^{4})(\pi(.65\times10^{-15})^2)(1)(2.5)$
$= (1.05\times10^{4})(1.33\times10^{-30})(2.5)$
$\boxed{\tau = 3.48\times10^{-26}\ N\cdot m}$

3 Chapter 12

1a) $B = \mu_0 n I$

$n = 500$
$I = 0.3A$
$\mu_0 = 4\pi\times10^{-7}$

$B = (4\pi\times10^{-7})(500)(.3)$
$= \boxed{1.885\times10^{-4}\,T}$

1b) $\mu_0 = 5000(4\pi\times10^{-7}) = .00628$

$B = .00628(500)(.3)$
$\boxed{B = 0.9425\ T}$

2a) $F_E = qE \quad F_B = q\vec{v}\times B$

$F_{net} = F_E + F_B = 0$ * $v\times B$ is down

$\Rightarrow qE + q\,v\times B = 0$

$\Rightarrow F_{net} = q(E - vB) = 0$

since $v = \frac{E}{B}$, $q\left(E - \frac{E}{B}B\right) = 0$

$\Rightarrow \boxed{F_{net} = q(E-E) = q(0) = 0}$

2b) $\frac{mv^2}{r} = qvB$

$\Rightarrow r = \frac{mv^2}{qvB} = \frac{mv}{qB}$

since $v = \frac{E}{B}$, $\boxed{r = \frac{mE}{qB^2}}$

$m = 16(1.67 \times 10^{-27})$
$E = 10$
$q = 1.602 \times 10^{-19}$
$B = 0.01\ T$

$r = \frac{(2.672 \times 10^{-26})(10)}{(1.602 \times 10^{-19})(10^{-2})^2}$

$= \frac{2.672 \times 10^{-25}}{1.602 \times 10^{-23}} = \boxed{0.0168\ m}$

4 Chapter 13

1) $B(t) = B_0\left(\frac{1}{2} + \frac{2}{\pi}\sin(2\pi f t) + \frac{2}{3\pi}\sin(6\pi f t) + \frac{2}{5\pi}\sin(10\pi f t)\right)$

a)

$\frac{dB}{dt} = B_0\left(\frac{2}{\pi}\cos(2\pi f t)\,2\pi f + \frac{2}{3\pi}\cos(6\pi f t)\,6\pi f + \frac{2}{5\pi}\cos(10\pi f t)\,10\pi f\right)$

since $\varepsilon = -N\frac{d\Phi}{dt} \Rightarrow \varepsilon = -\frac{d\Phi}{dt}$

and $\Phi = BA$, $\varepsilon = -A\left(\frac{dB}{dt}\right)$ so, $A = \pi r^2$

$\boxed{\varepsilon = -4\pi r^2 f B_0\left(\cos(2\pi f t) + \cos(10\pi f t) + \cos(10\pi f t)\right)}$

1b) $B_0 = 0.1\,T$
$r = 0.1\,m$
$f = 10^3\,Hz$
$t = 0$

$$\mathcal{E} = 4\pi(.01)(10^3)(.1)\left(\cos(0)+\cos(0)+\cos(0)\right)$$

$$= 4\pi 3$$

$$\boxed{\mathcal{E} = 12\pi\,V}$$

1c) $$\mathcal{E} = 4\pi\left(\cos(2\pi)+\cos(6\pi)+\cos(10\pi)\right)$$

$$\boxed{\mathcal{E} = 12\pi\,V}$$

5 Chapter 14

1) $L = .50\,H$
$\Delta\mathcal{E} = .150\,V$

$$\Delta V = -L\left(\frac{dI}{dt}\right)$$

$$\Rightarrow \frac{dI}{dt} = -\frac{\Delta V}{L}$$

$$\frac{dI}{dt} = -\frac{.150}{.50} = \boxed{0.3\,A}$$

2) $$\Delta V = -L\left(\frac{dI}{dt}\right)$$

$\Delta V = 500\,V$
$L = 2\times10^{-3}\,H$
$I = -.100\,A$

$$.500 = -(2\times10^{-3})\,\frac{(-.1)}{dt}$$

$$dt = \boxed{4\times10^{-7}\,s}$$