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Midterm 3 Work

CH.11 1. $\vec{F} = q\vec{v} \times \vec{B}$ a) B-field into page; b) B-field goes left c) B-field comes out of page

2. $\vec{F} = q\vec{v} \times \vec{B} = qE \rightarrow qvB\sin\theta = qE$ $\theta = 90°$ (given)

a) $qvB = qE \rightarrow vB = E \rightarrow \boxed{v = E/B}$

b) $E = \frac{\Delta V}{\Delta x}$ Show $\Delta V = \frac{B\Delta x I}{nq_e A}$

$\Delta V = E(\Delta x) \rightarrow \Delta V = vB\Delta x$ $v = v_d = \frac{I}{nq_e A}$

$$\Delta V = \frac{I}{nq_e A}(B\Delta x) = \frac{B\Delta x I}{nq_e A} \checkmark$$

$$\Delta V = \frac{(1.33\,T)(.02\,m)(10\,A)}{(2\times10^{28}\,m^{-3})(1.6\times10^{-19}\,C)(10^{-6}\,m)^2} = \boxed{-8.31\times10^{-5}}$$

3. $I = 1.05\times10^{4}\,A$ radius $= 0.65\times10^{-15}\,m$

$\tau = NIAB\sin\theta$ Max τ occurs when $\sin\theta = 1$; $\theta = 90$

$\tau = (1)(1.05\times10^{4}\,A)(\pi(0.65\times10^{-15}\,m)^2)(2.50\,T)$

$\boxed{\tau \approx 3.48\times10^{-26}}$

CH.12 1.

a) $B = \mu_0 nI \rightarrow \mu_0 = 4\pi\times10^{-7}$ $n = \frac{500}{1\,m}$ $I = 0.3\,A$

$B = (4\pi\times10^{-7})(500)(0.3\,A) = \boxed{1.88\times10^{-4}\,T}$

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

$B = 5000\mu_0(500)(.3) = \boxed{0.94\,T}$

2.

a) Show if $v = E/B$, $F_{net} = 0$

$\vec{F} = q\vec{v} \times \vec{B} = qE \rightarrow qvB\sin\theta = qE$

$v = E/B \rightarrow \vec{F}_{net} = q(E/B)B = qE \rightarrow qE = qE \rightarrow qE - qE = 0$

$\rightarrow \vec{F}_{net} = 0$ ✓

b) $F_c = mv^2/r$

$\frac{mv^2}{r} = qvB\sin\theta \rightarrow r = \frac{mv^2}{qvB} = \frac{mE}{q\frac{E}{B}B^2}$

$\boxed{r = \frac{mE}{qB^2}}$ ✓ $m = 1.67\times10^{-27}\,kg$; $q = 1.6\times10^{-19}\,C$

$E = 10\,V/m$ B-Field $= 0.01T$

$r = \frac{(1.67\times10^{-27}\,kg)(10\,V/m)}{(1.6\times10^{-19}C)(0.01T)^2} = \boxed{1.001\,m \text{ or } 1mm}$

CH. 13

1.

a) Induced emf $\epsilon = -N\frac{d\Phi}{dt}$

$\epsilon = -\left(\frac{d(BA)}{dt}\right) = -\left(\frac{A\,dB}{dt}\right)$

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

$= B_0(4f\cos(2\pi ft) + 4f\cos(6\pi ft) + 4f\cos(10\pi ft))$

$\frac{dB}{dt} = 4fB_0(\cos(2\pi ft) + \cos(6\pi ft) + \cos(10\pi ft))$

$\boxed{\epsilon = -4\pi r^2 fB_0(\cos(2\pi ft) + \cos(6\pi ft) + \cos(10\pi ft))}$

b) $\epsilon = -4\pi(0.1)^2(10^3\,Hz)(.1)(3) = \boxed{-37.70\,V}$

c) $t = 10^{-3}\,s$ $\epsilon = -37.70\,V$ $R = 5\,\Omega$

$I = \frac{\epsilon}{R} = \frac{-37.70\,V}{5\,\Omega} = \boxed{-7.54\,A}$

CH.14 1.

a) $\epsilon = 0.150\,V$ $\quad .50\,H = 0.50\,\frac{V \cdot s}{A}$

Self inductance

$$\Delta V = -L\left(dI/dt\right)$$

$\Delta V = \epsilon \rightarrow \quad \epsilon = -L\left(dI/dt\right)$

$$-\frac{\epsilon}{L} = \frac{dI}{dt} = -\frac{0.150\,V}{0.50\,H} = -0.3\,A/s$$

2. $I = 0.1\,A$ $\quad L = 2\,mH$ $\quad \epsilon = 500\,V$

$L = 2\times10^{-3}\,H$

$\epsilon = -L\left(dI/dt\right)$ $\quad t = ??$

$$-\frac{\epsilon}{L} = dI/dt \rightarrow \int dt = \int -\frac{L}{\epsilon}\,dI$$

$$t = -\frac{L}{\epsilon}(I) \rightarrow t = -\frac{(2\times10^{-3}\,H)}{500\,V}(0.1\,A) = 4\times10^{-7}\,s$$