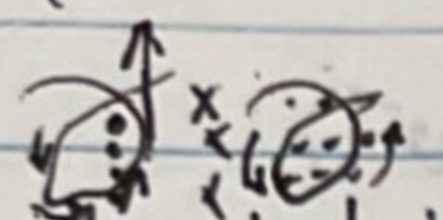
Owen Moore

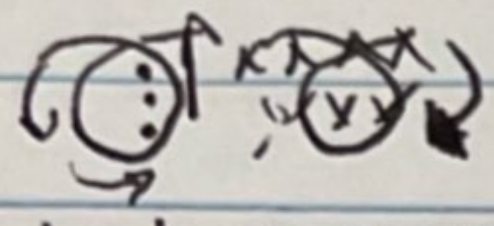
Midterm 2

Unit 4

1. a)

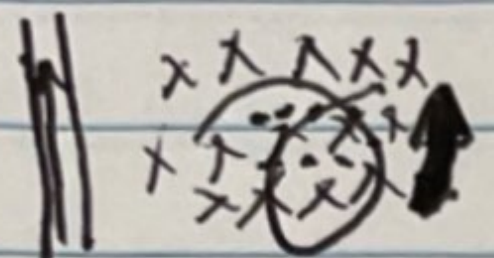


counterclockwise if increasing

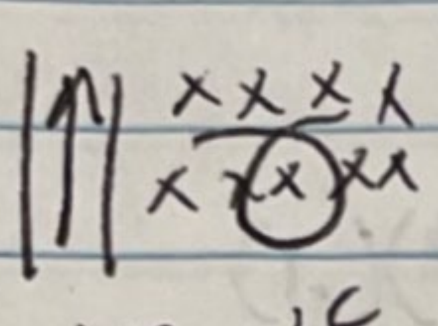


clockwise if decreasing

b)

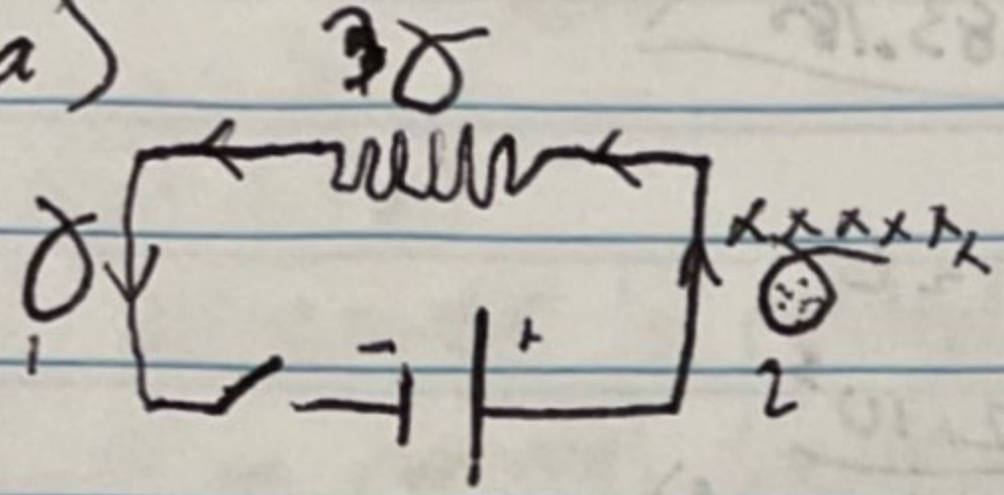


counterclockwise if ~~decreasing~~ increasing



clockwise if decreasing

2. a) 3γ



a) counterclockwise, none, clockwise

b) counterclockwise, none, clockwise

c) ~~[illegible]~~ none, none, none

3. $\frac{\Delta\Phi}{\Delta t} = V$

$1T \cdot m^2/s$

$\frac{N}{C \cdot m/s} \cdot m^2/s$

$\frac{N \cdot \cancel{s} \cdot m^2}{C \cdot m/s}$

$\frac{N \cdot m}{C}$

$\boxed{\frac{J}{C} = V}$

4. a) $B_i = 0$ $\quad \Delta B = 2$

$B_f = 2.00T$

$EMF_i = \frac{-N\Delta\Phi}{\Delta t}$

$EMF_i = -N\frac{\Delta BA\cos\theta}{\Delta t}$

$= -1\frac{2(\pi(\frac{2.2}{2}\times10^{-2})^2\cos(0))}{.25}$

$= \boxed{-3.04\times10^{-3}V}$

b) $EMF_i = 3.04\times10^{-3}V$

$V = IR$

$I = \frac{V}{R}$

$= \frac{3.04\times10^{-3}}{.01}$

$= \boxed{3.04\times10^{-1}A}$

c) $P = IV$

$= 3.04\times10^{-1}(3.04\times10^{-3})$

$= \boxed{9.24\times10^{-4}W}$

5. $EMF_i = Blv\sin\theta$

$= Blv\sin(90)$

$= Blv(1)$

$EMF_i = Blv$ when $\theta = 90$

6. a) $V_p = NAB\omega$

$N = \frac{V_p}{AB\omega}$

$N = \frac{18}{(3\times10^{-4})(.64)(1875)}$

$\boxed{N = 50}$

b) $P = \frac{1}{f}$ $\quad P = \frac{1}{1875}$

$\boxed{P = \frac{1}{1875}s}$

7. a) $\frac{V_s}{V_p} = \frac{N_s}{N_p}$

$\frac{V_p}{V_o} = \frac{N_p}{N_s}$

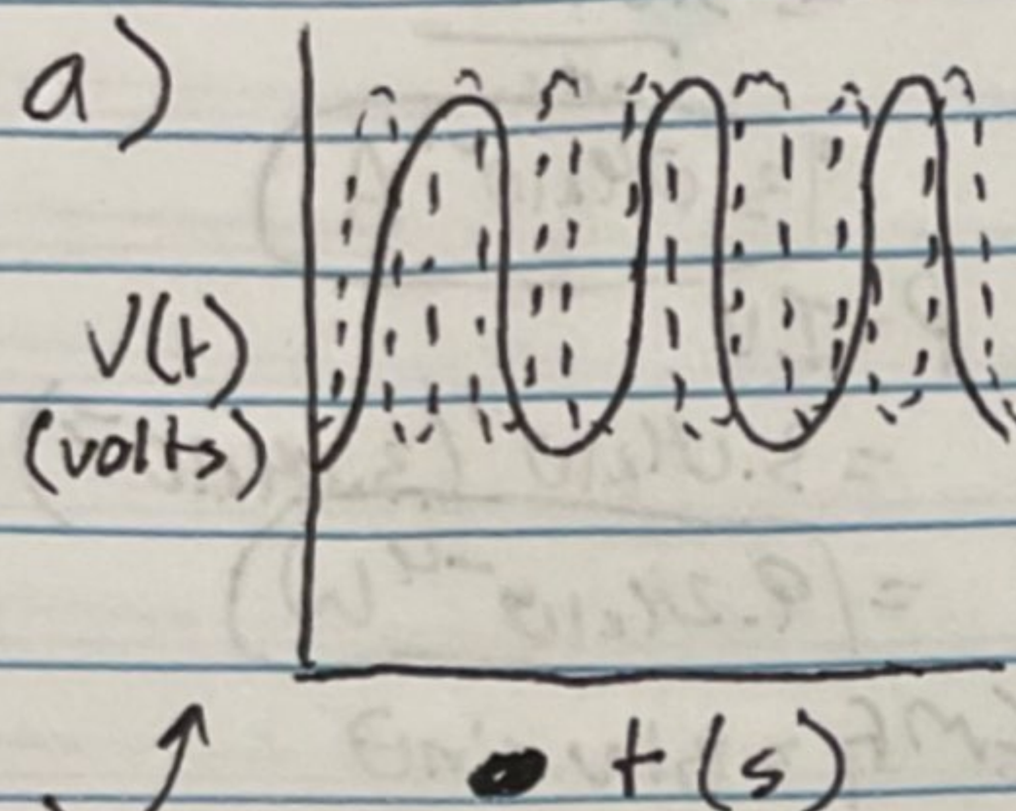
$\frac{240}{120} = \frac{N_p}{N_o} = \boxed{2}$

b) $\frac{I_p}{I_s} = \frac{N_s}{N_p}$

$\frac{I_p}{I_s} = \boxed{\frac{1}{2}}$

c) Flip the coils within the transformers

8. a)



b)

c) $0 = 120\sin(240\pi t)$

$0 = \sin(240\pi t)$

$0 = 240\pi t$

$\boxed{t = 0\,s}$

9. $EMF = -L\frac{\Delta I}{\Delta t}$

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

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

10. a) $EMF = -L\frac{\Delta I}{\Delta t}$

$= -25\left(\frac{100}{80\times10^{-3}}\right)$

$= \boxed{3.13\times10^{4}\,V}$

b) $E_{ind} = \frac{1}{2}LI^2$

$= \frac{1}{2}(25)(100)^2$

$= \boxed{1.25\times10^{5}\,J}$

c) $P = \frac{1.25\times10^{5}}{80\times10^{-3}}$

$= \boxed{1.56\times10^{6}\,W}$

d) No it is not

e) $L = N^2/R$

$25 = \frac{N^2}{I/A}$

$25 = \frac{N^2 A}{I}$

11. a) $L = R\cdot\tau$

$= 5\times10^{6}(20\times10^{-9})$

$= \boxed{.1\,H}$

b) $R = \frac{.1}{1\times10^{-9}}$

$\boxed{R = 1\times10^{8}\,\Omega}$

c) $I = I_0 e^{-t/\tau}$

$1 = I_0 e^{-\frac{3\times10^{-9}}{1\times10^{-9}}}$

$= .049787$

$= \boxed{4.98\%}$

d) $X_L = 2\pi(10\times10^{3})(.1)$

$\boxed{X_L = 6283.185}$

12. a) $\frac{X_L}{2\pi f} = L$

$L = \frac{2\times10^{3}}{2\pi(15\times10^{3})}$

$L = \boxed{2.12\times10^{-2}\,H}$

b) $X_L = 2\pi(60)(2.12\times10^{-2})$

$\boxed{= 8.0\,\Omega}$

13) a) The resistor-capacitor combination makes it a low pass filte

b) $V_{in} - iR - \frac{1}{c} = 0$

c) $V_{out} - \frac{1}{c} = 0$

d) $V_{in} = iR + \frac{1}{c}$ $\quad \frac{V_{out}}{V_{in}} = \frac{iR + \frac{1}{c}}{\frac{1}{c}}$

$V_{out} = \frac{1}{c}$

e) $\boxed{\frac{V_{out}}{V_{in}} = \frac{100 + \frac{1}{c}}{2\pi RC\left(\frac{1}{c}\right)}}$

$\boxed{\frac{V_{out}}{V_{in}} = \frac{.1 + \frac{1}{c}}{2\pi RC\left(\frac{1}{c}\right)}}$

Unit 5

1. a) $B = \frac{\mu_0 I}{2\pi r}$

$= \frac{(4\pi \times 10^{-7})(10^{-4})}{2\pi \cdot .01}$

$= \boxed{2 \times 10^{-9}\ T}$

b) Displacement current

2. a) $v = \frac{d}{t}$

$2d = vt$

$2d = 3 \times 10^8 (1 \times 10^{-5})$

$2d = 3000$ $\boxed{d = 1500 m}$

b) $v = f\lambda$

$2\lambda = \frac{v}{f} = \frac{3 \times 10^6}{100 \times 10^6}$

$2\lambda = 3.$

$\boxed{\lambda = 1.5 m}$

c) All power is reflected assuming normal incidence.

3. a) $I = \frac{P}{A}$

$= \frac{1000 W}{.001} = \boxed{1000000\ W/m^2}$

b) $t = \frac{d}{s}$

$t = \frac{1}{3 \times 10^8}$

$= \boxed{3.33 \times 10^{-9} s}$

c) $E_{peak} = \sqrt{\frac{2I}{c \cdot \epsilon_0}}$

$= \sqrt{\frac{2 \cdot 1000000}{(3 \times 10^8)(8.56 \times 10^{-12})}}$

$\boxed{= 27874.73\ V/m}$

4. a) $\theta_3 = \theta_1$ $\quad \underline{\underline{n_1 = n_3}}$

$\cancel{n_1} \sin\theta_1 = \cancel{n_3} \sin\theta_3$

$\sin^{-1}(\sin\theta_1 = \sin\theta_3)$

$\theta_1 = \theta_3$

b) c) $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{15} = \frac{1}{13.5} + \frac{1}{d_i}$

$\frac{1}{d_i} = \frac{2}{675}$

$\boxed{d_i = 337.5 cm}$

d) $M = \frac{d_i}{d_o}$

$= \frac{337.5}{13.5} = \boxed{25}$

e) $1 \times 25 = \boxed{25 cm}$

5. a) $\frac{1.78}{1.31} = \boxed{1.359}$

b) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$1.31 \sin 30 = 1.78 \sin\theta_2$

$\sin\theta_2 = .367978$

$\boxed{\theta_2 = 21.591°}$

6. a) $m = \frac{d_i}{d_o}$ $\quad \frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$

$\frac{1}{-m \cdot d_o} = \frac{1}{f} - \frac{1}{d_o} \rightarrow -\frac{1}{m} = \frac{d_o - f}{f \cdot d_o}$

$-m = \frac{f \cdot d_o}{d_o - f}$

$m = \frac{-f \cdot d_o}{d_o - f}$

$\boxed{M = \frac{f}{f - d_o}}$

b) d_o approaching f leads to m approaching infinity.

c) It is formed at an infinitely large distance away from d_i.

10. a) $\text{Dose} = \frac{E}{m}$

$= \frac{250 \times 10^{-3}}{60\text{ kg}}$

$= \boxed{.00417 \text{ rads}}$

b) $= \frac{250 \times 10^{-3}}{2\text{ kg}}$

$= \boxed{.125 \text{ rads}}$

c) $Sv = \text{rads} \cdot RBE$

$\text{Dose} = .125 \cdot 1 = \boxed{.125\, Sv}$

d) It does not represent serious health risk at very low dosage, but could at high exposure.

7. a) $I = I_0 e^{-\mu x}$ $\quad \sigma = N_A \cdot \frac{\mu}{\rho}$

$I = I_0 e^{-\mu x}$ $\quad \mu = \frac{\sigma \cdot \rho}{N_A}$

$I = 10 \times 10^3 e^{-\mu \cdot .01}$ $\quad \mu = \frac{200 \cdot 11.34}{6.022 \times 10^{23}}$

$\boxed{I = 10000\, eV}$

b) $5000 = 10000 e^{-\mu x}$

$.5 = e^{-\mu x}$

$\boxed{x = 1.839 \times 10^{20}}$