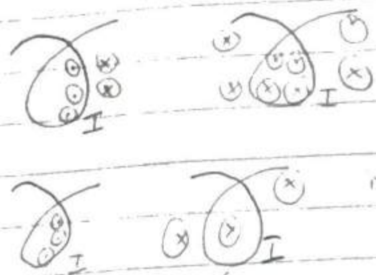
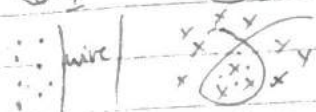
Unit 4 #1 (a)

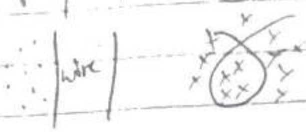


if current ↑, it would go counterclockwise

if current ↓, it would go clockwise

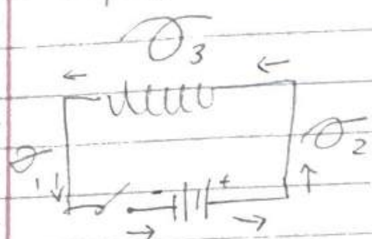
b) 

it would go counterclockwise

c) 

it would go clockwise

#2



(a) Coil 1 runs counterclockwise when the switch is closed. If it's left closed for a long time, it will be neither counterclockwise or clockwise. When it's open, it will run clockwise

(b) Coil 2 runs counterclockwise when the switch is closed. If its left closed for a long time, it will be neither. When it's open, it will run clockwise

(c) Coil 3 runs neither when the switch is closed. If it's left closed for a long time, it will run neither way. when its open, it will run neither way as well

#3 $\frac{1\,T\cdot m^2}{s} = \frac{1}{V}\quad \frac{\Delta\phi}{\Delta t}$

$$\frac{1\,T\cdot m^2}{s} = \frac{\frac{N}{C}\cdot m^2}{s} = \frac{N\cdot \cancel{s}\cdot m^{\cancel{2}}}{C\cdot \cancel{m}\cdot \cancel{s}} = \frac{N\cdot m}{C} = \frac{J}{C} = V$$

#4 (a) $emf = -N\frac{\Delta\phi}{\Delta t}$ $\quad\Delta\phi = \Delta BA\cos\theta$ $\quad 2.20\,cm/2 = r = 1.1\times10^{-2}\,m$

$$= -N\frac{\Delta BA\cos\theta}{\Delta t} = -1\,\frac{2(\pi(1.1\times10^{-2})^2\cos 0}{0.250}$$

$emf = -3.04\times10^{-3}\,V$

b) $I = \frac{V}{R} = \frac{3.04\times10^{-3}\,V}{0.0100\,\Omega}$

$I = 3.04\times10^{-1}\,A$

(c) $P = IV$

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

$P = 9.24\times10^{-4}\,W$

#5 B, l, v are not mutually $\perp$ $\quad$ $v \perp B$, θ b/w l and B $\quad$ $l \perp B$, θ b/w $v B$

$\mathcal{E} = \frac{\Delta \Phi}{\Delta t}$ $\quad \Phi = B(A \sin\theta)$

$\mathcal{E} = \frac{\Delta B A \sin\theta}{\Delta t}$ $\quad A = l \Delta x$

$\mathcal{E} = \frac{\Delta B\, l \Delta x \sin\theta}{\Delta t}$ $\quad v = \frac{\Delta x}{\Delta t}$

$\mathcal{E} = \Delta B\, l\, v \sin\theta$

$\mathcal{E} = B l v \sin\theta$

#6 a) $\mathcal{E}_0 = NAB\omega$

$N = \frac{\mathcal{E}_0}{A B \omega} = \frac{18}{(3\times10^{-4})(0.640)(1875)}$

$N = 50$ turns

b) $f = \frac{2\pi}{\omega} = \frac{2\pi}{1875} = 3.3\times10^{-3}$

$T = \frac{1}{f} = \frac{1}{3.3\times10^{-3}}$

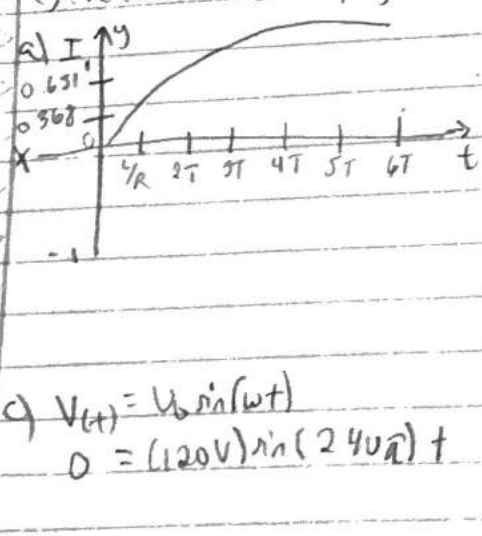
$T = 298.6s$

#7 a) $\frac{V_p}{V_s} = \frac{N_p}{N_s} \Rightarrow \frac{240}{120} = \frac{N_p}{N_s} = 2$

b) $\frac{I_p}{I_s} = \frac{N_s}{N_p} \Rightarrow \frac{1}{2} = \frac{N_s}{N_p} = 0.5$

c) The traveler needs to plug in the output of the first one so it can become the new input of the other

#8 a)



c) $V_{(t)} = V_0 \sin(\omega t)$

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

#9 $emf = L\frac{\Delta I}{\Delta t}$

$\Delta t = L\frac{\Delta I}{emf} = 2\times10^{-3}\left(\frac{0.1}{500}\right)$

$\Delta t = 4\times10^{-7}s$

#10 a) $emf = L\frac{\Delta I}{\Delta t}$

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

$emf = 3.13\times10^{4}V$

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

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

$E = 1.25\times10^{5}J$

c) $P = \frac{J}{s} = watts$

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

$P = 1.56\times10^{6}W$

d) Since we got a really big value for P, its not surprising for shutting it down quickly

e?) $L = \frac{\mu_0 N^2 A}{l}$ $\frac{4(\pi\times10^{-7})(1000^2)(200)}{10m}$ $L = 25.12$

25 H

#11 a) $L = RT$

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

$L = 0.100H$

b) $R = \frac{L}{T}$

$= \frac{0.1}{1\times10^{-9}}$

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

c) $\underline{I} = I_0(1-e^{-t/\tau})$

$= 1-e^{-3\tau/\tau}$

$1 - 0.0498$

$= 0.950$ or 95%

d) $X = 2\pi f L$

$= 2(3.14)(10000\,Hz)(0.05)$

$X = 3140\,\Omega$

#12 a) $L = \frac{X}{2\pi f} = \frac{2\times10^3}{2(3.14)(15\times10^3)}$

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

b) $X = 2\pi f L$

$= 2(3.14)(60)(2.12\times10^{-2})$

$X = 8.0\,\Omega$

#13 a) RC circuit will receive low frequency signals closer to ground level and block out the higher frequency signals

b) $I_1 = I_2 + I_3$

#14

#5

#16

Unit 5 #1 $B = \frac{\mu_0 I}{2\pi R} = \frac{4\pi \times 10^{-7} \times 100}{2\pi \times 5 \times 10^{-3}}$

$\frac{2 \times 10^{-1} \text{ C}}{2 \times 10^{-3} \text{ s}} = 100 A$

$B = 4 \times 10^{-3} T$

#2 a) $V = \frac{d}{t}$ $\frac{2d}{1 \times 10^{-5} s} = 3 \times 10^{8}$

$2d = 3000$

$d = 1500 m$

b)

#3 a) $\frac{1000W}{0.001m^2} = 1\times10^6\ W/m^2$

b)

c) $E = \sqrt{2(3.0\times10^8)(4\pi\times10^{-7})(1\times10^6)}$

$E = 2.7\times10^4\ V/m$

#4 a) $n_1 \sin\theta_1 = n_2 \sin\theta_2 \rightarrow n_2 \sin\theta_2 = n_3 \sin\theta_3 \rightarrow n_1 \sin\theta_1 = n_3 \sin\theta_3$

b) $\frac{1}{\frac{1}{0.15} - \frac{1}{0.135}} = -1.35m$ $-$ $+$

c) it will be on the left side

d) $m = \frac{-d_i}{d_o} = \frac{-(-1.35)}{0.135}$

$m = 10$

e?) $1cm = 10mm \times 10 = 100mm$

#5. a) $V = \frac{c}{n} = \frac{3\times10^8}{1.333} = 2.25\times10^8\ m/s$ in water/snow

$V = \frac{c}{n} = \frac{3\times10^8}{1.309} = 2.29\times10^8\ m/s$ in ice

$\frac{2.29\times10^8}{2.25\times10^8} = 1.02$

b) $\sin\theta_2 = \frac{1.333}{1.309}\sin 30$

$\theta_2 = \sin^{-1}(0.509)$

$\theta_2 = 30.6^\circ$

#6 a) $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

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

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

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

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

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

$$\frac{f d_o}{(f - d_o)(d_o)} = m$$

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