

Circuit diagram for problem 51:

A series circuit consisting of a 10V DC voltage source, an inductor labeled L , and a resistor labeled R . The current I flows through the circuit in a clockwise direction.

30-53

$E = 14 \text{ Volts}$
 $L = 6.30 \mu\text{H}$
 $R = 1.20 \text{ k}\Omega$

$$T = \frac{L/R}{1.20 \times 10^{-3}} = \frac{6.30 \times 10^{-6}}{1.20 \times 10^{-3}} = 5.25 \times 10^{-9} \text{ sec}$$

$$T = 0.217 \text{ sec}$$

$$T = \frac{1}{\rho} = 0.217$$

$$\rightarrow R = 46.1$$

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$$\text{Q) when } \tau = 80\% \text{ of } T_{\max} ? \\ 0.80 T_{\max} = T_{\max} \left[1 - e^{-t/\tau} \right]$$

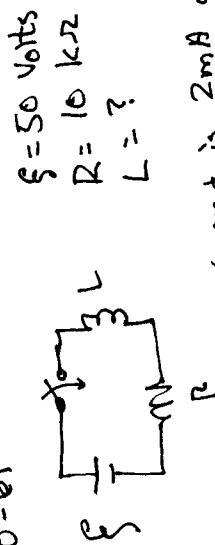
$$\frac{\pi}{4} = 1.57 \quad 2 = 1.57 \quad 9 = 1.57 \times 10^{-9}$$

When $t = \tau$, current i_{ex} is zero.

$$I = I_{\max} \left[1 - e^{-\frac{t}{\tau}} \right]$$

$$= I_{max} [0.632] = [0.017] [0.632] \\ = 7.40 \times 10^{-3} \text{ Amp.}$$

30-61



Current is 2 mA after 5 ms

$$I = \frac{E}{R} = \frac{50}{10 \times 10^3} = 5 \times 10^{-3} \text{ Amp.}$$



$$I(t) = I_{\max} \left[1 - e^{-t/\tau} \right]$$

$$\Rightarrow 2 \times 10^{-3} = 5 \times 10^{-3} \left[1 - e^{-t/\tau} \right]$$

$$\frac{t}{\tau} = 0.510$$

$$\frac{5 \times 10^{-3}}{\tau} = 0.510 \rightarrow \tau = 9.79 \times 10^{-3} \text{ sec}$$

$$\text{so } T = \frac{1}{\tau}$$

$$9.79 \times 10^{-3} = \frac{1}{10 \times 10^3}$$

$$L = 97.9 \text{ H.}$$

b) Energy stored in Inductor-

$$U = \frac{1}{2} L I^2$$

$$= \frac{1}{2} (97.9) (2 \times 10^{-3})^2$$

$$= 1.96 \times 10^{-4} \text{ Joules}$$

30-67

For a solenoid

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{\text{Am}}$$

$$B \cdot L = \mu_0 N I$$

$$B = \mu_0 \frac{N}{L} I$$

$$B = (4\pi \times 10^{-7}) \frac{950}{0.85} (6.6)$$

$$B = 9.26 \times 10^{-3} \text{ Tesla}$$

$$d = 0.85 \text{ m}$$

$$A = 17 \text{ cm}^2 = 17 \times 10^{-4} \text{ m}^2$$

$$N = 950 \text{ turns}$$

$$I = 6.6 \text{ Amp}$$

$$\text{a) Energy density}$$

$$\frac{1}{2} \frac{1}{\mu_0} B^2 = \frac{1}{2} \frac{1}{4\pi \times 10^{-7}} (9.26 \times 10^{-3})^2$$

$$= 34.2 \text{ Joules/m}^3$$

b) Total Energy stored

$$\left(\frac{\text{Energy}}{\text{density}} \right) \left[\frac{\text{volume}}{\text{[volume]}} \right]$$

$$(34.2) \left[(0.85) (17 \times 10^{-4}) \right]$$

$$4.94 \times 10^{-2} \text{ Joules}$$

30-72

$$L_1 = 25 \text{ mH} \quad N_1 = 100 \quad I = 6 \text{ mA}$$

$$\frac{dI}{dt} = 4 \text{ A/s}$$

$$\text{mutual inductance } M = 3 \text{ mH}$$

a) Link 1 flux in coil #1

$$N_1 \phi_B = L_1 I_1$$

$$100 \phi_B = (25 \times 10^{-3})(6 \times 10^{-3})$$

$$\phi_B = 1.5 \times 10^{-6} \text{ Weber}$$

b) Induced Emf in coil #1 from itself

$$\text{Ind Emf} = L_1 \frac{dI}{dt} = (25 \times 10^{-3}) 4$$

$$= 100 \times 10^{-3} = 0.1 \text{ Volt}$$

c) Flux in coil #2 from coil #1

$$N_2 \phi_B = M I_1$$

$$200 \phi_B = (3 \times 10^{-3})(6 \times 10^{-3})$$

$$\phi_B = 9 \times 10^{-9} \text{ Weber}$$

d) Induced Emf in coil #2 from coil #1

$$\text{Ind Emf} = M \frac{dI_1}{dt} = (3 \times 10^{-3})(4)$$

$$= 12 \times 10^{-3} \text{ Volts}$$

$$31-1$$

$C = \frac{1}{L} = \frac{1}{75 \text{ mH}} = 13.33 \text{ mF}$

$$31-10$$

$C = \frac{1}{L} = \frac{1}{3.6 \mu\text{F}} = 277.78 \text{ Hz}$

$$C = 6.7 \mu\text{F}$$

$$f = 10 \text{ kHz}$$

$$\omega = \sqrt{\frac{1}{LC}}$$

$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{1}{LC}}$$

$$10 \times 10^3 = \frac{1}{2\pi} \sqrt{\frac{1}{LC}}$$

$$L = 3.78 \times 10^{-5} \text{ Henry}$$

- a) Total energy in circuit calculated from
 $\frac{1}{2} CV^2$ or $\frac{1}{2} \frac{Q^2}{C} = \frac{1}{2} \frac{(2.9 \times 10^{-6})^2}{3.6 \times 10^{-6}} = 1.17 \times 10^{-6} \text{ Joules}$
- b) Max current occurs when all energy resides in inductor.

$$1.17 \times 10^{-6} = \frac{1}{2} (75 \times 10^{-3}) I^2$$

$$I = 5.58 \times 10^{-3} \text{ Amp}$$

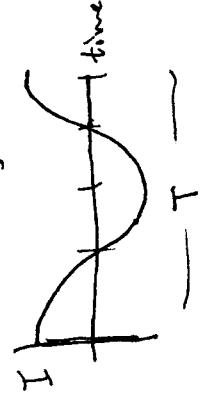
$$31-9$$

$C = \frac{1}{L} = \frac{1}{50 \text{ mH}} = 20 \text{ mF}$

$$\omega = \sqrt{\frac{1}{LC}}$$

$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{1}{LC}} = \frac{1}{2\pi} \sqrt{\frac{1}{3.56 \times 10^{-2}}} = 356 \text{ Hz}$$

$$\text{period } T = \frac{1}{f} = 2.81 \times 10^{-3} \text{ sec}$$



All energy resides in capacitor when $I \rightarrow 0$

so this occurs when $\frac{1}{4}T = 7.62 \times 10^{-4} \text{ sec}$

$$31-24 \quad C \frac{1}{L} \quad R = 7.2 \Omega \quad L = 10 H \quad C = 3.2 \mu F$$

$$Q_0 = 6.20 \mu C$$

Q Direct

$$Q = Q_0 e^{-\frac{1}{2} \frac{t}{L}} \cos(\omega t + \phi)$$

$$\omega' = \sqrt{\omega^2 - \left(\frac{R}{2L}\right)^2}$$

but assume $\omega' \approx \omega$

Since we are asked about the charge on the capacitor N-complete cycles later, the $\cos(\omega t + \phi) \Rightarrow 1$ always at that instant therefore we are only concerned about the amplitude of the oscillation

First find the period : $\omega = \sqrt{\frac{1}{LC}}$

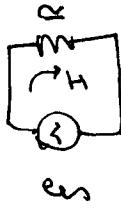
$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{1}{LC}} = 28.015 \text{ Hz}$$

$$T = 0.0355 \text{ sec}$$

Now find the LR time constant

$$\tau = \frac{L}{R} = \frac{10}{7.2} = 1.39 \text{ sec}$$

$$31-30$$



In this circuit, the max current doesn't depend on the oscillator frequency

$$I_{\max} = \frac{E_{\max}}{R} = \frac{30}{50} = 0.6 \text{ Amp}$$

$$E_{\max} = 30 \text{ Volts}$$

$$R = 50$$

$$C = 3.2 \mu F$$

In this circuit, the

max current depends on the oscillator frequency

$$I_{\max} = \frac{E_{\max}}{R} = \frac{30}{50} = 0.6 \text{ Amp}$$

$$I_{\max}$$

$$I = \frac{E_{\max}}{R} = \frac{30}{50} = 0.6 \text{ Amp}$$

$$I_{\max}$$

Since we are asked about the charge on the

capacitor N-complete cycles later, the $\cos(\omega t + \phi) \Rightarrow 1$ always at that instant

Therefore we are only concerned about the amplitude of the oscillation

First find the period : $\omega = \sqrt{\frac{1}{LC}}$

$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{1}{LC}} = 28.015 \text{ Hz}$$

$$T = 0.0355 \text{ sec}$$

Now find the LR time constant

$$\tau = \frac{L}{R} = \frac{10}{7.2} = 1.39 \text{ sec}$$

$$\frac{N}{5} \frac{t}{5(0.0355)} \frac{e^{-\frac{t}{\tau}}}{0.938} \frac{Q_0 e^{-\frac{t}{\tau}}}{5.81 \mu \text{Coul}}$$

$$10 \quad 10(0.0355) \quad 0.880$$

$$5.46 \mu \text{Coul}$$

$$100 \quad 100(0.0355) \quad 0.278$$

$$1.73 \mu \text{Coul}$$

31-32



$$E = E_m \sin \omega t$$

$$E_m = 25 \text{ Volts}$$

$$\omega = 377 \text{ rad/s}$$

a) Max current

$$I_{\max} = \frac{E_{\max}}{X_L} \rightarrow I_{\max} = \frac{25}{12.7 \times 10^{-3}} \text{ Amp}$$

$$= 5.22 \times 10^3 \text{ Amp}$$

b) When current maximum, what is $E(t)$?

$$I = I_{\max} \cos(\omega t - 90^\circ) \quad E(t) = E_{\max} \sin \omega t$$

The current is max when $\omega t = 90^\circ$

$$E(t) = E_{\max} \sin 90^\circ = E_{\max}$$

$$= 0 \text{ Volts}$$

c) When generator increases, what is current?
What is current E here

$$E(t) = E_{\max} \sin \omega t$$

$$= 25 \sin \omega t$$

$$-12.5 = 25 \sin \omega t$$

$$\omega t = 330^\circ$$

$\rightarrow I = I_{\max} \cos(\omega t - 90^\circ)$
 $= (5.22 \times 10^3) \cos(330^\circ - 90^\circ)$
 $= -2.61 \times 10^3 \text{ Amp}$

31-34



$$E = E_m \sin \omega t$$

$$E_m = 25 \text{ Volts}$$

$$\omega = 377 \text{ rad/s}$$

a) Max current

$$I_{\max} = \frac{E_{\max}}{X_C} \rightarrow I_{\max} = \frac{E_{\max}}{1/C} = \omega C E_{\max}$$

$$= 3.91 \times 10^{-2} \text{ Amp}$$

b) When current is max, what is $E(t)$?

$$I = I_{\max} \cos(\omega t + 90^\circ)$$

Current max when $\omega t = -90^\circ$

$$= 0$$

c) When generator increases, what is current?
What is current E here

$$I = I_{\max} \sin \omega t$$

$$\omega t = 330^\circ$$

$\rightarrow I = I_{\max} \cos(\omega t + 90^\circ)$
 $= (3.91 \times 10^{-2}) \cos(330^\circ + 90^\circ)$
 $= 1.96 \times 10^{-2} \text{ Amp}$

31-41

$$\begin{aligned} f &= 60 \text{ Hz} \\ f &= 200 \text{ rad/s} \\ C &= 70 \mu\text{F} \\ L &= 230 \text{ mH} \end{aligned}$$



31-53

$$\begin{aligned} \epsilon_{rms} &= 120 \text{ Volts} \\ R &= 12 \Omega \\ X_L &= 1.3 \text{ } \Omega \end{aligned}$$

$$a) \text{ Impedance } Z = R^2 + (X_L - X_C)^2 =$$

$$Z = 12^2 + (1.3 - 0.7)^2 = 12.7 \Omega$$

$$b) \text{ Power } P_{ave} = I_{rms} V_{rms}$$

$$\begin{aligned} Z &= \frac{V_{rms}}{I_{rms}} \\ &= \frac{120}{12.7} = 9.4 \Omega \\ I_{rms} &= \frac{V_{rms}}{\sqrt{2}} = \frac{120}{\sqrt{2}} = 84.8 \text{ A} \\ V_{rms} &= \frac{I_{rms} R}{\sqrt{2}} = \frac{84.8 \times 12}{\sqrt{2}} = 193 \text{ Volts} \end{aligned}$$

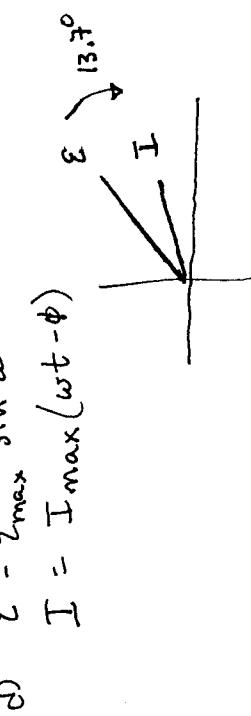
$$b) \text{ Phase tan } \phi = \frac{X_L - X_C}{R} = \frac{86.71 - 37.89}{200} = 0.244$$

$$\phi = 13.7^\circ$$

$$31-54 \quad \text{If } V_{rms} = 100 \text{ Volts}$$

$$= \frac{120}{12.7} = 9.4 \Omega$$

$$\begin{aligned} V_{rms} &= \frac{I_{rms} R}{\sqrt{2}} = \frac{100 \times 9.4}{\sqrt{2}} = 660 \text{ Volts} \\ I_{rms} &= \frac{V_{rms}}{R} = \frac{660}{9.4} = 70 \text{ A} \end{aligned}$$

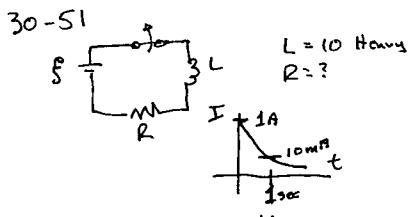


$$V_{max} = 144 \text{ Volts}$$

$$I_{max} = \frac{V_{max}}{R} = \frac{144}{12} = 12 \text{ A}$$

$$c) \text{ Current amplitude } I = I_{max} \sin(\omega t - \phi)$$

$$d) E = E_{max} \sin \omega t$$



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

$$10 \times 10^{-3} A = 1 A e^{-1/\tau}$$

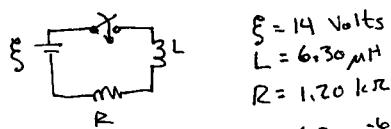
$$\tau = 0.217 \text{ sec}$$

$$\tau = L/R = 0.217$$

$$\frac{L}{R} = 0.217$$

$$\rightarrow R = 46.1 \Omega$$

30-53



$$\tau = L/R = \frac{6.30 \times 10^{-6}}{1.20 \times 10^3} = 5.25 \times 10^{-9} \text{ sec}$$

$$I_{\max} = \frac{E}{R} = \frac{14}{1.20 \times 10^3} = 0.0117 \text{ Amp}$$

$$I = I_{\max} [1 - e^{-t/\tau}]$$

a) when is $I = 80\%$ of I_{\max} ?

$$0.80 I_{\max} = I_{\max} [1 - e^{-t/\tau}]$$

$$\frac{t}{\tau} = 1.61$$

$$t = 1.61 \tau = 1.61 (5.25 \times 10^{-9}) = 8.45 \times 10^{-9} \text{ sec}$$

b) what is current when $t = \tau$

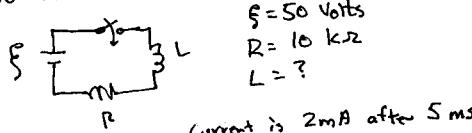
$$I = I_{\max} [1 - e^{-t/\tau}]$$

$$= I_{\max} [1 - e^{-1}]$$

$$= I_{\max} [0.632] = (0.0117) [0.632]$$

$$= 7.40 \times 10^{-3} \text{ Amp.}$$

30-61



$$E = 50 \text{ Volts}$$

$$R = 10 \text{ k}\Omega$$

$$L = ?$$

Current is 2 mA after 5 ms

$$I = I_{\max} [1 - e^{-t/\tau}]$$

$$I_{\max} = \frac{E}{R} = \frac{50}{10 \times 10^3} = 5 \times 10^{-3} \text{ Amp.}$$

$$I(t) = I_{\max} [1 - e^{-t/\tau}]$$

$$2 \times 10^{-3} = 5 \times 10^{-3} [1 - e^{-t/\tau}]$$

$$\frac{t}{\tau} = 0.510$$

$$\frac{5 \times 10^{-3}}{\tau} = 0.510 \rightarrow \tau = 9.79 \times 10^{-3} \text{ sec}$$

$$\text{so } \tau = L/R$$

$$9.79 \times 10^{-3} = \frac{L}{10 \times 10^3}$$

$$L = 97.9 \text{ H.}$$

b) Energy stored in Inductor

$$U = \frac{1}{2} L I^2$$

$$= \frac{1}{2} (97.9) (2 \times 10^{-3})^2$$

$$= 1.96 \times 10^{-4} \text{ Joules}$$

30-67



$$l = 0.85 \text{ m}$$

$$A = 17 \text{ cm}^2 = 17 \times 10^{-4} \text{ m}^2$$

$$N = 950 \text{ turns}$$

$$I = 6.6 \text{ Amp}$$

For a solenoid

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{\text{thru}}$$

$$B \cdot L = \mu_0 N I$$

$$B = \mu_0 \frac{N}{L} I$$

$$B = (4\pi \times 10^{-7}) \frac{950}{0.85} (6.6)$$

$$B = 9.26 \times 10^{-3} \text{ Tesla}$$

a) Energy density

$$\frac{1}{2} \frac{1}{\mu_0} B^2 = \frac{1}{2} \frac{1}{4\pi \times 10^{-7}} (9.26 \times 10^{-3})^2$$

$$= 34.2 \text{ Joules/m}^3$$

b) Total Energy Stored

$$(\text{Energy density}) [\text{volume}]$$

$$(34.2) [(0.85)(17 \times 10^{-4})]$$

$$4.94 \times 10^{-2} \text{ Joules}$$

30-72



$$L_1 = 25 \text{ mH}$$

$$N_1 = 100$$

$$I = 6 \text{ mA}$$

$$\frac{dI}{dt} = 4 \text{ A/s}$$

$$\text{mutual inductance } M = 3 \text{ mH}$$

a) Linking flux in coil #1

$$N_1 \phi_B = L_1 I_1$$

$$100 \phi_B = (25 \times 10^{-3})(6 \times 10^{-3})$$

$$\phi_B = 1.5 \times 10^{-6} \text{ Weber}$$

b) Induced Emf in coil #1 from itself

$$\text{Ind Emf} = L_1 \frac{dI}{dt} = (25 \times 10^{-3}) 4 \\ = 100 \times 10^{-3} = 0.1 \text{ Volt}$$

c) Flux in coil #2 from coil #1

$$N_2 \phi_B = M I_1$$

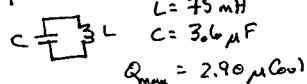
$$200 \phi_B = (3 \times 10^{-3})(6 \times 10^{-3})$$

$$\phi_B = 9 \times 10^{-6} \text{ Weber}$$

d) Induced Emf in coil #2 from coil #1

$$\text{Ind Emf} = M \frac{dI_1}{dt} = (3 \times 10^{-3})(4) \\ = 12 \times 10^{-3} \text{ Volts}$$

31-1



$$L = 75 \text{ mH}$$

$$C = 3.6 \mu\text{F}$$

$$Q_{\max} = 2.90 \mu\text{Coul}$$

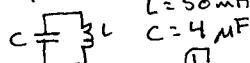
a) Total energy in circuit calculated from max energy in capacitor

$$\frac{1}{2} CV^2 \text{ or } \frac{1}{2} \frac{Q^2}{C} = \frac{1}{2} \frac{(2.90 \times 10^{-6})^2}{3.6 \times 10^{-6}} \\ = 1.17 \times 10^{-6} \text{ Joules}$$

b) Max current occurs when all energy resides in inductor.

$$\frac{1}{2} L I^2 \\ 1.17 \times 10^{-6} = \frac{1}{2} (75 \times 10^{-3}) I^2 \\ I = 5.58 \times 10^{-3} \text{ Amp}$$

31-9



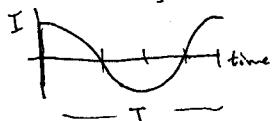
$$L = 50 \text{ mH}$$

$$C = 4 \mu\text{F}$$

$$\omega = \frac{1}{LC}$$

$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{1}{LC}} = \frac{1}{2\pi} 3.56 \times 10^2 \\ = 356 \text{ Hz}$$

$$\text{period } T = \frac{1}{f} = 2.81 \times 10^{-3} \text{ sec}$$



All energy resides in capacitor
when $I \rightarrow 0$

$$\text{so this occurs when } \frac{1}{4} T = 7.62 \times 10^{-4} \text{ sec}$$

31-10



$$\omega = \frac{1}{\sqrt{LC}}$$

$$C = 6.7 \mu\text{F}$$

$$f = 10 \text{ kHz}$$

$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{1}{LC}}$$

$$10 \times 10^3 = \frac{1}{2\pi} \sqrt{\frac{1}{LC}}$$

$$L = 3.78 \times 10^{-5} \text{ Henry}$$

31-24

$R = 7.2 \Omega$
 $L = 10 \text{ H}$
 $C = 3.2 \mu\text{F}$
 $Q_0 = 6.20 \mu\text{Coul}$

$Q = Q_0 e^{-\frac{Rt}{2L}} \cos(\omega't + \phi)$
 $\omega' = \sqrt{\omega^2 - (\frac{R}{2L})^2}$ but assume $\omega' \approx \omega$

Since we are asked about the charge on the capacitor N -complete cycles later, the $\cos(\omega't + \phi) \Rightarrow 1$ always at that instant
 Therefore we are only concerned about the amplitude of the oscillation

First find the period $\omega = \sqrt{\frac{1}{LC}}$
 $f = \frac{\omega}{2\pi} = \frac{1}{2\pi\sqrt{LC}} = 28.15 \text{ Hz}$
 $T = 0.0355 \text{ sec}$

Now find the LR time constant
 $\tau = \frac{L}{R} = \frac{10}{7.2} = 1.39 \text{ sec}$

$\frac{N}{5}$	$\frac{t}{5(0.0355)}$	$e^{-\frac{t}{\tau}}$	$\frac{Q_0 e^{-\frac{t}{\tau}}}{5.81 \mu\text{Coul}}$
10	$10(0.0355)$	0.880	$5.46 \mu\text{Coul}$
100	$100(0.0355)$	0.278	$1.73 \mu\text{Coul}$

31-32

$E = E_m \sin \omega t$
 $E_m = 25 \text{ Volts}$
 $\omega = 377 \text{ rad/s}$

a) Max current
 $I_{\max} = \frac{E_{\max}}{X_L} \rightarrow \frac{E_{\max}}{\omega L} = \frac{25}{377 \times 12.7} = 5.22 \times 10^{-3} \text{ Amp}$

b) When current maximum, what is $E(t) = ?$
 $I = I_{\max} \cos(\omega t - 90^\circ)$
 $E(t) = E_{\max} \sin \omega t$
 The current is max when
 $\omega t = 90^\circ \rightarrow E(t) = E_{\max} \sin 90^\circ = 0 \text{ Volts}$

c) When generator is -12.5 Volts and increasing,
 what is current E
 $E(t) = E_{\max} \sin \omega t = 25 \sin \omega t$
 $-12.5 = 25 \sin \omega t$
 $\omega t = 330^\circ \rightarrow I = I_{\max} \cos(\omega t - 90^\circ) = (5.22 \times 10^{-3}) \cos(330^\circ - 90^\circ) = -2.61 \times 10^{-3} \text{ Amp}$

31-30

$E = 30 \text{ Volts}$
 $R = 50 \Omega$

In this ~~series~~ circuit, the max current doesn't depend on the oscillator frequency
 $I = \frac{E_{\max}}{R} = \frac{30}{50} = 0.6 \text{ Amp}$

31-34

$E = E_m \sin \omega t$
 $E_m = 25 \text{ Volts}$
 $\omega = 377 \text{ rad/s}$

a) Max current
 $I_{\max} = \frac{E_{\max}}{X_L} \rightarrow \frac{E_{\max}}{1/\omega C} = \omega C E_{\max} = 3.91 \times 10^{-2} \text{ Amp}$

b) When current is max, what is $E(t) = ?$
 $I = I_{\max} \cos(\omega t + 90^\circ)$
 current max when
 $\omega t = -90^\circ \rightarrow E(t) = E_{\max} \sin(-90^\circ) = 0$

c) When generator is -12.5 Volts and increasing, what is current?
 $E(t) = E_{\max} \sin \omega t$
 $\omega t = 330^\circ \rightarrow I = I_{\max} \cos(\omega t + 90^\circ)$

$= (3.91 \times 10^{-2}) \cos(330^\circ + 90^\circ) = 1.96 \times 10^{-2} \text{ Amp}$

31-41

$$R = 200 \Omega$$

$$C = 70 \mu F$$

$$L = 230 \text{ mH}$$

$$f_d = 60 \text{ Hz} \quad \rightarrow$$

$$E_m = 36 \text{ V}$$

$$\omega = 2\pi f = 377 \text{ rad/s}$$

$$a) Z^2 = R^2 + (X_L - X_C)^2$$

$$X_L = \omega L = 86.71$$

$$X_C = \frac{1}{\omega C} = 37.89$$

$$Z^2 = 200^2 + (86.71 - 37.89)^2$$

$$Z = 206 \Omega$$

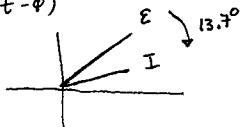
$$b) \text{Phase } \tan \phi = \frac{X_L - X_C}{R} = \frac{86.71 - 37.89}{200} = 0.244$$

$$\phi = 13.7^\circ$$

$$c) \text{Current amplitude } I = \frac{E_{\max}}{Z} = \frac{36}{206} = 0.175 \text{ Amp}$$

$$d) E = E_{\max} \sin \omega t$$

$$I = I_{\max} (\sin \omega t - \phi)$$



31-53

$$E_{\max} = 120 \sqrt{2} \text{ Volts}$$

$$R = 12 \Omega$$

$$X_L = 1.3 \Omega$$

$$a) \text{Impedance } Z^2 = R^2 + (X_L - X_C)^2 =$$

$$Z = 12.07 \Omega$$

$$b) \text{Power } P_{\text{ave}} = I_{\text{rms}} V_{\text{rms}}$$

$$= \frac{V_{\text{rms}}}{Z} V_{\text{rms}}$$

$$= \frac{120}{12.07} \cdot 120 = 1193 \text{ Watts}$$

31-54 If $V_{\text{rms}} = 100 \text{ Volts}$

$$V_{\text{rms}} = \frac{1}{\sqrt{2}} V_{\max}$$

$$100 = \frac{1}{\sqrt{2}} V_{\max}$$

$$V_{\max} = 144 \text{ Volts}$$