Electrical Engineering

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Ph.D. Power Engineering

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Chapter -1-

Introduction

1.1- SI Units

International system of unit (SI) or (m. Kg. S)

Quantity	Unit	Unit Symbol
Length	metre	m
Mass	Kilogram	Kg
Time	Second	S
Electric current	Amper	A (amp.)
Temperature	Kelvin	K
Illumination intensity	Candela (candle)	cd
Substance	Mole	Mol

1.2 - Ohm's Law

The ratio of potential difference (V) between any two points on a conductor to the current (I) flowing between them, is constant, provided the temperature of conductor does not change.

$$\frac{V}{I} = \text{constant} \quad \text{or} \quad \frac{V}{I} = R \text{ ------ (1.1)}$$

Where

V : applied voltage (Volt).

I : Current (A)

R : Resistance (ohm) or (Ω)

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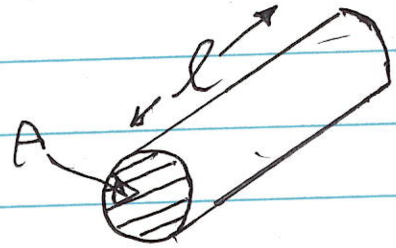
The resistance can be defined from the dimension, length (l) and area (A)

$$R \propto \frac{l}{A}$$



$$R = \rho \frac{l}{A} \quad \text{---- (1.2)}$$

Where ρ is the resistivity ($\Omega.m$)
for copper $\rho = 1.72 * 10^{-8}$ ($\Omega.m$) at $20\,^{\circ}C$
for Rubber $\rho = 10^{16}$ ($\Omega.m$)
The reciprocal of resistance (R) is the conductance (G) (mho or ℧)

$$G = \frac{1}{R} \quad \text{------ (1.3)}$$

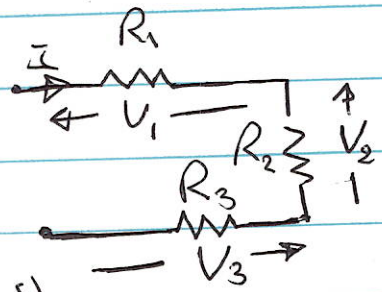
From eqn. (1.2)

$$G = \frac{1}{\rho \frac{l}{A}} = \frac{1}{\rho} \cdot \frac{A}{l} = \sigma \frac{A}{l} \quad \text{---- (1.4)}$$

σ is the conductivity (Siemens / metre)

1.3 - Resistances Connection

a - Resistance in Series



$$V = V_1 + V_2 + V_3$$
$$I R_{eq} = I R_1 + I R_2 + I R_3$$
$$R_{eq} = R_1 + R_2 + R_3 \quad (\Omega) \quad \text{--- (1.5)}$$

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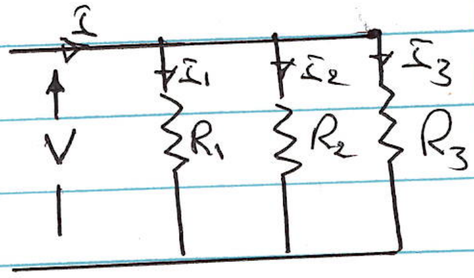
Where R_{eq} is equivalent resistance

b- Resistance in parallel

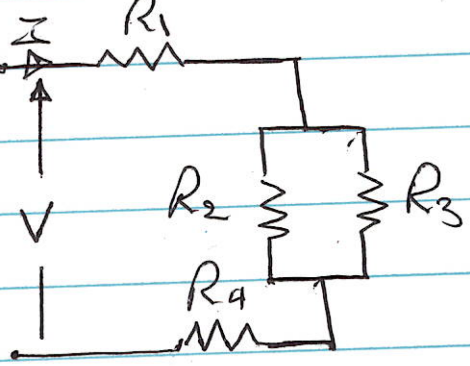


$I = I_1 + I_2 + I_3$

$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \quad \text{-----} (1.6)$$

C- Combined Connection

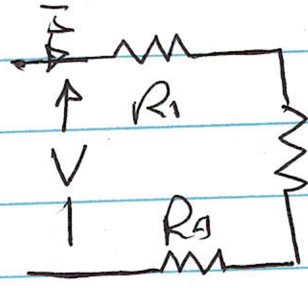


$R^- = R_2 // R_3$

$$\frac{1}{R^-} = \frac{1}{R_2} + \frac{1}{R_3}$$

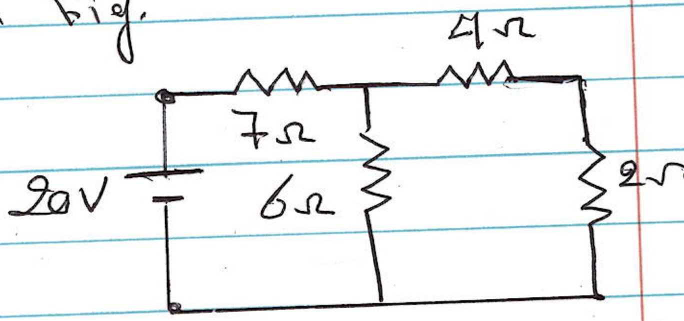
$$\frac{1}{R^-} = \frac{R_3 + R_2}{R_2 R_3}$$

$$\therefore R^- = \frac{R_2 R_3}{R_2 + R_3}$$



$\therefore R_{eq} = R_1 + R^- + R_4$

Ex (1.1): Calculate the total current for the circuit shown in Fig.



$R^- = 4 + 2 = 6\,\Omega$

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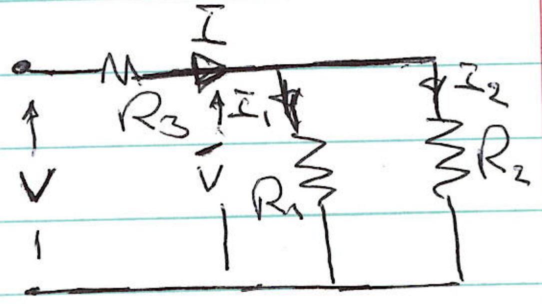
DC

b- Current divider



$R^{-} = R_1 // R_2$

$I = I_1 + I_2$

$$\frac{V^{-}}{R^{-}} = \frac{V^{-}}{R_1} + \frac{V^{-}}{R_2}$$

$$\frac{1}{R^{-}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_2 + R_1}{R_1 R_2}$$

$$\therefore R^{-} = \frac{R_1 R_2}{R_1 + R_2}$$

$$I_1 = \frac{V^{-}}{R_1}$$

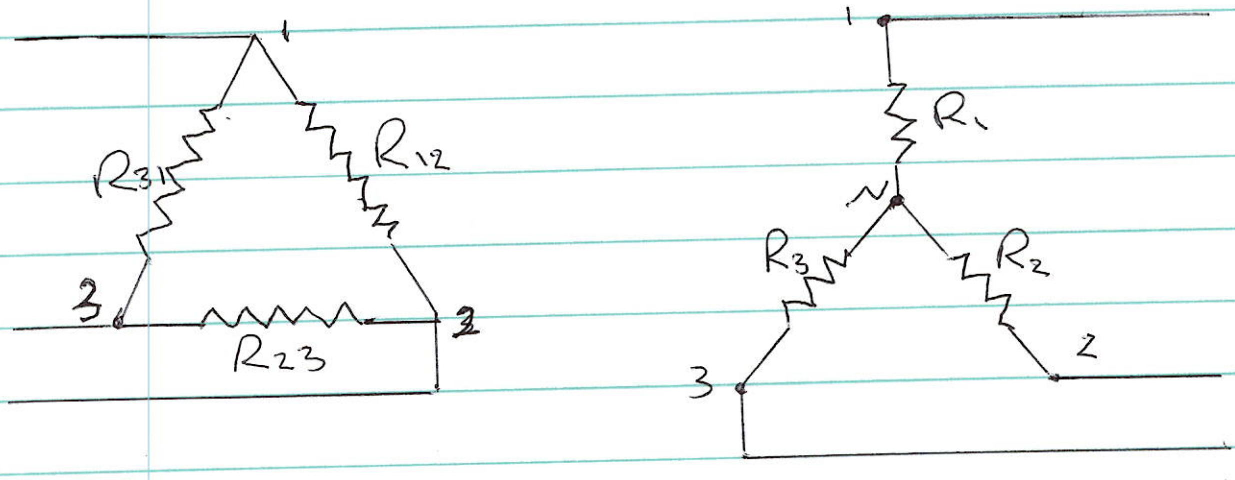
$$\therefore V^{-} = I_1 R_1$$

$$I R^{-} = I_1 R_1$$

$$I \cdot \frac{\cancel{R_1} R_2}{R_1 + R_2} = I_1 \cancel{R_1}$$

$$\therefore I_1 = I \frac{R_2}{R_1 + R_2} \quad (A) \text{ ----- } (1.8)$$

1.5- Star-Delta Transformation



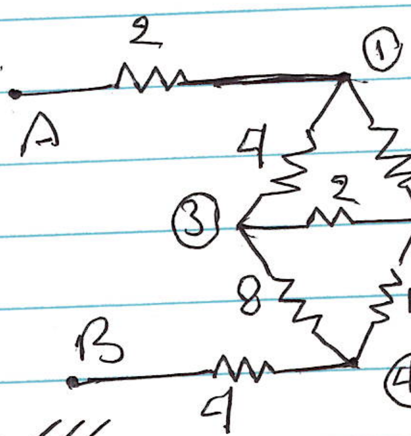
$$R_{12} = R_1 + R_2 + \frac{R_1 R_2}{R_3}$$

$$R_{23} = R_2 + R_3 + \frac{R_2 R_3}{R_1} \quad \text{--- (1.10)}$$

$$R_{31} = R_1 + R_3 + \frac{R_1 R_3}{R_2}$$

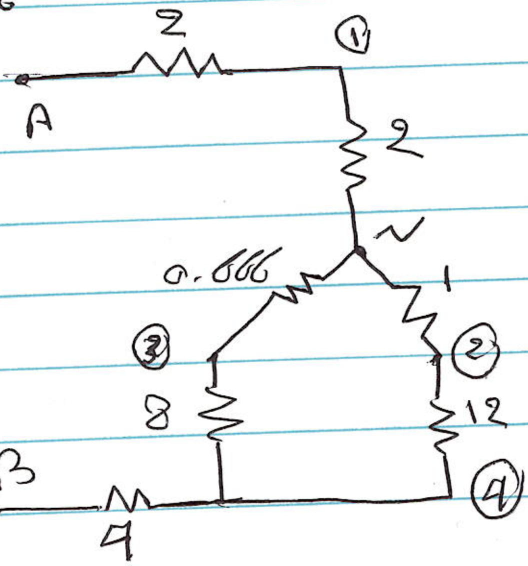
Ex(1.2): Find the equivalent resistance of the network show in Fig. An

$$R_{1N} = \frac{6 * 4}{6+4+2} = \frac{24}{12} = 2$$

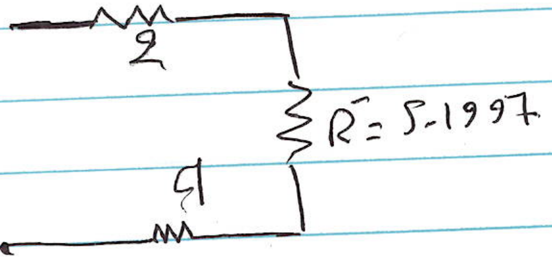


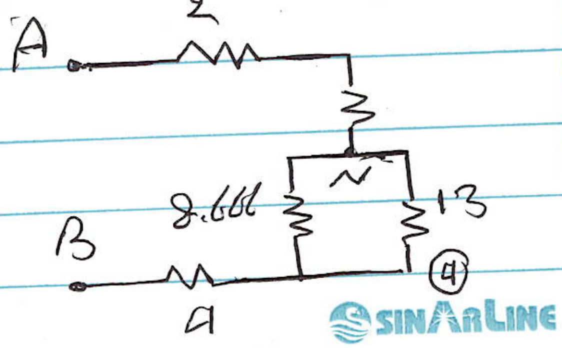
$$R_{2N} = \frac{6 * 2}{6+4+2} = \frac{12}{12} = 1$$

$$R_{3N} = \frac{4 * 2}{6+4+2} = \frac{8}{12} = 0.666$$



$$R' = \frac{8.666 * 13}{8.666 + 13} = 5.1997$$



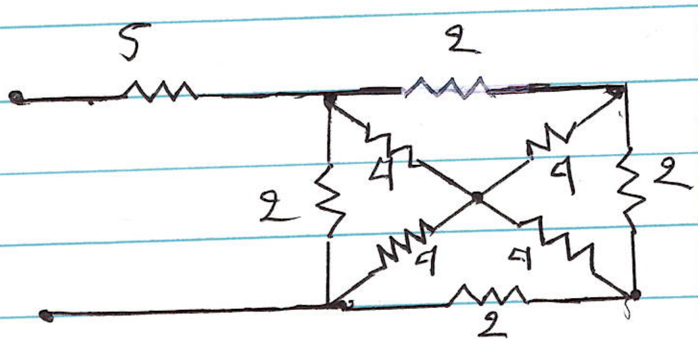


$$R_{eq} = R_{AB} = 2 + 5.1997 + 4$$
$$= 11.1997\ \Omega$$

equivalent resistance

Ex(1.3): Use Δ-Y conversion to find resistance between A and B. All resistances in ohm

(Ans. $R_{AB} = 6.249\ \Omega$)



1.6 - Power in DC Circuit

$$P = VI \quad \text{------} \quad (1.11)$$

$$V = IR$$

$$P = I^2 R \quad \text{------} \quad (1.12)$$

$$P = \frac{V^2}{R} \quad \text{------} \quad (1.13)$$

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Chapter - 2 -

DC Circuits Theorems

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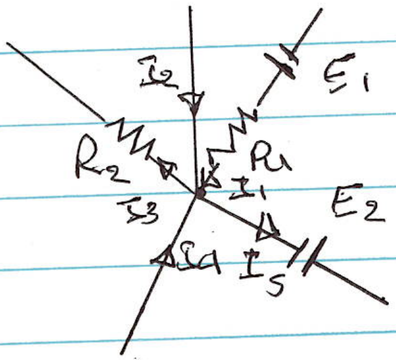
2.1 - Kirchhoff's Laws

a - Kirchhoff's Current Law (KCL)

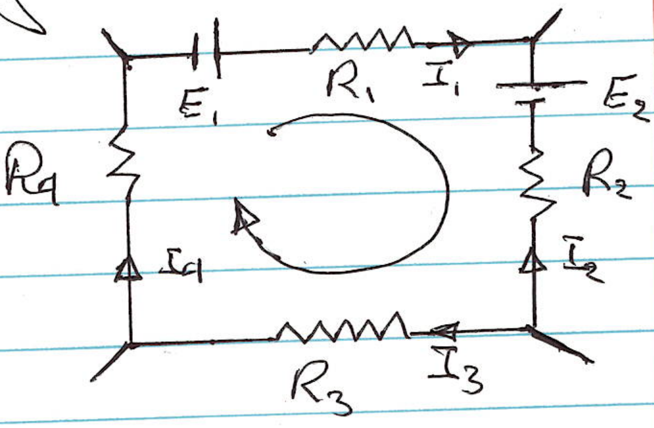
The elgebric sum of currents at node equal to zero.

b - Kirchhoff's Voltage Law (KVL)

The elgebric sum of voltages in closed loop (circuit) equal to elgebric sum of emf's.



KCL



KVL

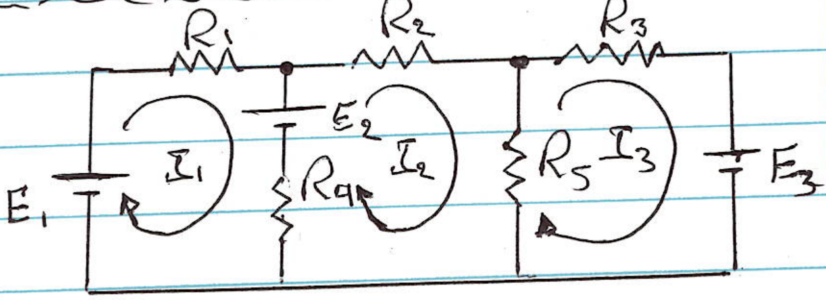
2.2 - Madwell's Loops Method (mesh method)

Loops = b + 1 - j

b: branches

j: nodes

Loops = 5 + 1 - 3 = 3



KVL for loop (1)

$$R_1 I_1 + R_4 (I_1 - I_2) = E_1 - E_2$$

$$(R_1 + R_4) I_1 + R_4 I_2 + 0 I_3 = E_1 - E_2$$

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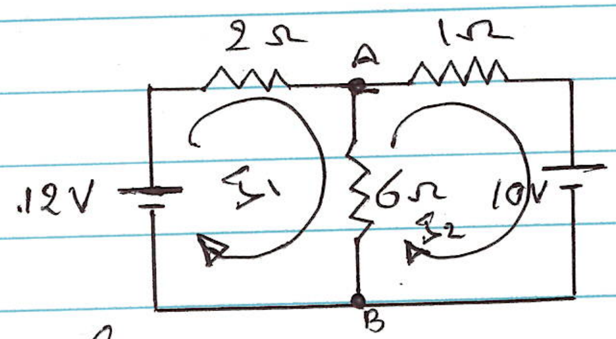
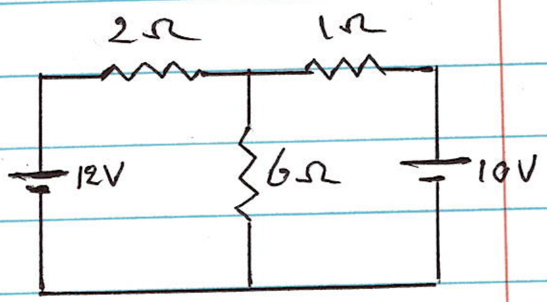
EX(2.1)

Using maxwell's loops method, find current in 6 Ω resistance.





loops = 3 + 1 − 2 = 2

loop ①

$(2+6) I_1 - 6 I_2 = 12$ $\qquad$ $8 I_1 - 6 I_2 = 12$

loop ②

$(1+6) I_2 - 6 I_1 = -10$ $\qquad$ $-6 I_1 + 7 I_2 = -10$

$$\begin{bmatrix} 8 & -6 \\ -6 & 7 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 12 \\ -10 \end{bmatrix}$$

$$\Delta = \det \begin{bmatrix} 8 & -6 \\ -6 & 7 \end{bmatrix} = 8 * 7 - (-6)(-6) = 56 - 36 = 20$$

$$\Delta_1 = \begin{bmatrix} 12 & -6 \\ -10 & 7 \end{bmatrix} = 12 * 7 - (-10)(-6) = 24$$

$$\Delta_2 = \det \begin{bmatrix} 8 & 12 \\ -6 & -10 \end{bmatrix} = 8(-10) - (-6)(12) = -80 + 72 = -8$$

$$I_1 = \frac{\Delta_1}{\Delta} = \frac{24}{20} = 1.2 \text{ amp} \qquad I_2 = \frac{\Delta_2}{\Delta} = \frac{-8}{20} = -0.4$$

$$I_{6\Omega} = I_1 - I_2 = 1.2 - (-0.4) = 1.6 \text{ amp} \quad \text{from A to B}$$

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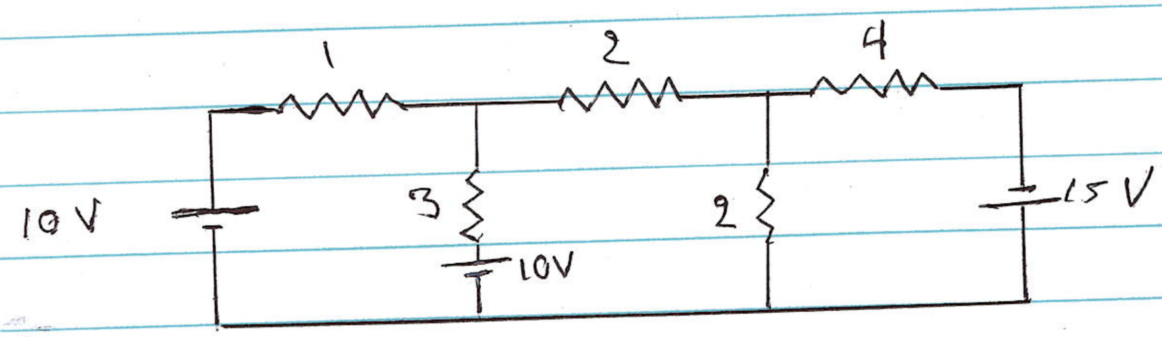
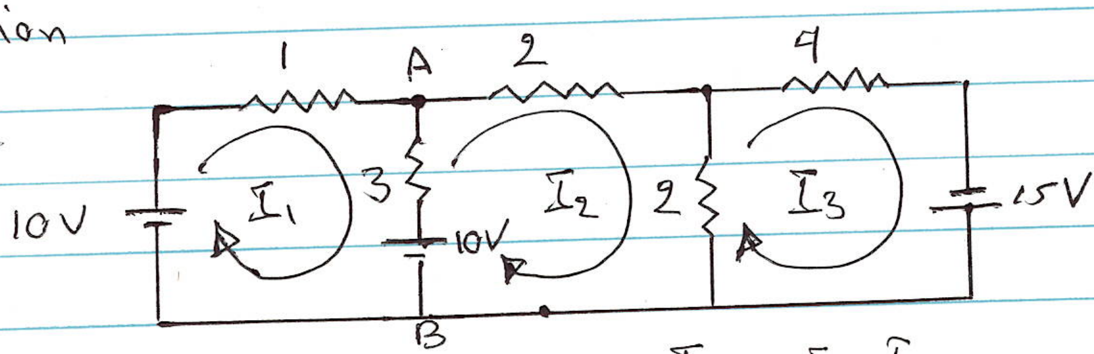
EX (2.2)

Using maxwell's loops method, find current in the 3 Ω resistance.



Solution



loops $= b + 1 - j = 5 + 1 - 3 = 3$ $\qquad I_{3\Omega} = I_1 - I_2$

loop ①

$(1+3) I_1 - 3 I_2 = 10 - 10$ $\qquad 4I_1 - 3I_2 + 0I_3 = 0$

loop ②

$(2+2+3) I_2 - 3 I_1 - 2 I_3 = 10$ $\qquad -3I_1 + 7I_2 - 2I_3 = 10$

loop ③

$(4+2) I_3 - 2 I_2 = 15$ $\qquad 0I_1 - 2I_2 + 6I_3 = 15$

$$\begin{bmatrix} 4 & -3 & 0 \\ -3 & 7 & -2 \\ 0 & -2 & 6 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 10 \\ 15 \end{bmatrix}$$

$$\Delta = \det \begin{bmatrix} 4 & -3 & 0 \\ -3 & 7 & -2 \\ 0 & -2 & 6 \end{bmatrix} = 4\left(7 \times 6 - (-2)(-2)\right) - (-3)\left((-3)6 - (0)(-2)\right) + 0\left((-3)(-2) - (0)(7)\right) = 98$$

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$$\Delta_1 = \begin{bmatrix} 0 & -3 & 0 \\ 10 & 7 & -2 \\ 15 & -2 & 6 \end{bmatrix} = 0(7\times6-(-2)(-2)) - (-3)(10\times6-(-2)(15)) = 270$$

$$\Delta_2 = \begin{bmatrix} 4 & 0 & 0 \\ -3 & 10 & -2 \\ 0 & 15 & 6 \end{bmatrix} = 4(10\times6-(-2)(15)) - 0 + 0 = 360$$

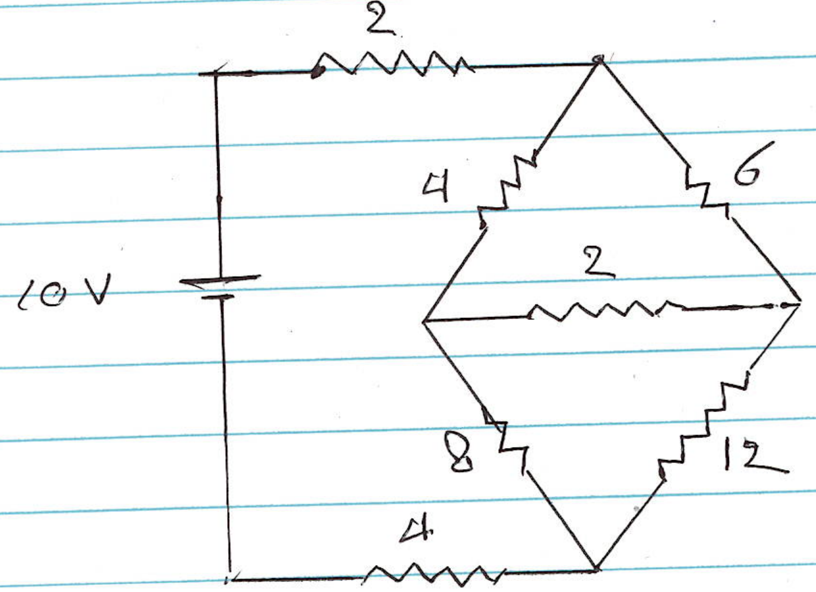
$$I_1 = \frac{\Delta_1}{\Delta} = \frac{270}{98} = 2.755 \text{ amp.}$$

$$I_2 = \frac{\Delta_2}{\Delta} = \frac{360}{98} = 3.673 \text{ amp.}$$

$I_{3\Omega} = I_2 - I_1 = 3.673 - 2.755 = 0.918$ amp from B to A

Q-1 Using maxwell's loops method, find current in the 8 Ω resistance

(Ans: $I_{8\Omega} = 0.4595$ amp.)



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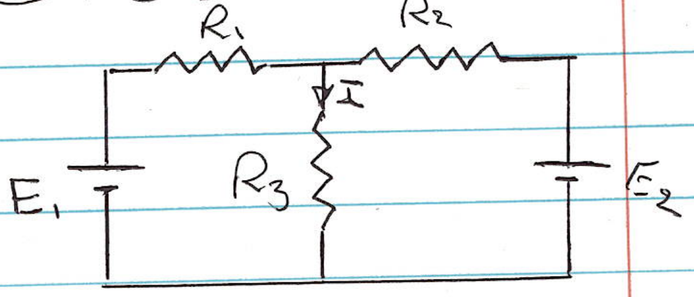
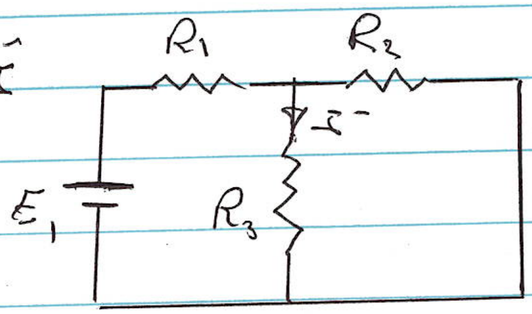
2.3 - Superposition Theorem

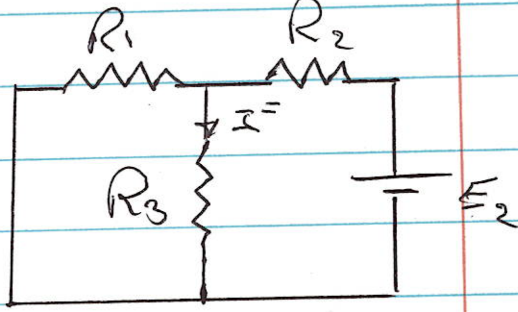
Assume we have the circuit shown, and we want to calculate the current in R_3 (I)



1- Current from source E_1, I'



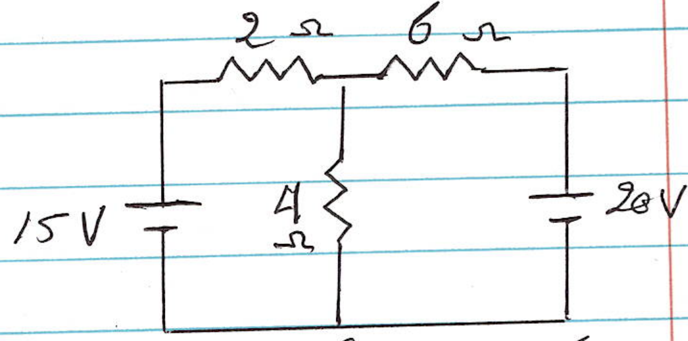
2- Current from source E_2, I''



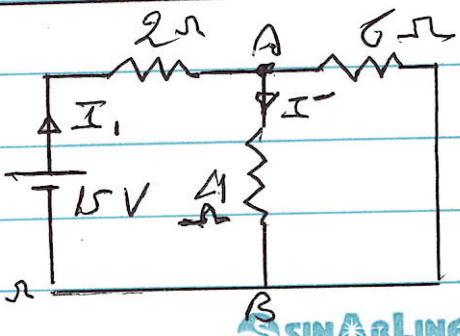
$$\therefore I_{3\Omega} = \pm I' \pm I''$$

EX(2.3)

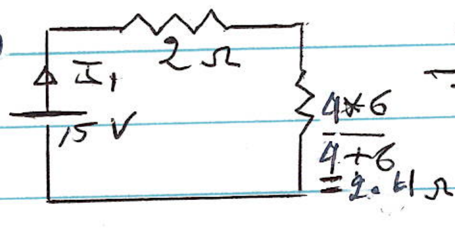
using superposition theorem, find current in 4 Ω resistance



1- Current from source 15 V, I'



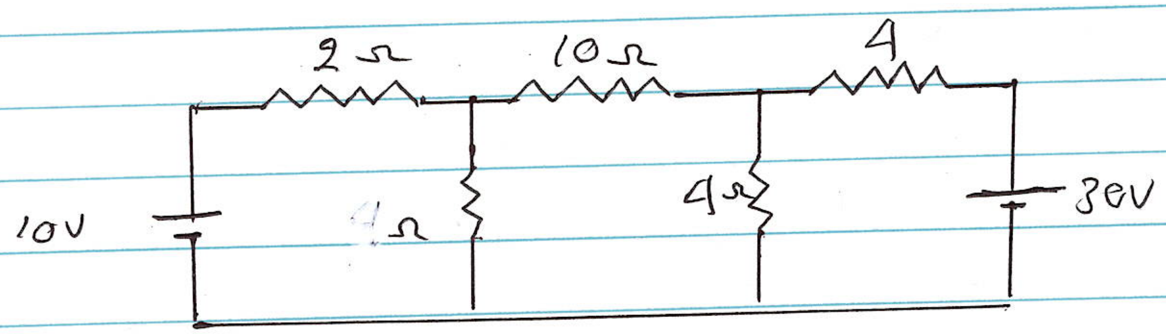
$$I = \frac{15}{2+2.4} = 3.409 \text{ amp.}$$



$$I' = I_1 \frac{6}{6+4}$$

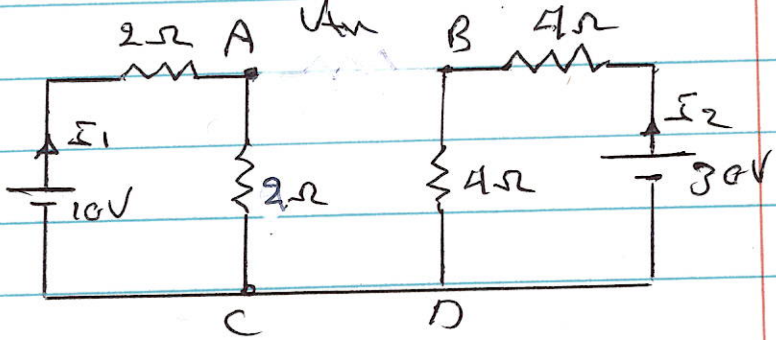
Ex (2.8)

Using Thevenin's theorem, find current in $10\,\Omega$ resistance.



1- V_{th}

$I_1 = \dfrac{10}{2+2} = 2.5$ amp



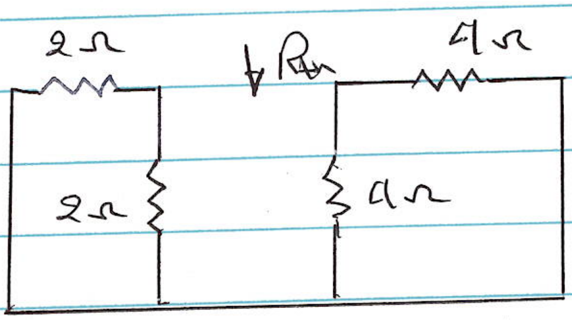
$V_{AC} = 2.5 * 2 = 5$ volt

$I_2 = \dfrac{30}{4+4} = 3.75$ amp

$V_{BD} = 4 * 3.75 = 15$ volt

$\therefore V_{AB} = V_{BD} - V_{AC} = 15 - 5 = 10$ volt

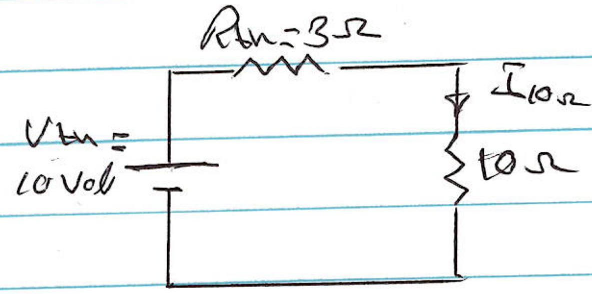
$V_{th} = V_{AB} = 10$ volt



$R_{th} = 2 /\!/ 2 + 4 /\!/ 4$

$= 1 + 2 = 3\,\Omega$

$I_{10\Omega} = \dfrac{10}{3+10} = 0.7692$ amp.



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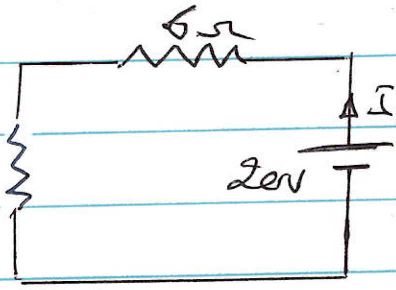
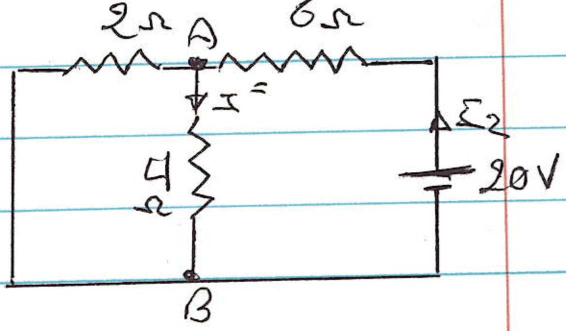
$$I' = 3.409 * \frac{6}{6+4} = 2.0454 \text{ amp. from A to B}$$

2 - Current from source 20V, I''

$$\frac{2*4}{2+4} = 1.3333\,\Omega$$





$$I_2 = \frac{20}{6+1.3333} = 2.7273 \text{ amp}$$

$$I'' = I_2 * \frac{2}{2+4} = 2.7273 * \frac{2}{2+4} = 0.9091$$

amp. from A to B

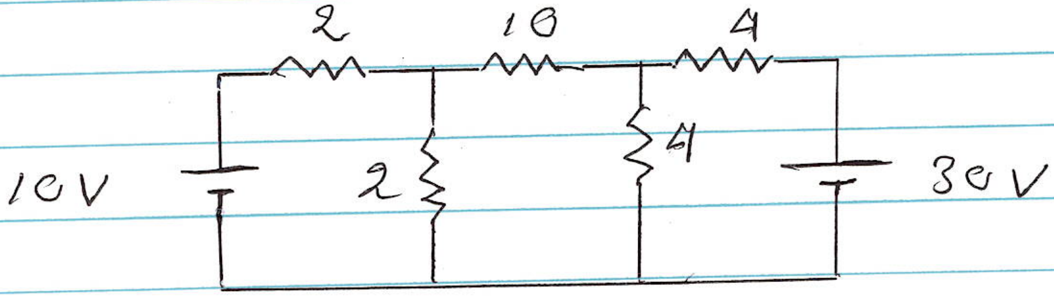
3 - $I_{4\Omega} = I' + I''$

$= 2.0454 + 0.9091 = 2.9545$ amp

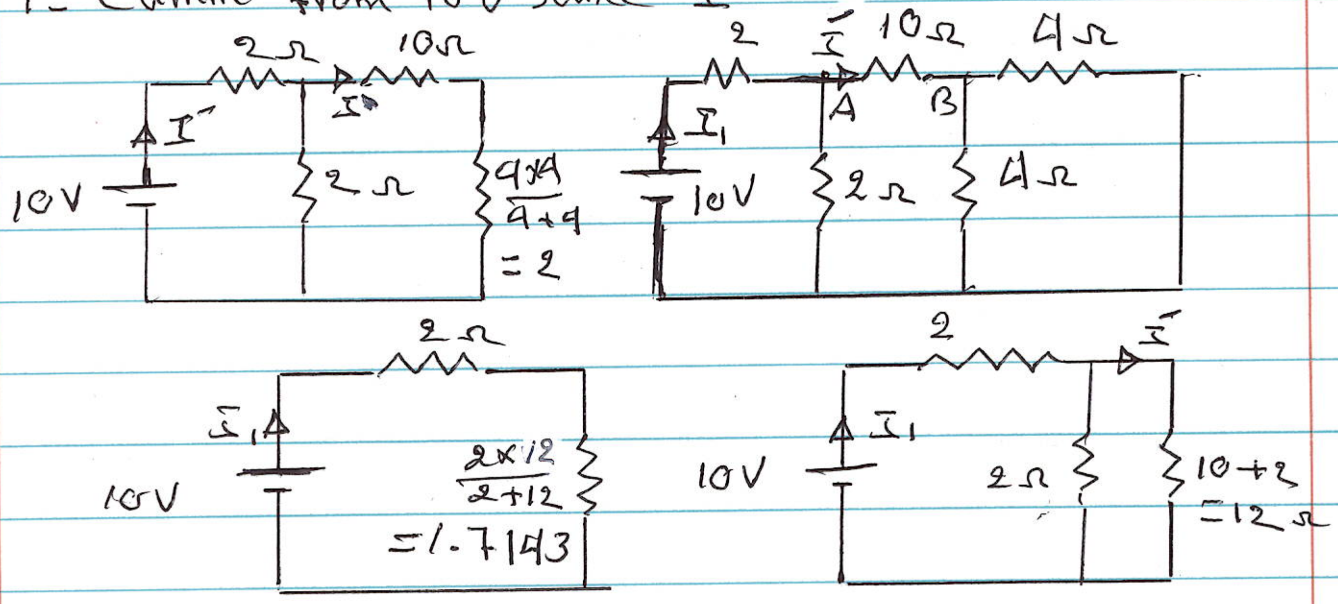
from A to B

Ex (2.9)

Using superposition theorem, find current in 10 Ω resistance.



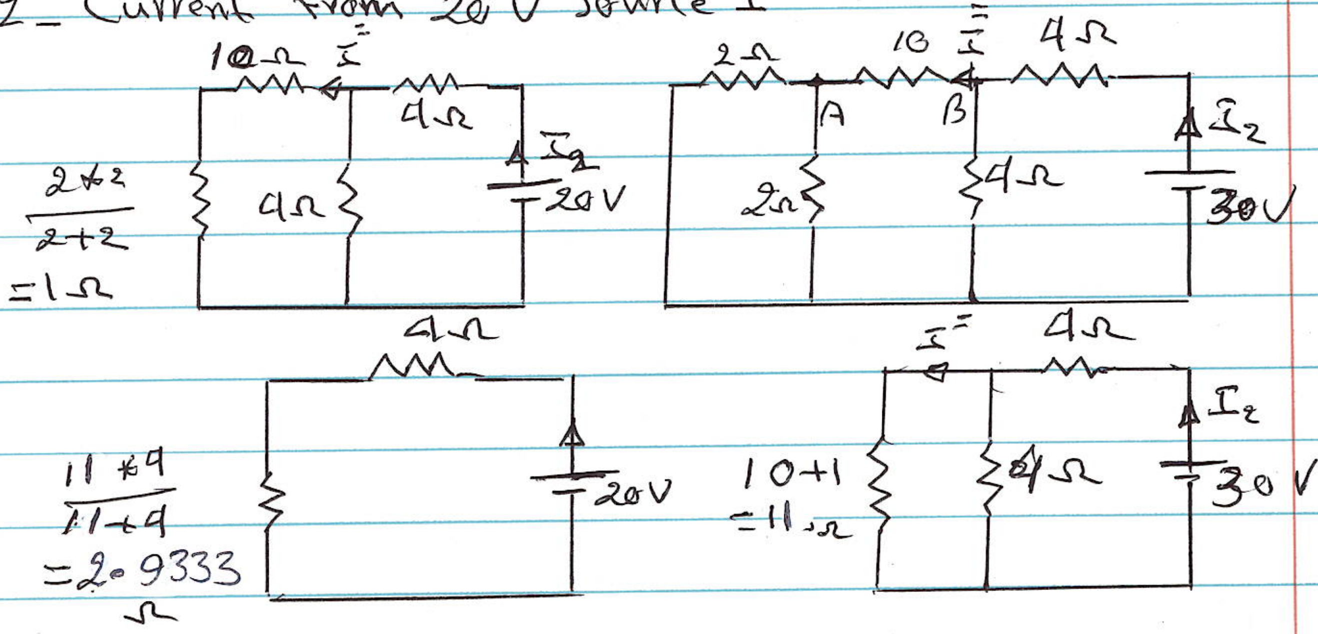
1_ Current from 10 V source I'



$$I_1 = \frac{10}{2+1.7143} = 2.6923$$

$$I' = I_1 * \frac{2}{2+12} = 0.3846 \text{ amp.}$$

2_ Current from 20 V source I''



$$I_2 = \frac{20}{4+2.9333} = 4.3269 \text{ amp.}$$

$$I'' = I_2 * \frac{4}{4+11} = 4.3269 * \frac{4}{15} = 1.1538 \text{ amp from B to A}$$

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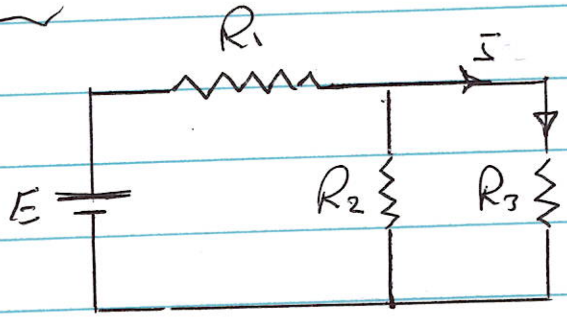
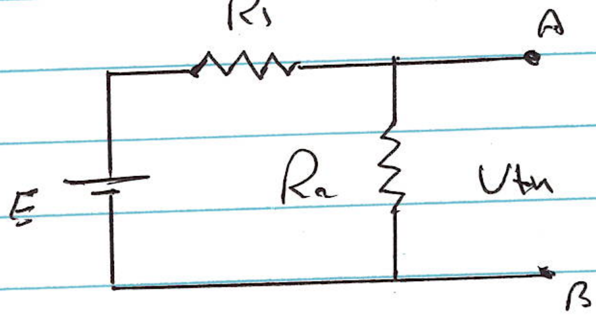
3- $I_{10\Omega} = I'' - I'$
$= 1.1538 - 0.3846 = 0.7692$ amp
from B to A

2.4- Thevenin's Theorem

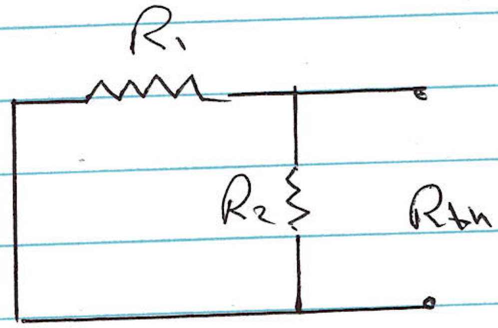
To find current in R_3 I



1- V_{th}

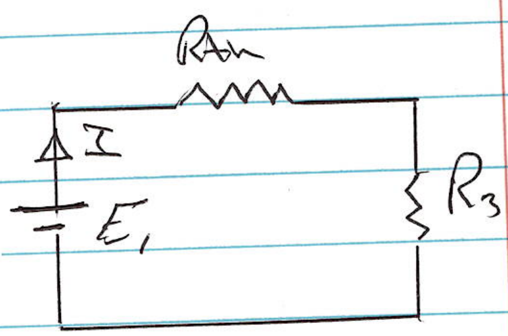


2- R_{th}



$$R_{th} = R_1 // R_2 = \frac{R_1 R_2}{R_1 + R_2}$$

3- Thevenin's Equivalent



$$I = \frac{V_{th}}{R_{th} + R_3}$$

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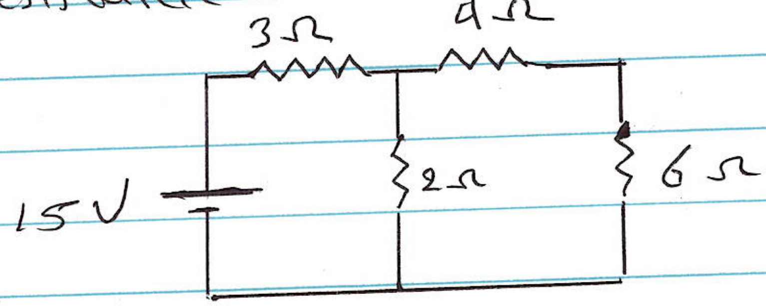
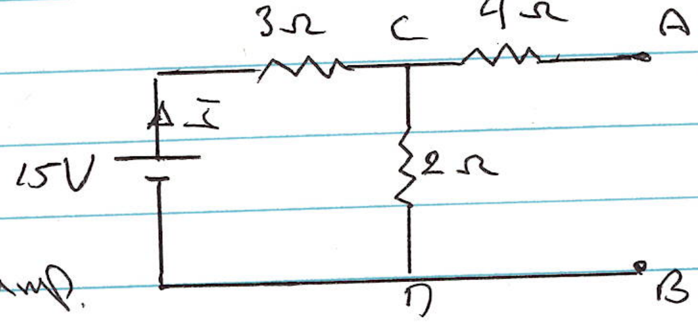
EX(2-5)

Using Thevenin's theorem, find current in 6 Ω resistance.



1- V_{th}



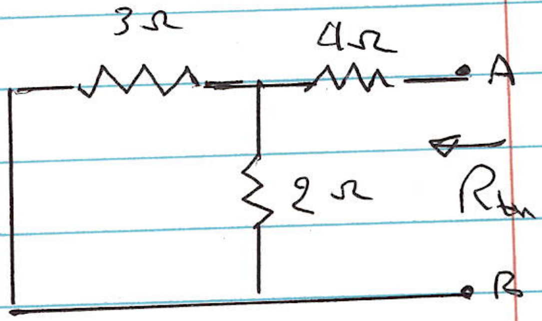
$V_{th} = V_{AB} = V_{CD}$

$$I = \frac{15}{3+2} = \frac{15}{5} = 3 \text{ amp.}$$

$\therefore V_{CD} = 2 * 3 = 6$ volt

$\therefore V_{th} = 6$ volt

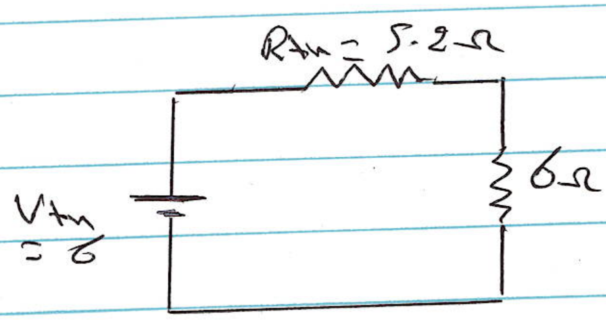
2- R_{th}



$R_{th} = 4 + 3 // 2$

$$= 4 + \frac{3 * 2}{3+2} = 5.2 \ \Omega$$

3- $$I_{6\Omega} = \frac{V_{th}}{R_{th} + 6}$$



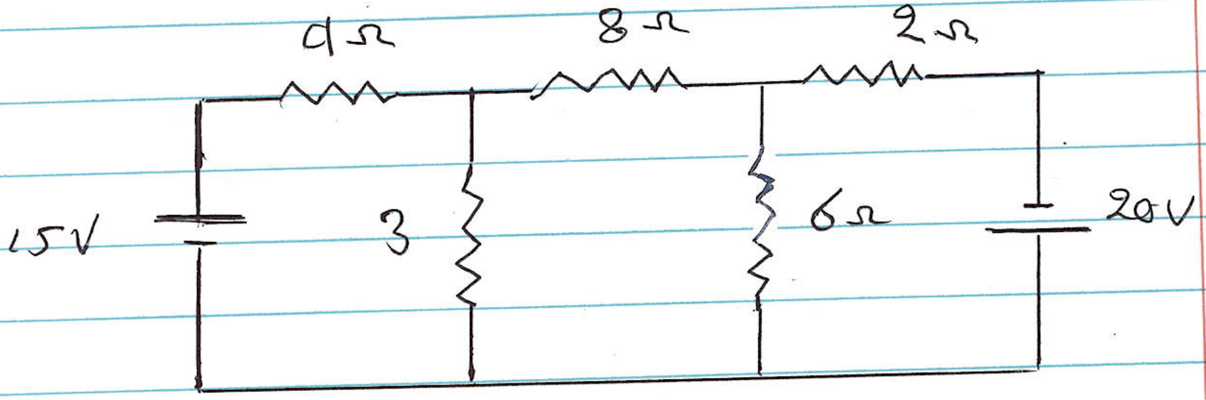
$$I_{6\Omega} = \frac{6}{6 + 5.2}$$

$= 0.5357$ amp.

Current in 6 Ω resistance

SINARLINE

Q-1 Using Thevenin's theorem find current in 8 Ω resistance.



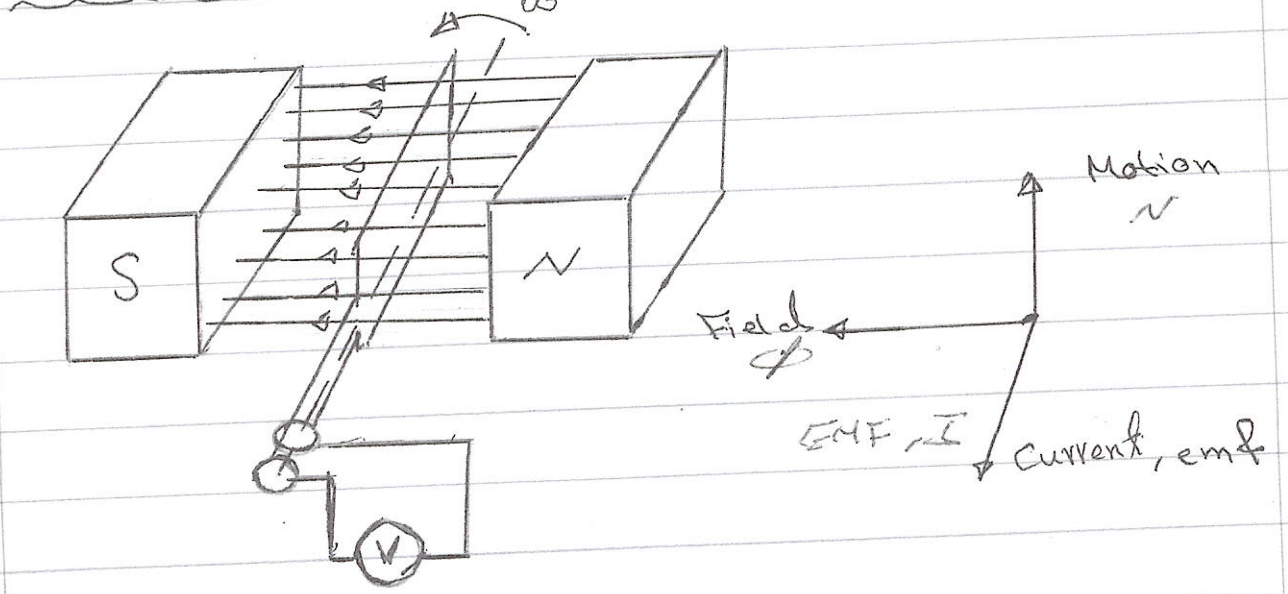
SINARLINE

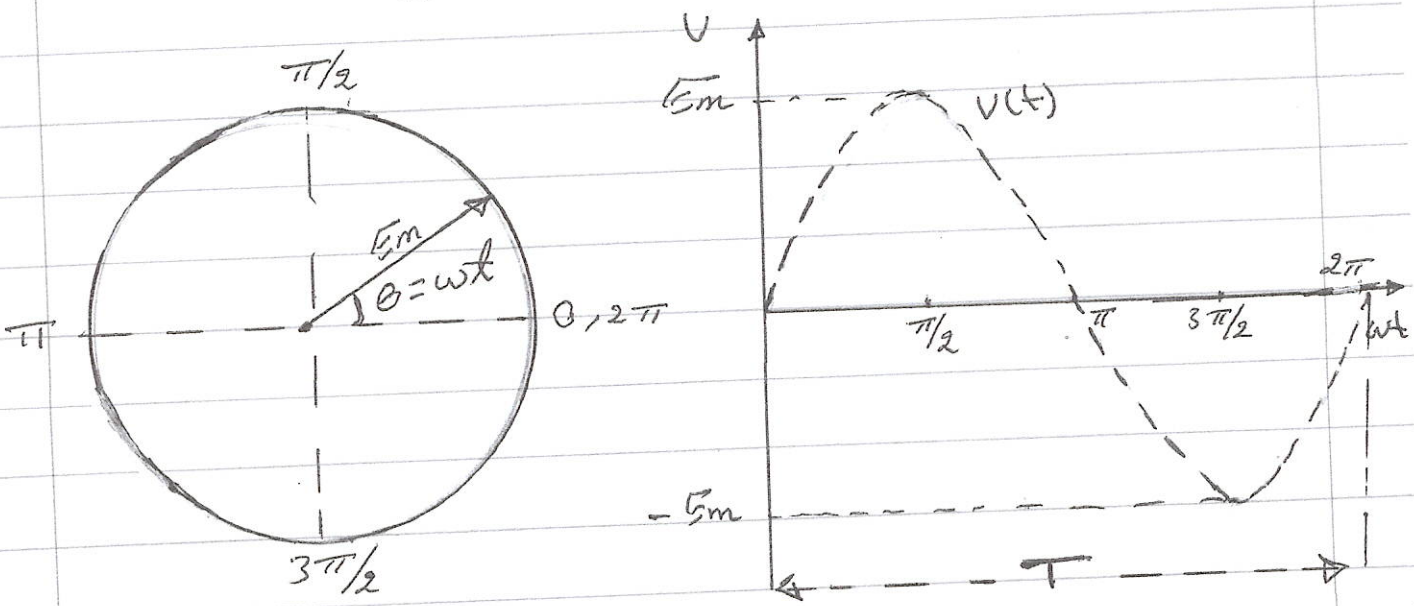
Chapter - 3 -

AC Fundamental

SINARLINE

3.1_ AC Generation and Waveforms:





$v(t) = E_m \sin \omega t$ ------ (1)

$i(t) = I_m \sin(\omega t \pm \phi)$ ------ (2)

$v(t)$ + $i(t)$: instantaneous values

ω : Angular speed rad/second

ϕ : phase difference

$\omega = 2\pi f$

f : Frequency Hz (cycle/sec.)

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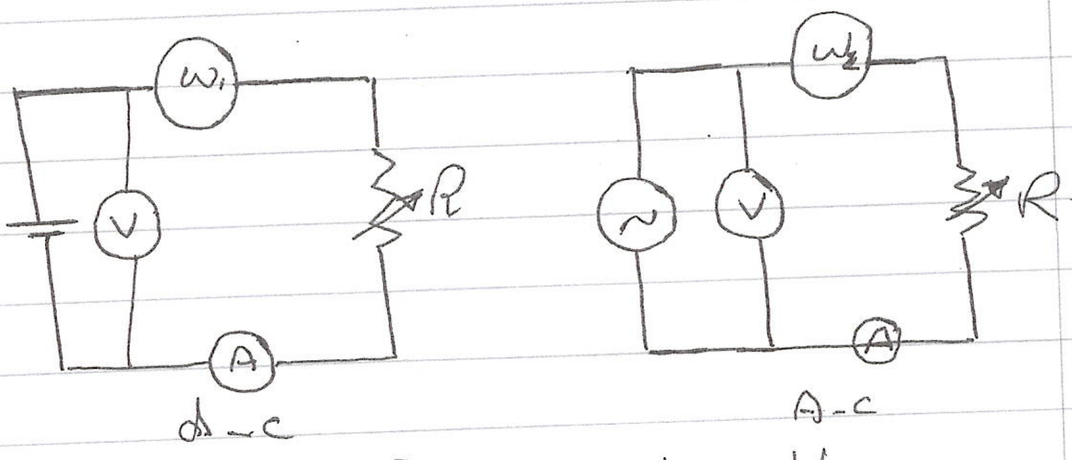
$$f = \frac{1}{T} \quad Hz \quad \text{-----} (3)$$

T : Time of one cycle (Sec.)

3.2 - Root Mean Square (R.M.S.) Values

The (r.m.s) value of an alternating current is given by that steady (dc) current which when flowing through a given circuit for given time produce the same heat as produced by the alternating current when flowing through the same circuit for the same time.



$W_1 = W_2$ $\quad I_{r.m.s} = I_{d-c}$ $\quad V_{r.m.s} = V_{d-c}$

$$I_{r.m.s} = \frac{I_m}{\sqrt{2}} = 0.707 I_m \quad \text{---} (4) \qquad V_{r.m.s} = \frac{V_m}{\sqrt{2}} = 0.707 V_m \quad \text{---} (5)$$

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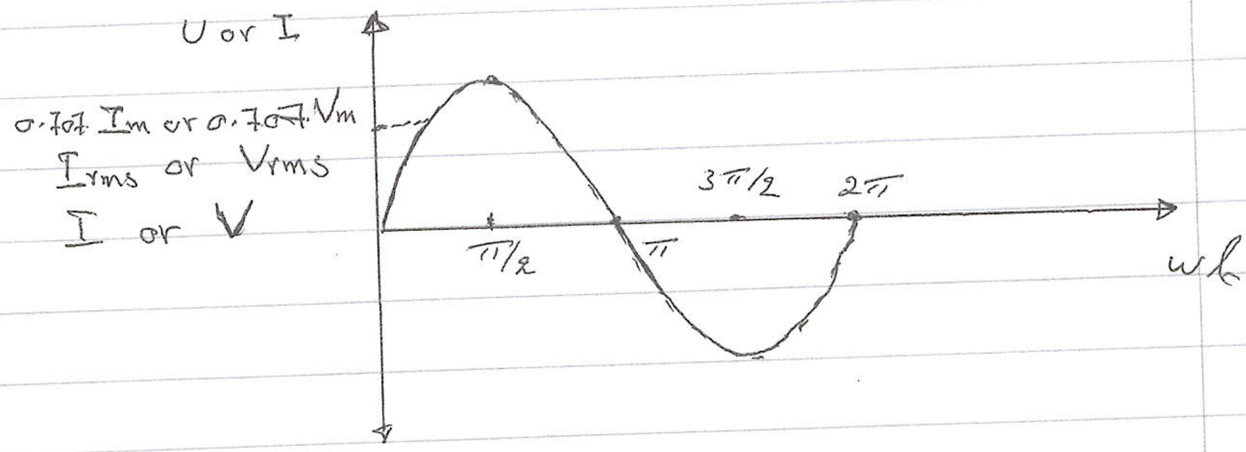
AC



Ex(3.1)

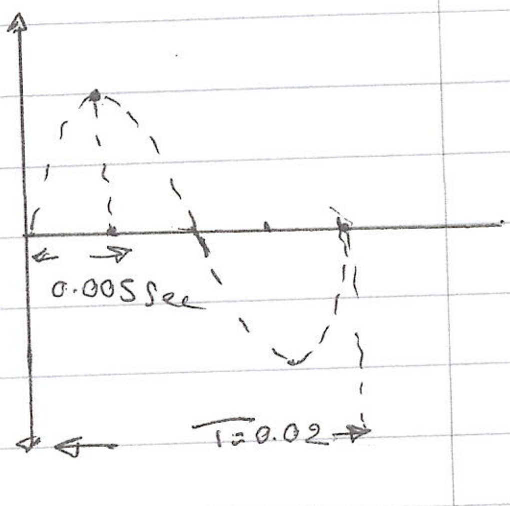
An alternating current varying sinusoidally with a frequency of 50 Hz has an RMS value of 20 amp. Write down the equation for the instantaneous value and find this value (a) 0.0025 second (b) 0.0125 second after first maximum value.

$I = \frac{I_m}{\sqrt{2}} = \quad \therefore I_m = \sqrt{2} * 20 = 28.28$ amp.

$\omega = 2\pi f = 2\pi * 50 = 100\pi$

$= 100 * 180^\circ = 18000^\circ$ degrees

$= 100 * 3.14 = 314$ radians



(a)

$i(t) = I_m \sin \omega t$

$= 28.28 \sin 18000 * 0.0075$

$= 28.28 \sin 135^\circ$

$= +20$ amp.

$T = \frac{1}{50} = 0.02$ sec

$t = 0.005 + 0.0025 = 0.0075$ sec.

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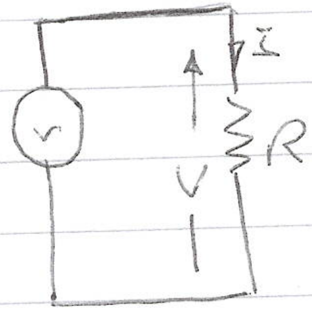
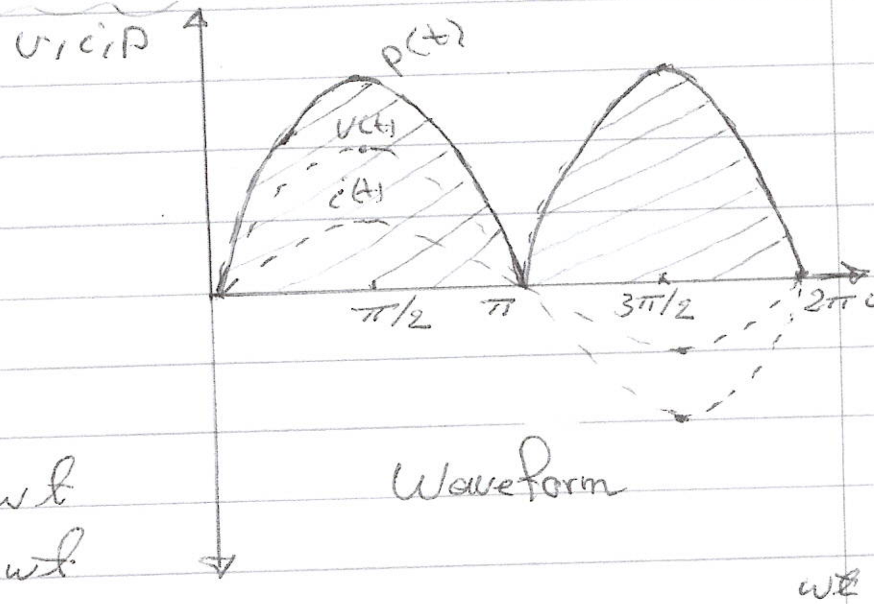
3.3 Pure Resistance



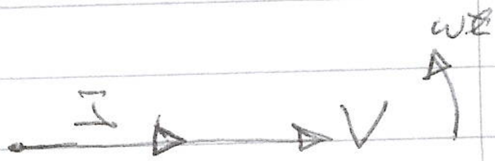


Waveform

$v(t) = V_m \sin \omega t$

$i(t) = I_m \sin \omega t$

$\phi = 0$ phase difference



Vector diagram

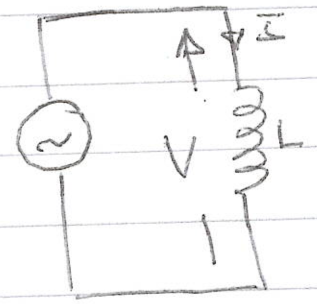
Phasor diagram

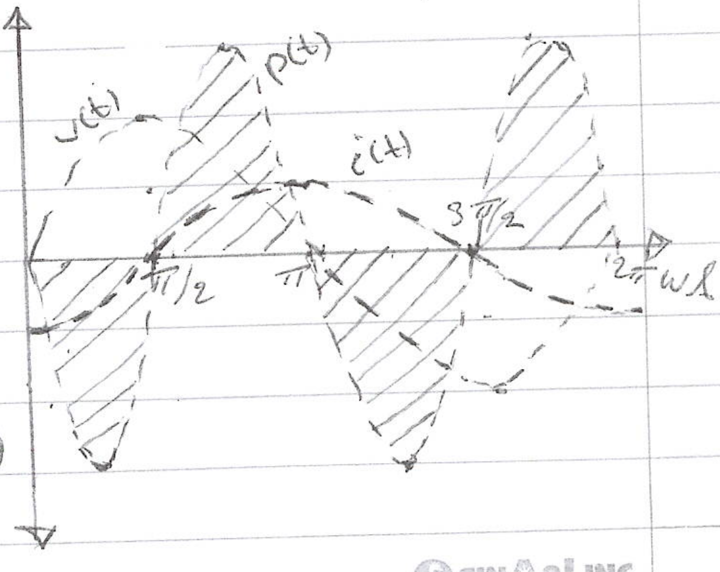
$p(t) = v(t) . i(t)$

$P = VI \cos 0 = VI$ ---- (6)

$= I^2 R = \frac{V^2}{R}$ ------ (7)

3.4 Pure Inductance





$V(t) = V_m \sin \omega t$

$i(t) = I_m \sin(\omega t - \phi)$

$\phi = 90^\circ$

SINARLINE

AC

$p(t) = v(t) \cdot i(t)$

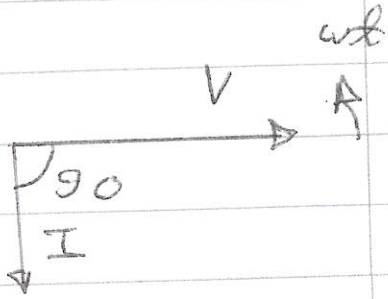
$= 0$ for one cycle

$P = VI \cos 90 = 0$

$X_L = 2\pi f L$ ------(8)

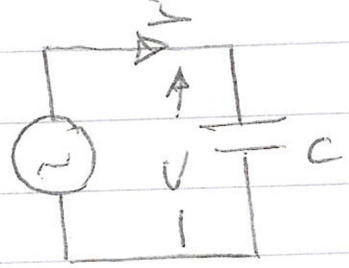
L : inductance Henery (H)

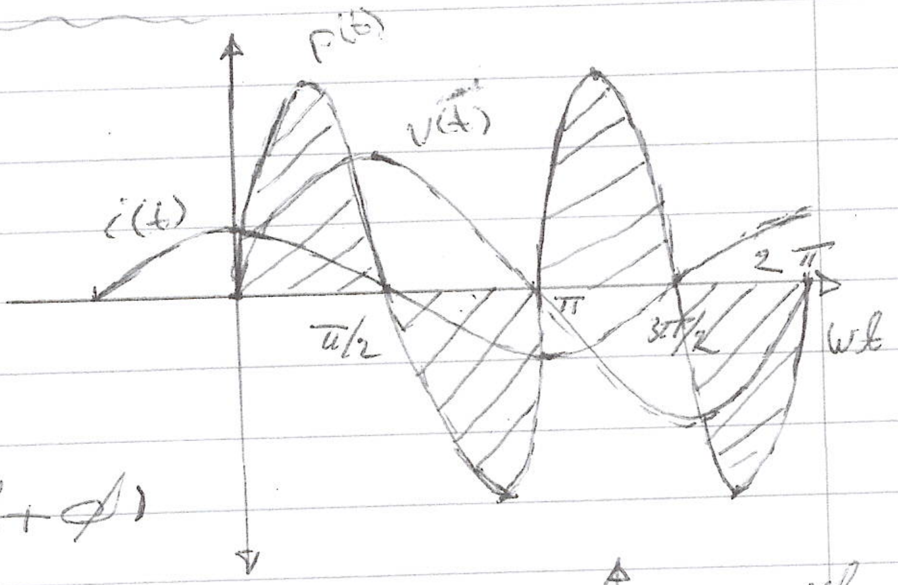
X_L : inductive reactance Ω



$$X_L = \frac{V}{I} \ \Omega \quad \text{------(9)}$$

3.5 _ Pure Capacitance





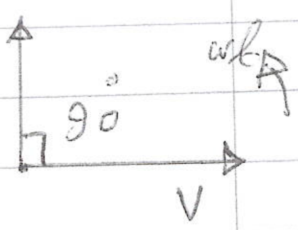
$v(t) = V_m \sin wt$

$i(t) = I_m \sin(wt + \phi)$

$\phi = 90°$

$p(t) = v(t) \cdot i(t) = 0$ for one cycle

$$X_C = \frac{1}{2\pi f C} \ \Omega \quad \text{------(10)}$$



C : Capacitance

X_C : Capacitive reactance Ω

$P = VI \cos 90 = 0$

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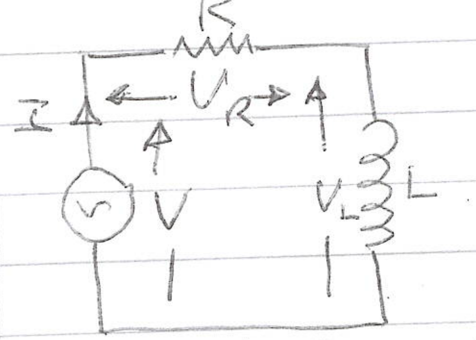
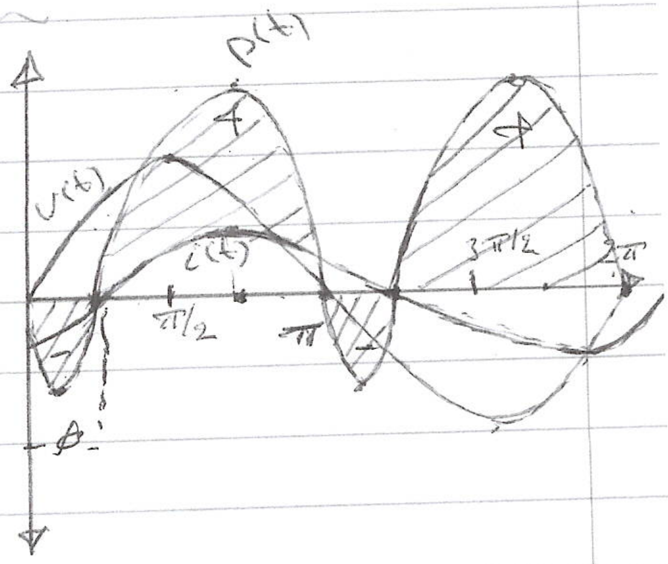
$$X_C = \frac{V}{I} \quad \Omega \text{ ---- } (11)$$

3.6 - Series RL Circuit





$v(t) = V_m \sin \omega t$

$i(t) = I_m \sin(\omega t - \phi)$

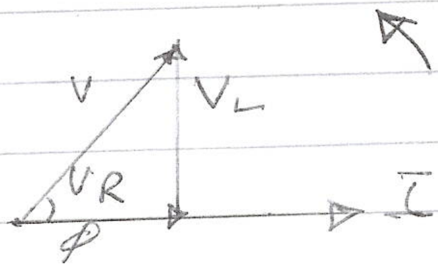
$90 > \phi > 0^\circ$

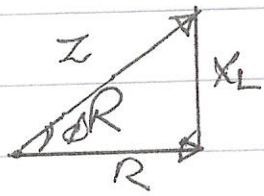
$P^+ > P^-$

$P(t) = v(t) \cdot i(t)$

$P = IV \cos\phi$

ϕ is lagging





$$\phi = \tan^{-1} \frac{X_L}{R} \text{ ---- } (12)$$

$$Z = \frac{V}{I} \quad \Omega \text{ ---- } (13)$$

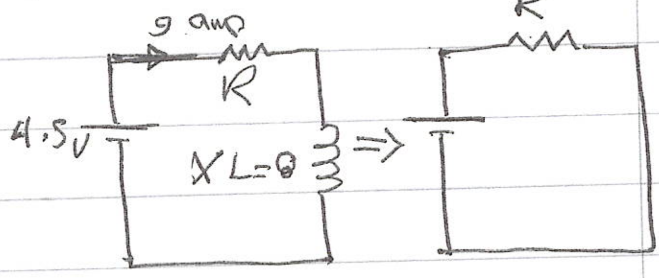
$$Z = \sqrt{R^2 + X_L^2} = |Z| \angle \phi \quad \Omega \text{ ---- } (14)$$

$\cos\phi$: Power factor ---- (15)

$$V = \sqrt{V_R^2 + V_L^2} \text{ ---- } (16)$$

SINARLINE

Ex(3.9): The potential difference measured across a coil is 4.V, when it carries a direct current of 9 amp. The same coil when carries an alternating current of 9 amp. at 25 Hz, the potential difference is 24 V. Find the current, the power factor when its supplied by 50 V, 50 Hz supply. Skin effect is 1.1 at 25 Hz and 1.2 at 50 Hz.



$$R_{d.c} = \frac{V_{dc}}{I_{dc}} = \frac{4.5}{9} = 0.5\ \Omega$$

at 25 Hz $R = 1.1 * R_{dc}$
$= 1.1 * 0.5 = 0.55\ \Omega$

at 50 Hz $R = 1.2 * R_{dc} = 1.2 * 0.5 = 0.6\ \Omega$

at 25 Hz $V = 24$ V, $I = 9$ amp.

$$\therefore Z = \frac{V}{I} = \frac{24}{9} = 2.666\ \Omega$$

$$X_L = \sqrt{Z^2 - R^2} = \sqrt{(2.666)^2 - (0.55)^2} = 2.608$$

$X_L = 2\pi f L \qquad 2.608 = 2 * 3.14 * 25\, L$

$L = 0.0166$ H

at 50 Hz $\quad V = 50$ Volt

$X_L = 2\pi f L = 2 * 3.14 * 50 * 0.0166 = 5.2124\ \Omega$

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{(0.6)^2 + 5.2124^2} = 5.247\ \Omega$$

$$I = \frac{V}{Z} = 50/5.247 = 9.529 \text{ amp}$$

$P.f = \cos\phi$

$\phi = \tan^{-1}\frac{X_L}{R} = \tan^{-1}\left(\frac{5.2129}{0.6}\right) =$

$\phi = 83.43^{\circ}$

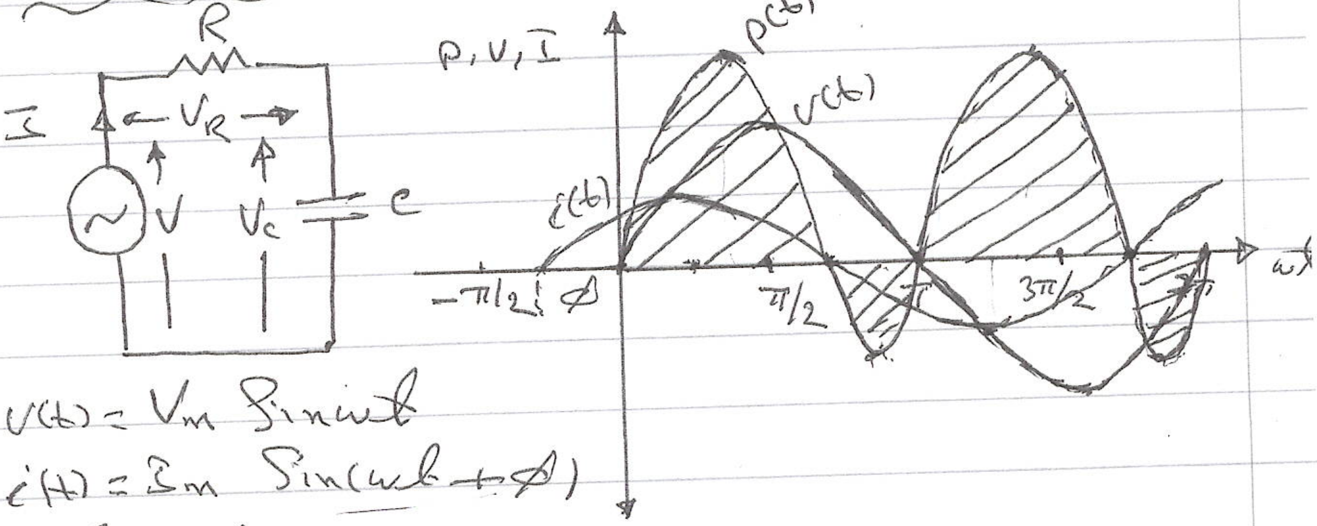
$P = IV\cos\phi$

$= 9.529 * 50 * \cos(83.43) = 54.514$ watt

or $P = I^2R = (9.529)^2 * 0.6 = 54.481$ watt

$p.f = \cos\phi = \cos(83.43) = 0.1144$

3.7 - Series R-C circuit



$v(t) = V_m \sin\omega t$

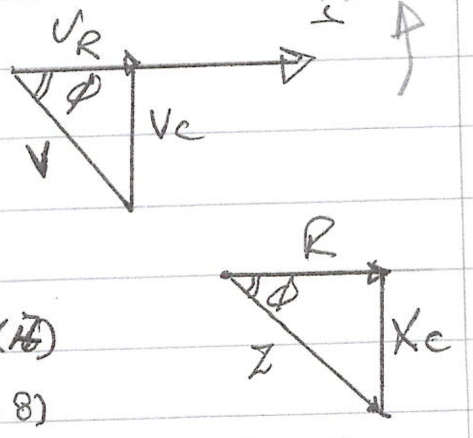
$i(t) = I_m \sin(\omega t + \phi)$

$90^{\circ} > \phi > 0$

$P^+ > P^-$

$p(t) = v(t) \cdot i(t)$

ϕ is leading



$\phi = \tan^{-1}\left(-\frac{X_c}{R}\right)$ ——— (17)

$V = \sqrt{V_R^2 + V_c^2}$ ——— (18)

SINARLINE

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

$$Z = \sqrt{R^2 + X_C^2} = |Z| \angle -\phi \quad \Omega \quad \text{---} (17)$$

$$X_C = \frac{1}{2\pi f C} \quad \Omega \quad \text{----} (18)$$

C : Capacitance Farad (F)

Ex(3.3) :

A pure resistance of 50 ohms with a pure capacitance of 100 microfarad (μF). The series combination is connected across 100 V, 50 Hz. Find (a) the impedance (b) current (c) power factor (d) phase angle (e) voltage across resistance (f) voltage across capacitor. Draw the vector diagram.

Solution:

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2*3.14*50*100*10^{-6}} = 31.19\ \Omega$$

$$R = 50\ \Omega$$

(a) $$Z = \sqrt{R^2 + X_C^2} = \sqrt{50^2 + 31.19^2} = 58.93\ \Omega$$

(b) $$|I| = \frac{|V|}{|Z|} = \frac{100}{58.9} = 1.7 \text{ amp.}$$

(c) : $$\phi = \tan^{-1}\frac{X_C}{R} = \tan^{-1}\left(\frac{31.19}{50}\right) = -31.956$$

$$P.F = \cos\phi = \cos(31.956) = 0.848 \text{ leading}$$

(d) $\phi = 31.956^\circ$ leading phase shift (angle)

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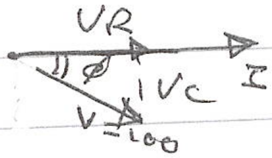
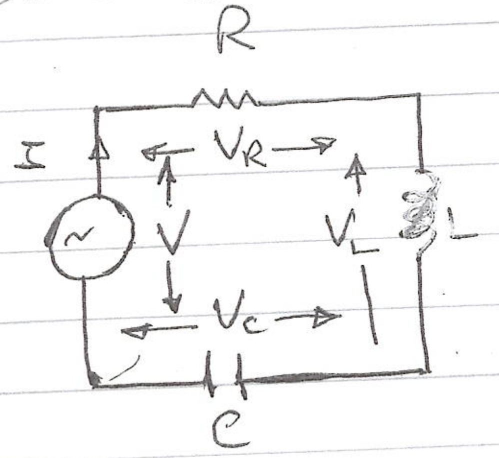
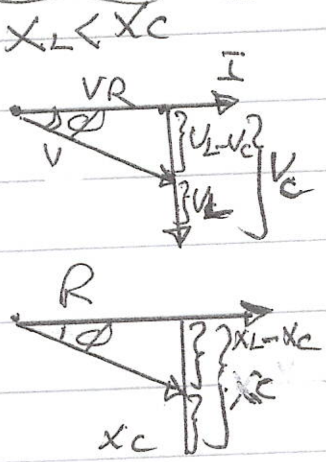
(e) $|V_R| = IR = 85$ volt
(f) $|V_c| = I X_c = 1.7 * 31.19 = 53.023$

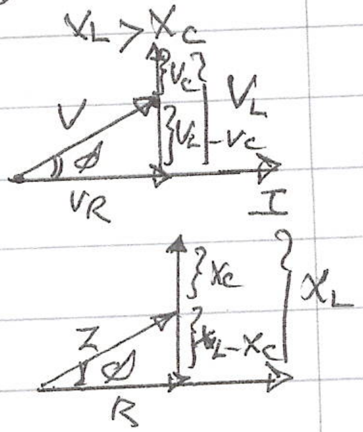
(phasor diagram) Vector diagram



3.8 Series R-L-C circuit







$$V = \sqrt{V_R^2 + (V_L - V_c)^2} \quad \text{volt} \quad (19)$$

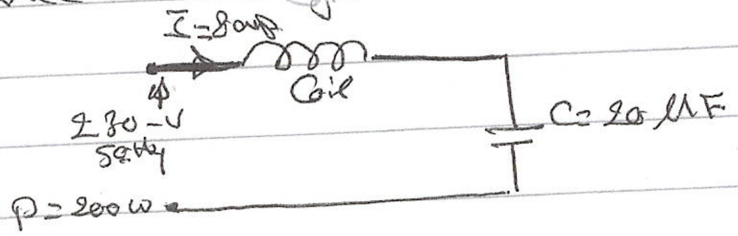
$$Z = \sqrt{R^2 + (X_L - X_c)^2} = \sqrt{R^2 + X^2} \quad --- (20)$$

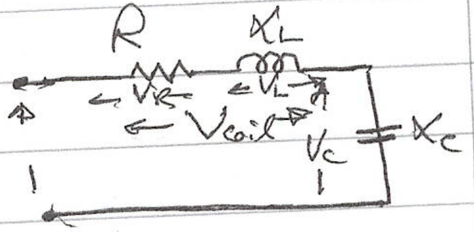
$$\phi = \tan^{-1}\left(\frac{X_L - X_c}{R}\right) = \tan^{-1}\left(\frac{X}{R}\right) \quad --- (21)$$

$$X = X_L - X_C$$

Ex(3.4):

A coil is in series with 20 µF capacitor a cross a 230-V, 50-Hz supply. The current taken by the circuit is 8 amp. and the power consumed is 200 W. calculate the voltage across the coil and draw the vector diagram





$$P = I^2 R \qquad 200 = 8^2 \cdot R \qquad R = \frac{200}{64} = 3.125\ \Omega$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2 * 3.14 * 50 * 20 \times 10^{-6}} = 159.23\ \Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \quad \text{or} \quad Z^2 = R^2 + (X_L - X_C)^2$$

$$Z = \frac{V}{I} = \frac{230}{8} = 28.75\ \Omega$$

$$(28.75)^2 = (3.125)^2 + (X_L - 59.23)^2$$

$$(X_L - 159.23)^2 = 816.79$$

$$X_L - 159.23 = 28.58 \qquad \therefore X_L = 187.81\ \Omega$$

$$Z_{coil} = \sqrt{R^2 + X_L^2} = \sqrt{3.125^2 + 187.81^2} = 187.83\ \Omega$$

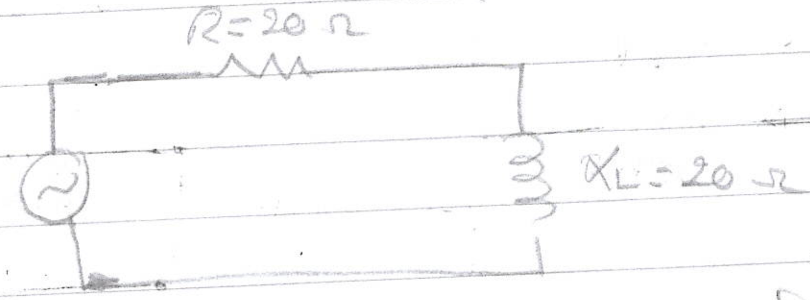
$$V_{coil} = I Z_{coil} = 8 \times 187.83 = 1502.64 \text{ volt}$$

$$V_L = I X_L = 8 \times 187.81 = 1502.48 \text{ volt}$$

$$V_C = I X_C = 1273.84 = 8 * 159.23$$

$$V_R = IR = 8 * 3.125 = 25 \text{ volt}$$

Q1- For the circuit shown in Fig. if the supply is 220 V, 50 Hz, find (a) the voltage across each element, (b) power consumed and (c) draw phasor diagram

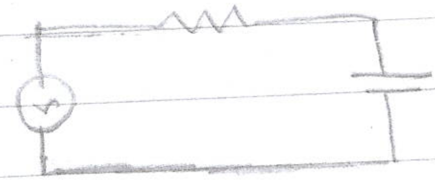


Q2- For the circuit shown in Fig, find (a) voltage across each element (b) power consumed (c) draw phasor diagram and waveform.

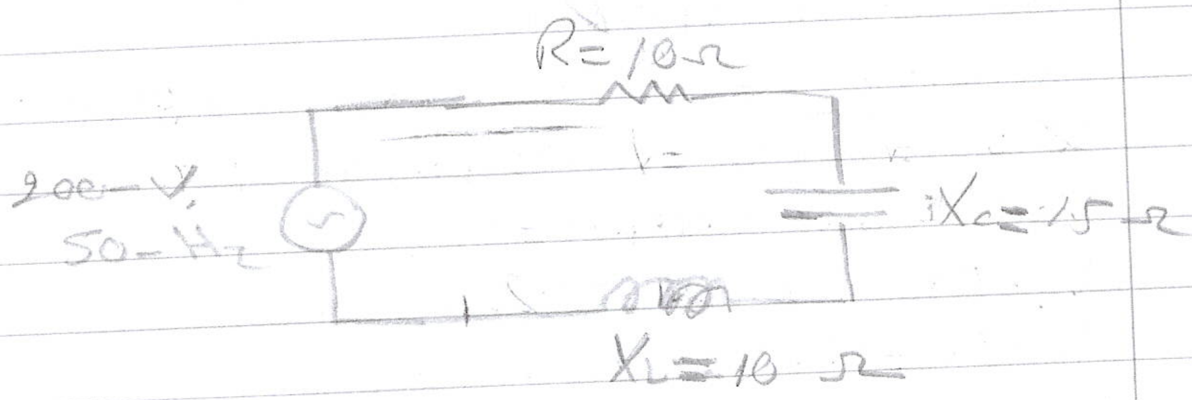
Supply 200 V, 50 Hz

$R = 50\ \Omega$

$X_c = 80\ \Omega$



Q-3) For the circuit shown in Fig, find (a) voltage across each element (b) power consumed (c) draw phasor diagram.



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