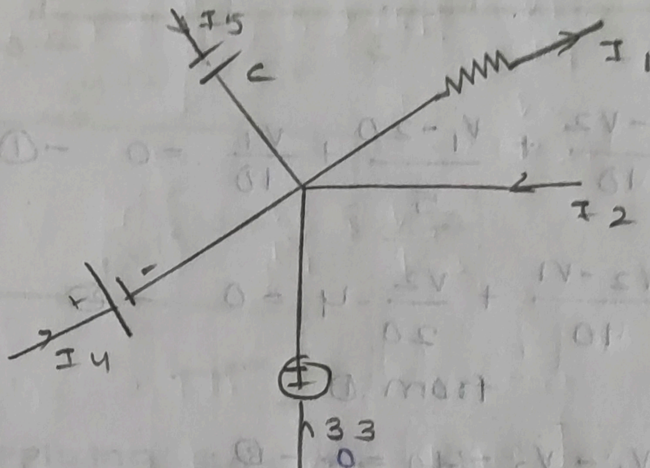
KCL :- This law is also called kirchoff's junction rule. It state's that the algebraic sum of the current meeting at a junction node is equal to zero

(or)

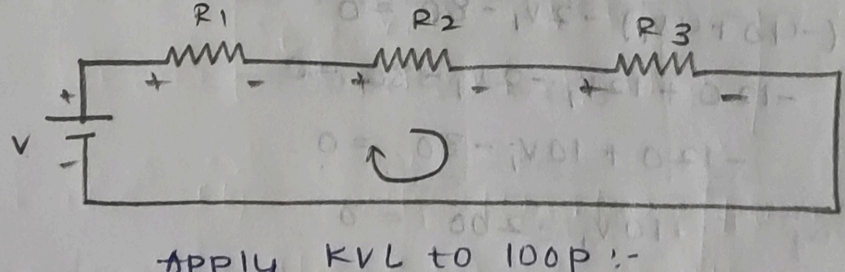
The sum of the current entering at node is equal to the sum of the current living that node



$$-I_1 + I_2 + I_3 + I_4 - I_5 = 0$$

$$\boxed{I_1 + I_5 = I_2 + I_3 + I_4}$$

KVL :- This law is also called as Kirchoff's of loop rule It is state's that the algebraic sum of potential difference around a closed circuit must be zero



Apply KVL to loop :-

$$-V_1 - V_2 - V_3 + V = 0$$

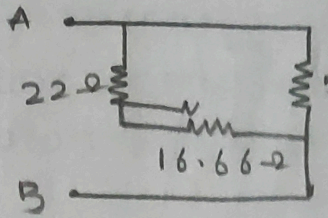
$$\boxed{V = V_1 + V_2 + V_3}$$

$$V = IR_1 + IR_2 + IR_3$$

$$V = I(R_1 + R_2 + R_3)$$

$$\boxed{I = \frac{V}{R_1 + R_2 + R_3}}$$

b) calculate the effective resistance b/w the terminals A and B ?

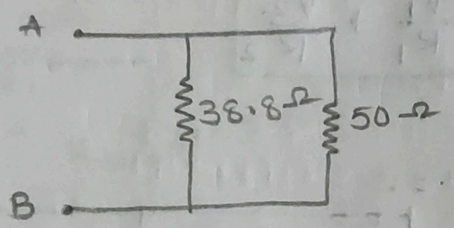


Let

$R_a = R_1 + R_2$

$= 22 + 16.6$

$= 38.6\ \Omega$



Let

$R_{AB} = \dfrac{R_1 \times R_2}{R_1 + R_2}$

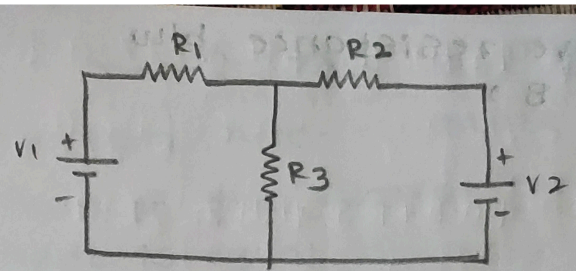
$= \dfrac{38.6 \times 50}{38.6 + 50} = \dfrac{1930}{88.6} = 21.8\ \Omega$

2) State and explain Norton's theorem,

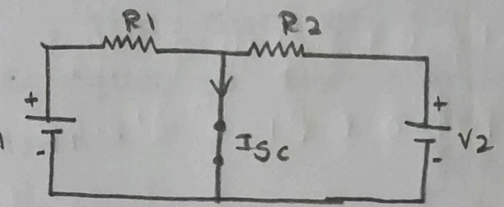
Any two terminal linear bilateral network can be replaced by an equivalent circuit consist of an equivalent source in in parallel with resistance R_n.

where

I_{sc} is a short circuited current measured through the load terminal R_n is the Norton's equivalent resistance measured across the load terminal when all the sources are replaced by their internal resistance.



To find I_N:-



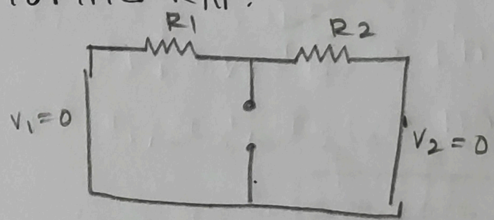
$$I_{SC} = I_1 + I_2$$

$$I_1 = \frac{V_1}{R_1}$$

$$I_2 = \frac{V_2}{R_2}$$

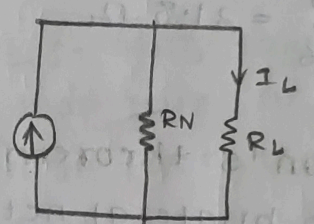
$$\boxed{I_{SC} = \frac{V_1}{R_1} + \frac{V_2}{R_2}}$$

Tofind R_N:-



$$\boxed{R_N = \frac{R_1 R_2}{R + R_2}}$$

Norton's equivalent:-

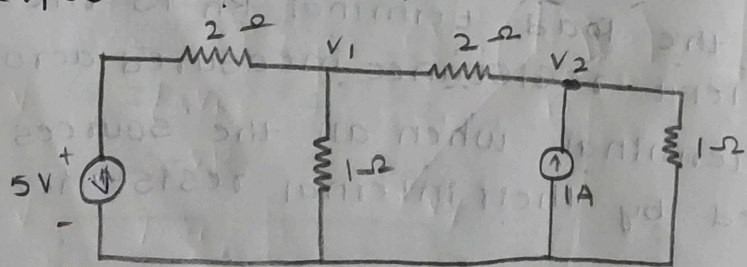


$$I_L = \frac{\left(\frac{V_1 R_2 + V_2 R_1}{R_1 R_2}\right) \times \left(\frac{R_1 R_2}{R_1 + R_2}\right)}{\frac{R_1 R_2}{R_1 + R_2} + R_3}$$

$$\boxed{I_L = \frac{V_1 R_2 + V_2 R_1}{R_1 R_2 + R_2 R_3 + R_3 R_1}}$$

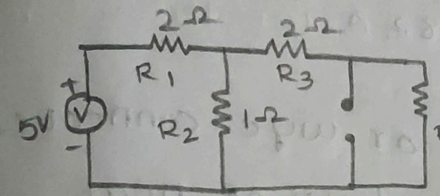
State the superposition principle?

Determine the current in all resistors using superposition theorem?



It states that in any linear network containing two or more sources, the respones in any element is equal to the algebraic sum of respones caused by indivudial sources acting alone, while the other source are kept zero.

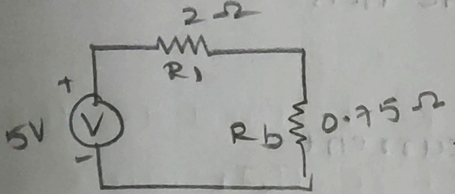
case i :- Remove 1A



$R_a = R_3 + R_4$

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

$R_b = R_a \| R_2 = \frac{3 \times 1}{3+1} = \frac{3}{4} = 0.75\,\Omega$



$R_{eq} = R_1 + R_b = 2 + 0.75 = 2.75\,\Omega$

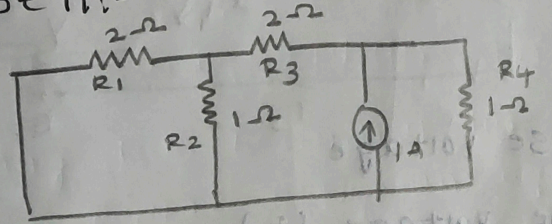
$I_1 = \frac{V}{R} = \frac{5}{2.75} = 1.818\,A$

$I_T = 1.82\,A$

$I_{1\Omega}' = 1.82 \times \frac{3}{3+1} = 1.365\,A$

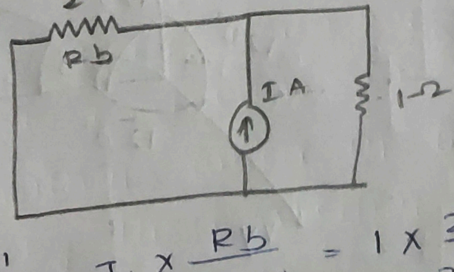
$I_2' - I_1' = 1.82 - 1.365 = 0.455\,A$

case ii :-



$R_a = R_1 \| R_2 = \frac{2 \times 1}{2+1} = \frac{2}{3} = 0.66$

$R_b = R_a + R_3 = 0.66 + 2 = 2.66\,\Omega$



$I_1'' = I_1 \times \frac{R_b}{R_b + 1} = 1 \times \frac{2.66}{2.66 + 1} = 0.726\,A$

$I_2'' = 1 - 0.726 = 0.271\,A$

$I_2'' = 0.272 - 0.181 = 0.09\,A$

case 3:-

$I_2\,\Omega = 1.82 + 0.09 = 1.910$

$I_1\,\Omega = 1.365 + 0.1818 = 1.546\,A$

$I_2\,\Omega = 0.455 + 0.272 = 0.727\,A$

$I_1\,\Omega + I_2\,\Omega = 0.45 + 0.727 = 1.182\,A$

3) Show that in a star or wye connected network $V_L = \sqrt{3}\,V_{ph}$ with the help of neat vector diagram.

$I_R, I_Y, I_B \rightarrow$ phase current

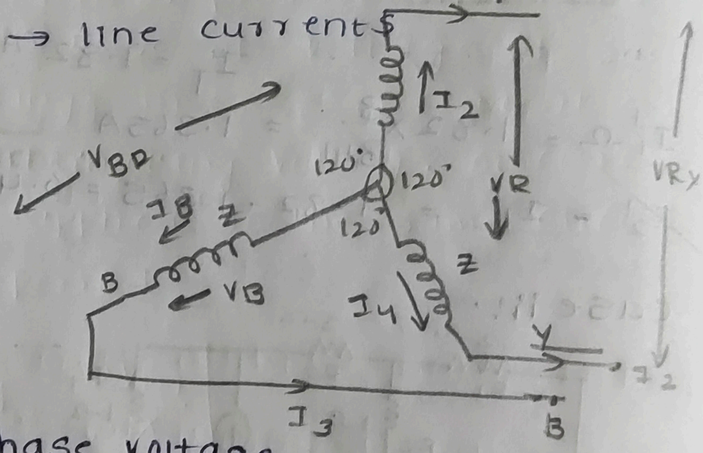
$I_1, I_2, I_3 \rightarrow$ line currents

$I_R = I_1$

$I_Y = I_2$

$I_B = I_3$

$\boxed{I_{ph} = I_L}$



$V_R, V_Y, V_B \rightarrow$ phase voltage

$V_{RY}, V_{RB}, V_{BR} \rightarrow$ line voltage (V_L)

$V_{RY} = V_R - V_Y$

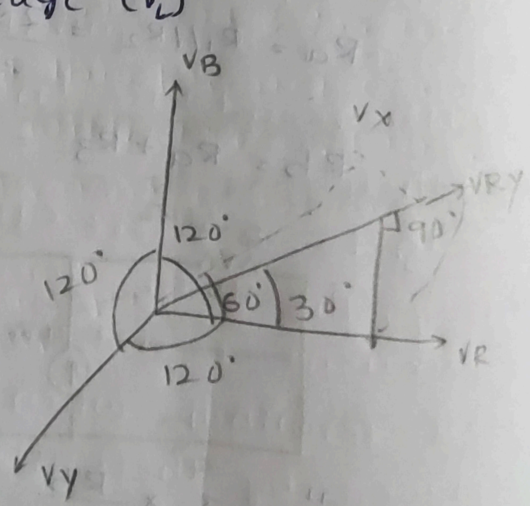
$\frac{1}{2}(V_L)$

$\cos 30^\circ = \frac{OC}{OA}$

$\frac{\sqrt{3}}{2} = \frac{\frac{1}{2} V_{RY}}{V_R}$

$\frac{\sqrt{3}}{2} = \frac{\frac{1}{2} V_L}{V_{ph}}$

$\sqrt{3} = \frac{V_L}{V_{ph}}$ $\boxed{V_L = \sqrt{3}\,V_{ph}}$



4) Define power factor? What is its significance?

It is the ratio of watts that are to the volt amperes that are fed into the circuit.

$$\text{Power factor} = \frac{\text{Active power}}{\text{Apparent power}} = \frac{P}{S}$$

$$P.f = \frac{P}{S} = \frac{V.\cancel{I}\cos\phi}{V.\cancel{I}}$$

$$P.f = \cos\phi$$

B) Distinguish b/w ideal and practial transfor-mer? A single phase 250KVA 50Hz transformer having the voltage ratio of 1100V/415V. Then calculate primary and secondary current

Transformer KVA = 250KVA

frequency = 50Hz

$$\frac{V_1}{V_2} = \frac{1100}{415}$$

Primary current $I_1 = \frac{KVA}{V_1}$

$$= \frac{250}{1100} = 0.22$$

Secondard current $I_2 = \frac{KVA}{V_2}$

$$\frac{250}{415}$$

$$= 0.602,$$

5) Define the following
i) RMS value ii) Average value

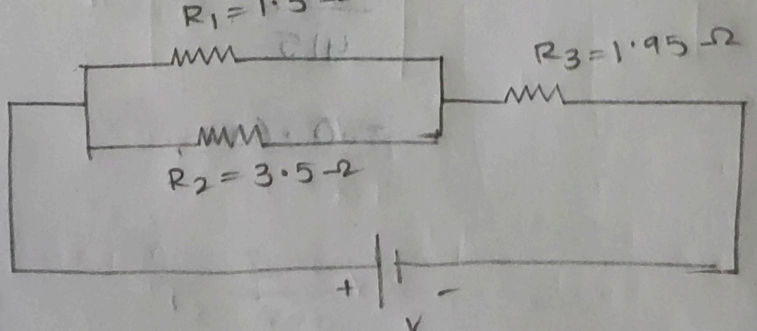
RMS value:- RMS value of an AC voltage is define as that constant voltage, which produces the same amount of heat energy as produced by AC voltage, when both are applied to the same circuit for the same period

$$\boxed{V_{rms} = \frac{V_m}{\sqrt{2}}}$$

Average value:- Avg value is defined as that constant value, which produce the same amount flux in case of voltage of same amount of change in case of current as produced by alternating voltage or current when both are applied to the same circuit for the same period

$$\boxed{V_{avg} = \frac{2V_m}{\pi}}$$

5b) Two resistances of 1.5Ω and 3.5Ω are connected in parallel and this parallel combination is connected in series with a resistance of 1.95Ω calculate the equivalent resistance value.



$$R_a = R_1 // R_2 = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{1.5 \times 3.5}{1.5 + 3.5} = \frac{5.25}{5} = 1.05\,\Omega$$

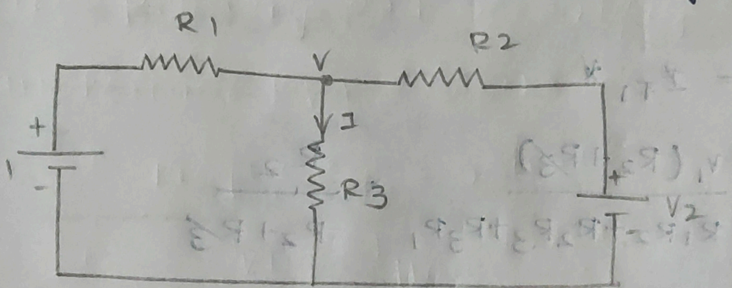
$$R_{eq} = R_a + R_3 = 1.05 + 1.95 = 3\,\Omega.$$

6) State and explain superposition theorem?

It states that in any linear network containing two or more sources, the response any element is equal to the algebraic sum of responses caused by individual source acting also while the other sources are kept at zero

verification :-

let us find the current flowing through resistance R_3. let the node voltage be.



Applying KCL to fig

$$\frac{V - V_1}{R_1} + \frac{V}{R_3} + \frac{V - V_2}{R_2} = 0$$

$$V = IR_3$$

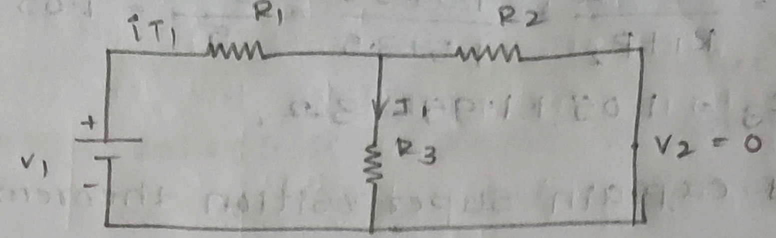
$$\therefore \frac{IR_3 - V_1}{R_1} + I\cancel{\frac{R_3}{R_3}} + \frac{IR_3 - V_2}{R_2} = 0$$

$$I\left[\frac{R_3}{R_1} + \frac{R_3}{R_2} + 1\right] = \frac{V_1}{R_1} + \frac{V_2}{R_2}$$

let ~~us consider V_1 acting~~ alone

$$i\left[\frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1 R_2}\right] = \frac{V_1 R_2 + V_2 R_1}{R_1 R_2}$$

$$\frac{V_1 R_2 + V_2 R_1}{\ldots + R_2 R_1}$$



$$i_T = \frac{V}{R_T}$$

$$R_T = \frac{V_1}{R_1 + \frac{R_2 R_3}{R_2 + R_3}}$$

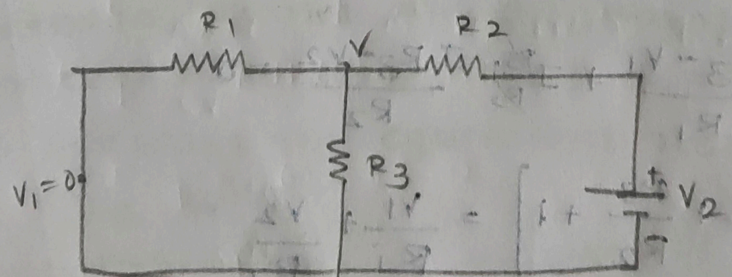
$$\Rightarrow \frac{V_1 (R_2 + R_3)}{R_1R_2 + R_2R_3 + R_3R_1}$$

$$I' = I_{T_1} \times$$

$$i' = \frac{V_1 (R_2 + \cancel{R_3})}{R_1R_2 + R_2R_3 + R_3R_1} \times \frac{R_2}{R_2 + \cancel{R_3}}$$

$$i' = i_T \times \frac{R_2}{R_2 + R_3}$$

$$\boxed{i' = \frac{V_1 R_2}{R_1R_2 + R_2R_3 + R_3R_1}}$$



$$I_{T_2} = \frac{V_2}{R_T}$$

$$I_{T_2} = \frac{V_2}{R_2 + \frac{R_1 R_3}{R_1 + R_3}}$$

$$i_{T_2} = \frac{V_2(R_1+R_3)}{R_1R_2+R_2R_3+R_3R_1}$$

$$i'' = \frac{V_2(R_1+\cancel{R_3})}{R_1R_2+R_2R_3+R_3R_1} \times \frac{R_1}{(R_1\cancel{+R_3})}$$

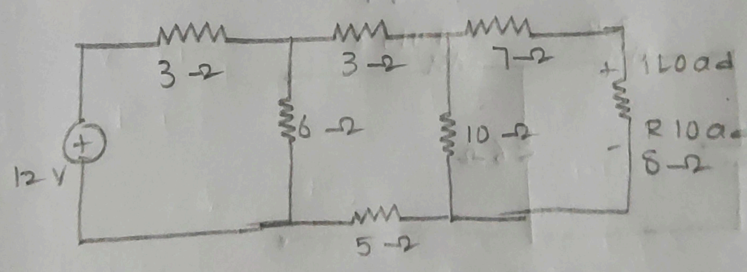
$$\boxed{i'' = \frac{V_2R_1}{R_1R_2+R_2R_3+R_3R_1}}$$

$$I = i' + i''$$

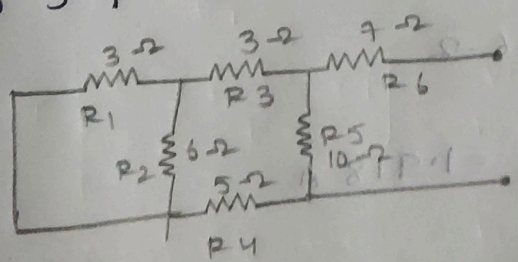
$$I = \frac{V_1R_2}{R_1R_2+R_2R_3+R_3R_1} + \frac{V_2R_1}{R_1R_2+R_2R_3+R_3R_1}$$

$$\boxed{I = \frac{V_1R_2+V_2R_1}{R_1R_2+R_2R_3+R_3R_1}}$$

(b) find load current through load resistor using thevenin's theorem



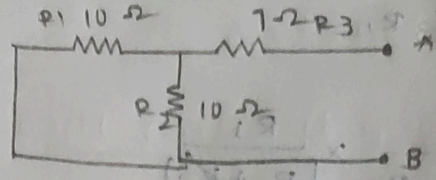
For S-1 for Rth



let

$$R_a = \frac{R_1 * R_2}{R_1+R_2} = \frac{3*6}{3+6} = \frac{18}{9} = 2\ \Omega$$

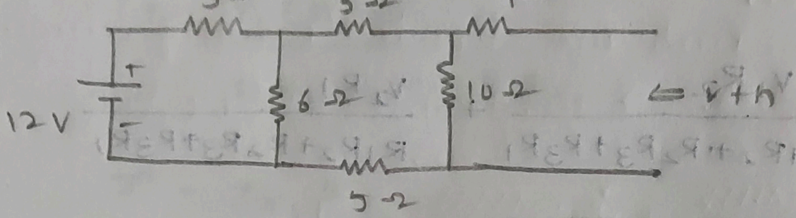
$R_b = R_a + R_3 + R_4 = 2 + 3 + 5 = 10\,\Omega$



$R_{th} = \frac{R_1 \times R_2}{R_1 + R_2} + R_3 = \frac{10 \times 10}{10+10} + 7 = \frac{\cancel{100}^{5}}{\cancel{20}_{1}} + 7$

$= 12\,\Omega$

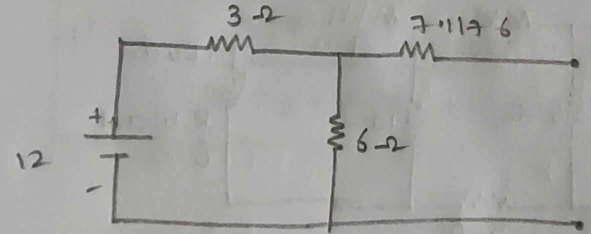
S-2 for V_{th}



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

$R_{eq} = 7 /\!/ 10 + 3 = \frac{7 \times 10}{7+10} + 3$

$= \frac{70}{17} + 3 = \frac{121}{17} = 7.11$



$R_{eq} = 7.117 /\!/ 16 + 3$

$R_{eq} = 6.256\,\Omega$

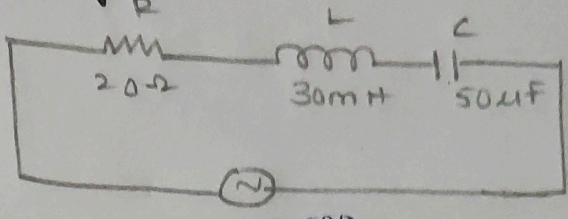
$I_T = \frac{12}{6.256} = 1.918\ A$

$V_{th} = 1.918 \times \frac{6}{19} = 0.605$

$V_{th} = V_{10th} = 0.605 \times 10 = 6.057\ V$

7) Derive
function
excited

7a) A Series connected RLC circuit has R=20ohm, L=30mH, C=50uF. calculate the impedance and current when the circuit is excited by 500V 50Hz supply.



Given data

$R=20\Omega$, $L=30mH$, $C=50\mu F$ $f=50Hz$

$$X_L = 2\pi f L = 2\times3.14\times50\times30\times10^{-3} = 9.42\,\Omega$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\times3.14\times50\times50\times10^{-6}} = 63.9\,\Omega$$

$$Z = R + j(X_C - X_L)$$

$$Z = 20 + j(63.9 - 9.42)$$

$$Z = 20 + j(54.48)$$

$$Z = 58\angle 69.84$$

$$I = \frac{V}{Z} = \frac{500\angle 0^\circ}{58\angle 69.84}$$

$$I = 8.62\angle 69.84^\circ$$