Paper 1, TDC Part-1
Chapter– 1, Introduction to Passive Elements
Inductor

By:

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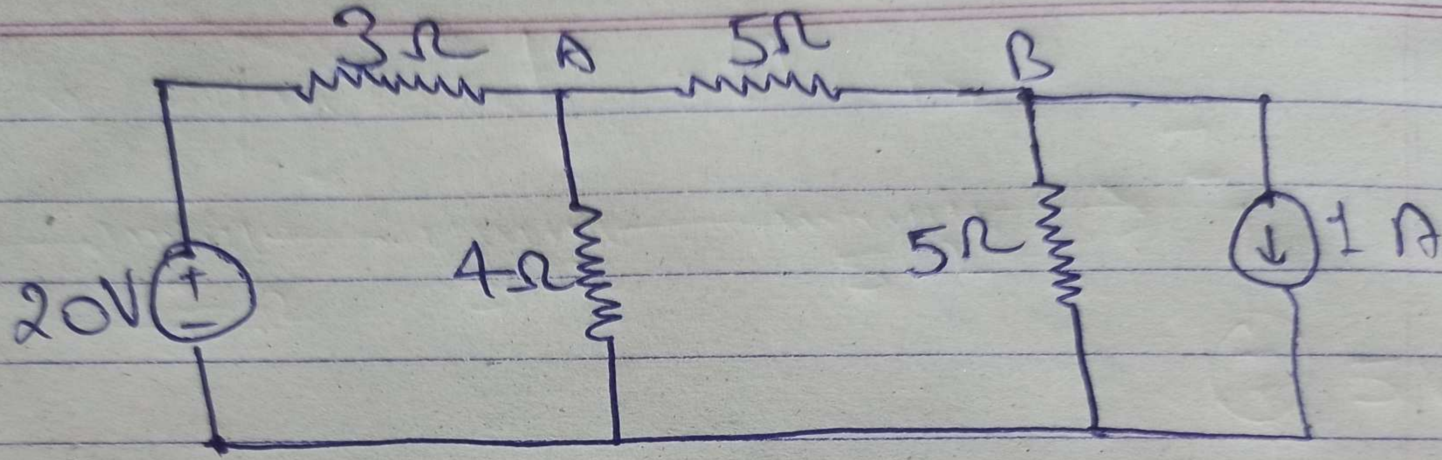

To find the magnitude and direction of current in 5 Ω resistor connected in branch AB using source transformation technique.

Here we can convert voltage source ~~with~~ of 20V, with series resistor of 3 Ω into equivalent current source, i.e.

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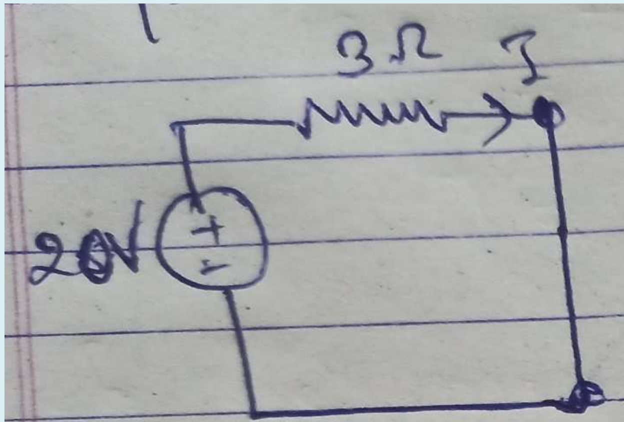
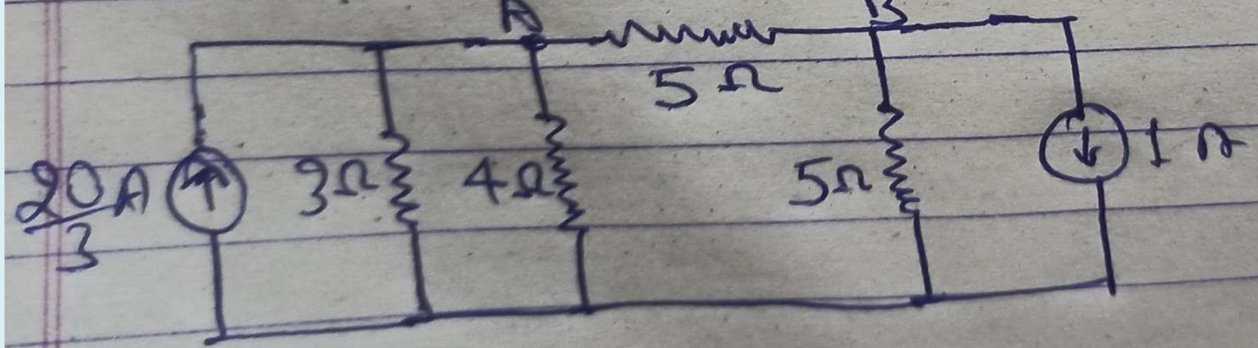


$$I = \frac{20}{3}\ A.$$

So equivalent current source have magnitude of $\frac{20}{3}$ A and parallel resistor of 3Ω. Then the n/w can be redrawn as.



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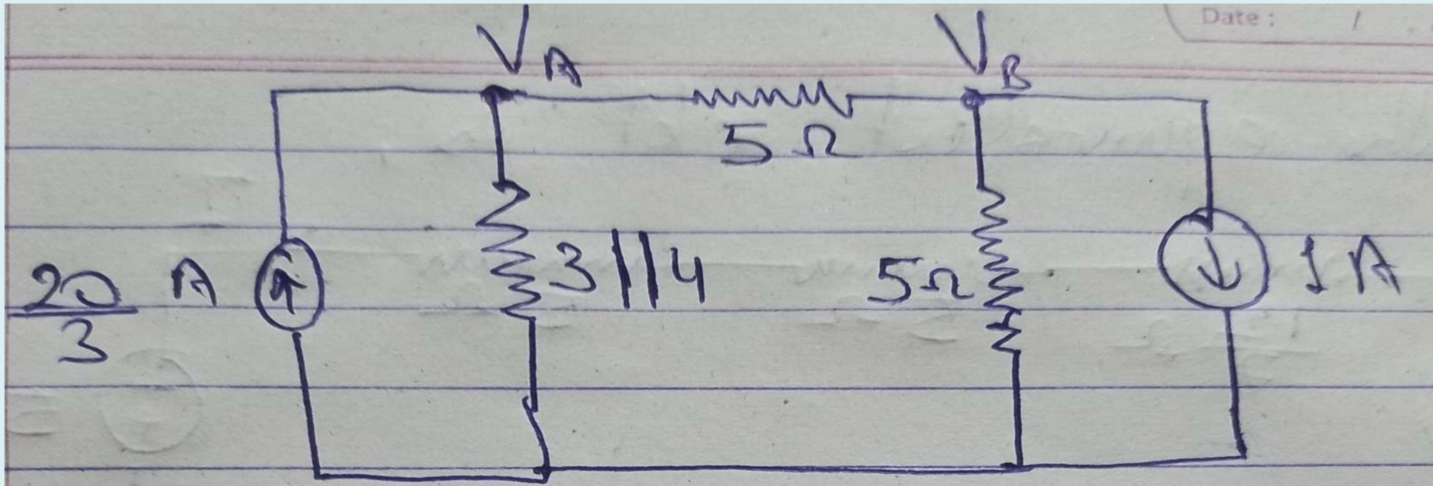

$$3||4 = \frac{3 \times 4}{7} = \frac{12}{7}$$

Now we can convert (i) $\frac{20}{3}$ A current source and parallel resistor of $\frac{12}{7}\Omega$ into voltage source with series resistance of $\frac{12}{7}\ \Omega$

i.e. $V_{\frac{12}{7}\Omega} = \frac{12}{7} \times \frac{20}{3} = \frac{80}{7}$ V

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So the practical voltage source with supply voltage of $\frac{80}{7}$ V in series with $\frac{12}{7}$ Ω

ii) We convert (↓) 1A current source and parallel resistor of 5 Ω into practical voltage source ~~is~~ with series resistance of 5 Ω

i.e. $V_{5\Omega} = 5 \times 1 = 5V$

So the practical voltage source with supply voltage of 5V in series with 5 Ω resistor

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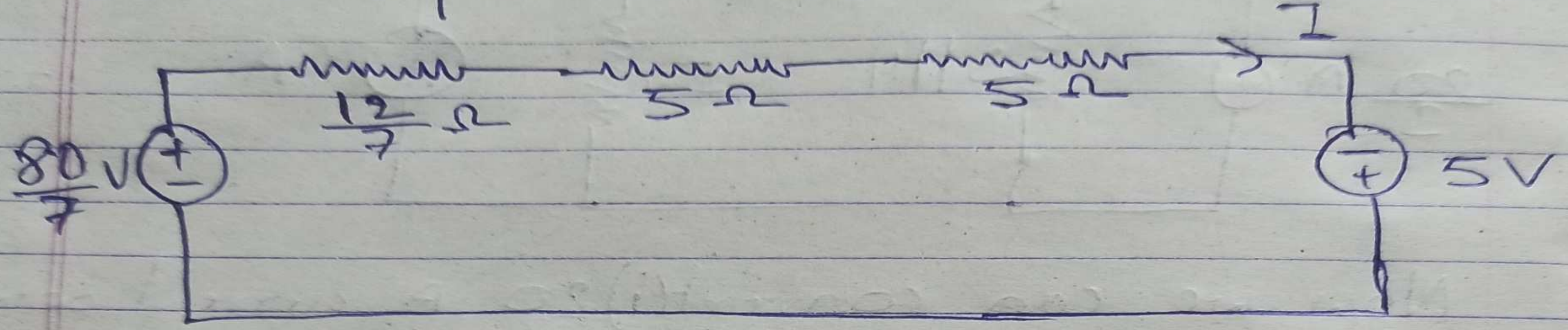
So the equivalent ckt is,



Now apply KVL we find current I in the above ckt.

$$-\frac{80}{7}V + \frac{12}{7}I + 5I + 5I - 5V = 0$$

$$\text{or, } \frac{12I + 70I}{7} = \frac{115}{7}V$$

$$\text{or, } I = \frac{115}{82} \approx 1.4\,A$$

So the magnitude of current through 5Ω resistor is 1.4 A and its direction is from A to B.

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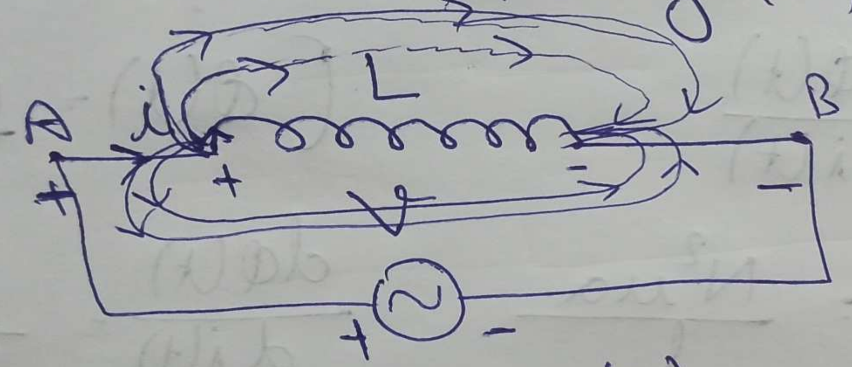
Unit - 1 (Inductor) -

~~In~~ We denote Inductor by 'L'.

It is represented by ─ooooo─ (L)

It's unit is Henry (H)



$$V_{AB}(t) = L\frac{di(t)}{dt}$$

Suppose it has 'N' no. of turns then.
when current flows through this inductor
then magneto motive force ~~(At)~~ (mmf) develop
and mmf = N i(t)

N. i(t)

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and mmf = N i(A)

$$\text{flux}(\phi) = \frac{\text{mmf}}{\text{Reluctance}} = \frac{N \cdot i(A)}{R}$$

Reluctance represents opposition to magnetic flux. and is given by

$$R = \frac{l}{\mu A}$$

l = length

A = Cross-section Area

& μ = permeability of the material.

When alternating current passes through the inductor then.

$$\phi(t) = \frac{N \cdot I_m \sin \omega t}{R} = \phi_m \sin \omega t$$

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$$e(t) = \frac{N\,d\phi(t)}{dt} = \frac{N\,d\phi(t)}{di(t)} \times \frac{di(t)}{dt}$$

$$= L\,\frac{di(t)}{dt}$$

So, $L = N\,\dfrac{d\phi(t)}{di(t)}$ $\quad \left[\phi(t) = \dfrac{N\,i(t)}{R}\right]$

$$L = \frac{N^2}{R} = \frac{N^2 \mu a}{l} \qquad \frac{d\phi(t)}{di(t)} = \frac{N}{R}$$

So we can define the inductance as the property of material that oppose change of current through the material.

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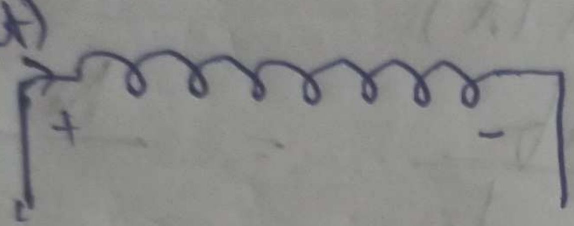
material



$$V_L(t) = \frac{L \, di_L(t)}{dt}$$

$$di_L(t) = \frac{1}{L} V_L(t) \, dt$$

$$\int_{i_L(0)}^{i_L(t)} d\, i_L(t) = \frac{1}{L} \int_0^t V_L(t) \, dt$$

$$i_L(t) - i_L(0) = \frac{1}{L} \int_0^t V_L(t) \, dt$$

$$\boxed{i_L(t) = i_L(0) + \frac{1}{L} \int_0^t V_L(t) \, dt}$$

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For any query contact- 9771474020

Thank You