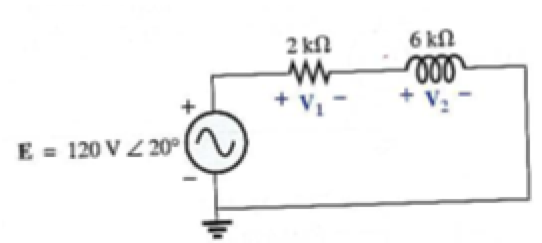
Q- Calculate the voltages V_1 and V_2 for the circuit shown in figure.



If the total impedance in the circuit is Z then the current through the circuit is given by using Ohms law as

$$I = E/Z.$$

The voltage drop across any element of the circuit is given by

$$V_1 = Z_1 * I_1$$

Now if the elements of the circuit are in series the current through each element will be the same I and hence voltage across any element is given by

$$V_1 = Z_1 I = Z_1 * (E/Z)$$

Or $$V_1 = \frac{Z_1 E}{Z}$$

Similarly, the voltage across the second element will be

$$V_2 = \frac{Z_2 E}{Z}$$

As the whole source voltage is divided to the elements we have

$$V_s = \frac{Z_1 E}{Z} + \frac{Z_2 E}{Z} + \frac{Z_3 E}{Z} + \cdots$$

This is called voltage divider rule.

(a) The source voltage is

$$E = 120 \text{ V} \angle 20^0$$

The total impedance of the circuit

$$Z = 2k\Omega + 6k\Omega\, j$$

In phasor form

$$Z = \sqrt{(2k)^2 + (6k)^2}\, \angle tan^{-1}\left(\frac{6k}{2k}\right) = 6.325k\angle 71.57^0$$

Hence voltage across the resistor

$$V_1 = \frac{Z_1 E}{Z} = \frac{(2k\Omega\angle 0) * (120V\angle 20^0)}{(6.325k\Omega\angle 71.57^0)} = \left(\frac{2k * 120}{6.325k}\right)\angle(20 - 71.57)$$

Or $$\boldsymbol{V_1 = 37.945\, V\angle - 51.57^0}$$

And voltage across the inductor

$$V_2 = \frac{Z_2 E}{Z} = \frac{(6k\Omega\angle 90) * (120V\angle 20^0)}{(6.325k\Omega\angle 71.57^0)} = \left(\frac{6k * 120}{6.325k}\right)\angle(90 + 20 - 71.57)$$

Or $$\boldsymbol{V_2 = 113.834\angle 38.43^0}$$