Tutorial Sheet-3 (Unit-1)

Q 1. Find the average and effective values of voltage of sinusoidal waveform shown in Fig. 11.33.

Solution. Although, the given waveform would ›e integrated from π/4 to π, it would be averaged ›ver the whole cycle because it is unsymmetrical. ›he equation of the given sinusoidal waveform is › = 100 sin θ.

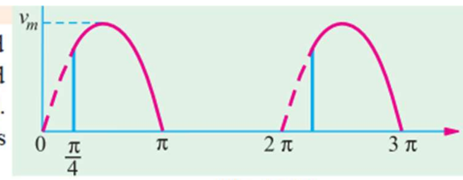


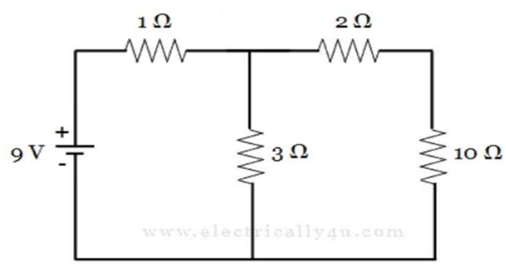
Fig. 11.33

$$\therefore \quad V_{av} = \frac{1}{2\pi}\int_{\pi/4}^{\pi} 100 \sin\theta \, d\theta = \frac{100}{2\pi}\left| -\cos\theta \right|_{\pi/4}^{\pi} = 27.2 \text{ V}$$

$$V^2 = \frac{1}{2} \quad {}_{/4} \; 100^2 \sin^2 \quad d \quad \frac{100^2}{4} \frac{}{4}(1 \quad \cos 2 \;) d \quad \frac{100^2}{4}\Bigg| \quad \frac{\sin 2}{2}\Bigg|_{/4} \quad \frac{100^2}{4} \quad \frac{}{4} \quad \frac{1}{2}$$

$$\therefore \quad V = 47.7 \text{ V}$$

Q2. Solve the given circuit to find the current through 10 Ω using Thevenin's Theorem.



Ans.

$$R_{TH} = 2 + \frac{1*3}{1+3} = 2.75\Omega$$

By Ohm's law,

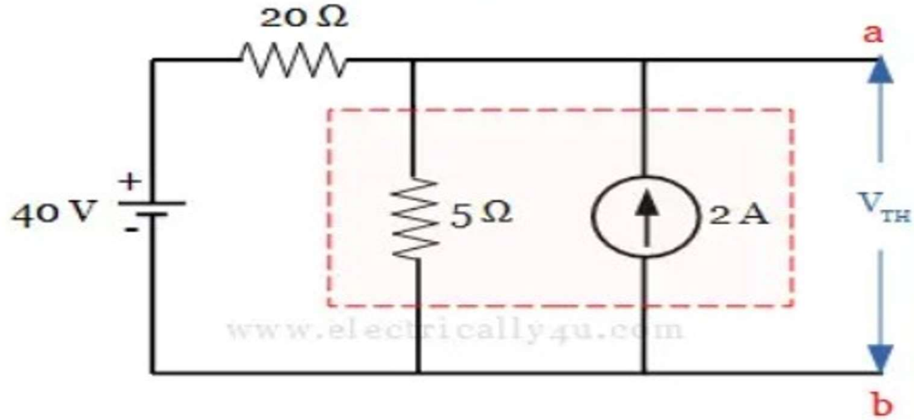
$$I = \frac{V}{R} = \frac{9}{4} = 2.25A$$

Thus, the voltage across 3 Ω resistor(or Thevenin's voltage V_{TH}) is given by,

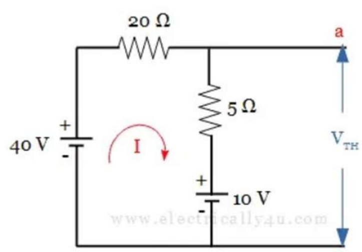
$$V_{ab} = V_{TH} = I * R = 2.25 * 3 = 6.75V$$

$$I_L = \frac{V_{TH}}{R_{TH} + R_L} = \frac{6.75}{2.75 + 10} = 0.529A$$

Q3. Solve the given circuit to find the current through 15 Ω using Thevenin's Theorem.



Ans.



$$R_{TH} = \frac{5 * 20}{5 + 20} = 4\Omega$$

Let us apply Kirchoff's Voltage Law to this loop and find the value of loop current.

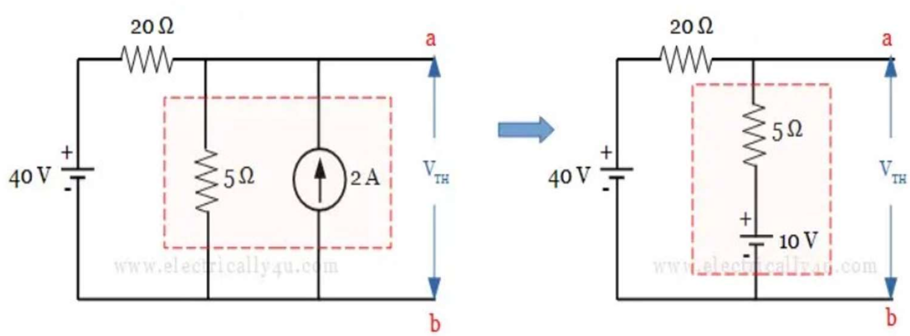
Applying KVL, $20I + 5I + 10 - 40 = 0$

$$25I = 30$$

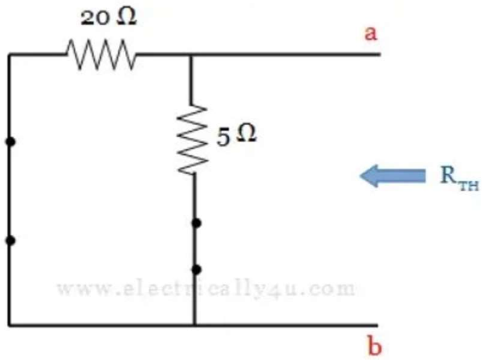
$$I = 1.2\,A$$

$$V_{TH} = 10 + (5 * 1.2) = 16\,v$$

By source transformation, let us convert this current source into its equivalent voltage source in series with 5 Ω resistor.



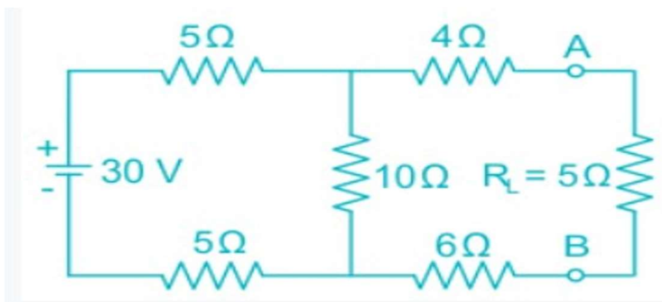
V = IR = 2 x 5 = 10 V



$$R_{TH} = \frac{5 * 20}{5 + 20} = 4\Omega$$

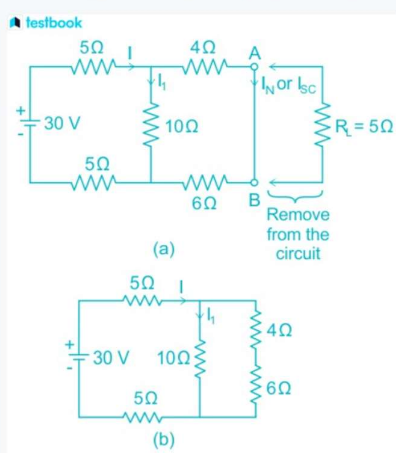
$$I_L = \frac{V_{TH}}{R_{TH} + R_L} = \frac{16}{4 + 15} = 0.842A$$

Example 4: In the network shown in figure, calculate the current through the load resistor *RL* by using Norton's Theorem.



Ans.

Step 1 : Remove the load resistance $R_L = 5\Omega$ and short circuit the terminals A and B



Step 2 : Find the current I_N flowing through A and B

Total resistance R = $(5 + 5)\Omega + (10\Omega||(4 + 6)\Omega)$

$= 10 + \frac{10\times10}{10+10} = 10 + 5 = 15\Omega$

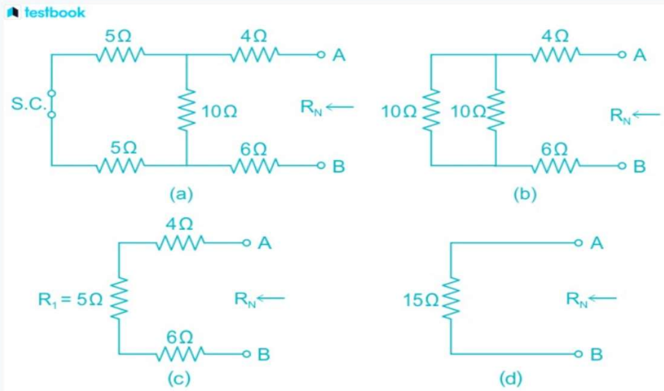
Current $I = \frac{V}{R}$

$I = \frac{30}{15} = 2A$

Short circuit current, I_{SC} or $I_N = I \times \frac{10}{10+4+6}$

$2 \times \frac{10}{20} = 1A$

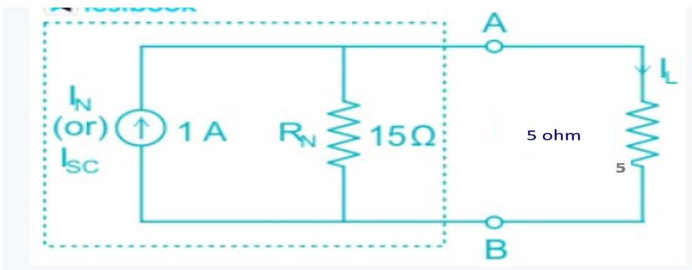
Step 3: Short circuit the voltage source and find the Norton equivalent resistance R_N as seen from the terminal A and B.



$R_1 = 10\Omega || 10\Omega = \frac{10\times10}{10+10} = 5\Omega$

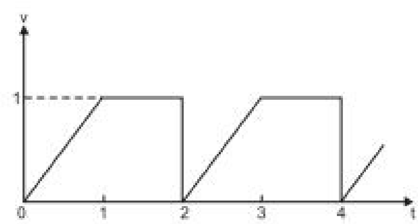
$R_N = R_{AB} = 4 + R_1 + 6$

$4+5+6 = 15\Omega$



Assignment Home Work

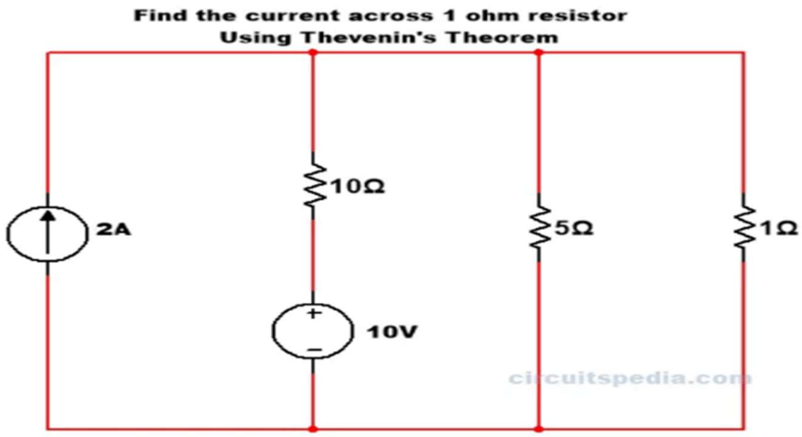
Q1. Calculate the RMS value of power supply of given wave function in fig.



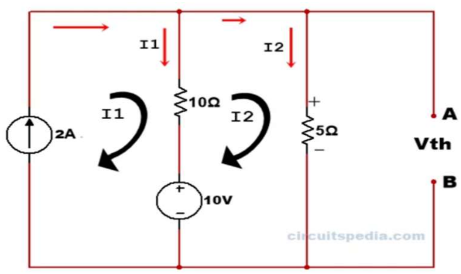
Ans: 5/4V [Area of graph from 0 to 2-time unit and divided by 2]

Q2.

Q. Find the value of current through 1Ω Resistor in the given circuit using Thevenin's theorem.



Ans 1:



Applying KVL in All meshes.

I=2A

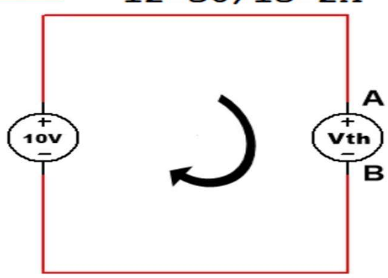
10−10(I2−I1)−5I2=0

−15I2=10I1=−10

−15I2=−10−20=−30

−15I2=−30

I2=30/15=2A



The voltage across the 5Ω resistor is **V=I*R=2*5=10Ω**

Q . A sine wave voltage has a maximum value of 20 V and a frequency of 50 Hz. Determine the instantaneous voltage present (a) 2.5 ms and (b) 15 ms from the start of the cycle.

Solution

We can find the voltage at any instant of time using:

$v = V_{max} \sin (20\, t)$

where $V_{max} = 20$ V and $f = 50$ Hz. In (a), t = 2.5 ms, hence:

$v = 20 \sin (20 \times 50 \times 0.0025) = 20 \sin (0.785) = 20 \times 0.707 = 14.14$ V

In (b), t = 15 ms, hence:

$v = 20 \sin (20 \times 50 \times 0.0015) = 20 \sin (4.71) = 20 \times -1 = -20$ V.

MCQs (Gate question)

1.Thevenin's theorem states that any linear bilateral network can be replaced by a single voltage source in series with a:

a. Current source
b. Impedance
c. Capacitor
d. Resistor
Answer: d. Resistor

2.Thevenin's equivalent voltage is:

a. The open-circuit voltage at the terminals of the load
b. The short-circuit current at the terminals of the load
c. The voltage across the load resistor
d. The voltage across the source resistor
Answer: a. The open-circuit voltage at the terminals of the load

3.To find Thevenin's resistance, we need to:

a. Short all voltage sources and open all current sources
b. Open all voltage sources and short all current sources
c. Open all voltage and current sources
d. Short all voltage and current sources
Answer: a. Short all voltage sources and open all current sources

4.**In Thevenin's equivalent circuit, the load resistor is connected:**

a. In parallel with the Thevenin resistance
b. In series with the Thevenin resistance
c. Across the voltage source
d. Between the Thevenin voltage and ground
Answer: b. In series with the Thevenin resistance

5.**Thevenin's theorem is applicable to:**

a. Linear circuits only
b. Non-linear circuits
c. Both linear and non-linear circuits
d. AC circuits only
Answer: a. Linear circuits only

6.Norton's theorem states that any linear bilateral network can be replaced by a single current source in parallel with a:

a. Voltage source
b. Capacitor
c. Impedance

d. Resistor
Answer: d. Resistor

7.**Norton's equivalent current is:**

a. The open-circuit current at the terminals of the load
b. The short-circuit current at the terminals of the load
c. The current through the load resistor
d. The current through the source resistor
Answer: b. The short-circuit current at the terminals of the load

8.**To find Norton's resistance, we need to:**

a. Short all voltage sources and open all current sources
b. Open all voltage sources and short all current sources
c. Open all voltage and current sources
d. Short all voltage and current sources
Answer: a. Short all voltage sources and open all current sources

9.In Norton's equivalent circuit, the load resistor is connected:

a. In series with the Norton resistance
b. In parallel with the Norton resistance
c. Across the current source
d. Between the Norton current and ground
Answer: b. In parallel with the Norton resistance

10.Norton's theorem is applicable to:

a. Linear circuits only
b. Non-linear circuits
c. Both linear and non-linear circuits
d. DC circuits only
Answer: a. Linear circuits only

11. **The average value of a full-wave rectified sinusoidal current over one complete cycle is:**

a. Zero
b. $2I_m/\Pi$
c. $I_m/\sqrt{2}$
d. I_m

Ans b

The RMS value of a sinusoidal voltage $v(t) = V_m \sin(\omega t)$ is:

a. V_m

b. $\frac{V_m}{\sqrt{2}}$

c. $\frac{V_m}{2}$

d. $\frac{V_m}{\pi}$

Answer: b. $\frac{V_m}{\sqrt{2}}$

The average value of a pure sinusoidal voltage over one complete cycle is:

a. Zero

b. $\frac{V_m}{\pi}$

c. $\frac{2V_m}{\pi}$

d. V_m

Answer: a. Zero

For a triangular waveform with peak value V_m, the RMS value is:

a. $\frac{V_m}{\sqrt{3}}$

b. $\frac{V_m}{2}$

c. $\frac{V_m}{\sqrt{2}}$

d. $\frac{V_m}{\pi}$

Answer: a. $\frac{V_m}{\sqrt{3}}$