**Department of Electrical Engineering**

**Assignment**

**Date: 13/04/2020**

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## Course Details

**Course Title:** Linear Circuit Analysis **Module:** 2

**Instructor:** Sir Sohail Imran **Total Mark** 30

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## Student Details

**Name: Hasnat Khan** **Student ID: 16631**

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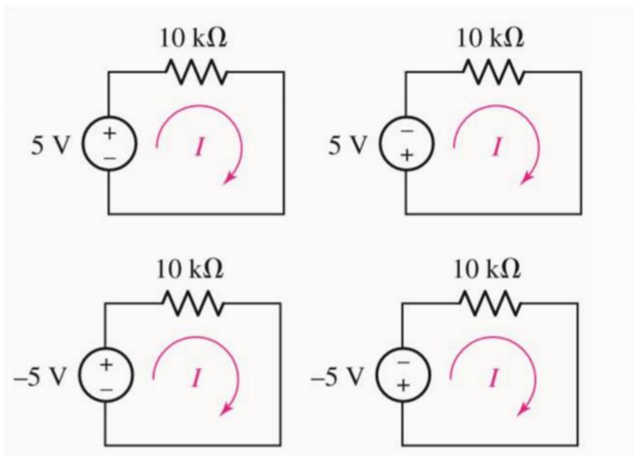
|---|---|---|---|
| Q1. | (a) | For each of the circuits in figure, find the current I and compute the power absorbed by the resistor   | Marks 3<br>PLO1 |
| | (b) | | Marks 4 |

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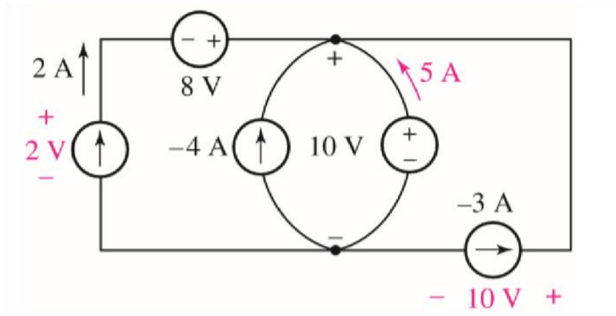
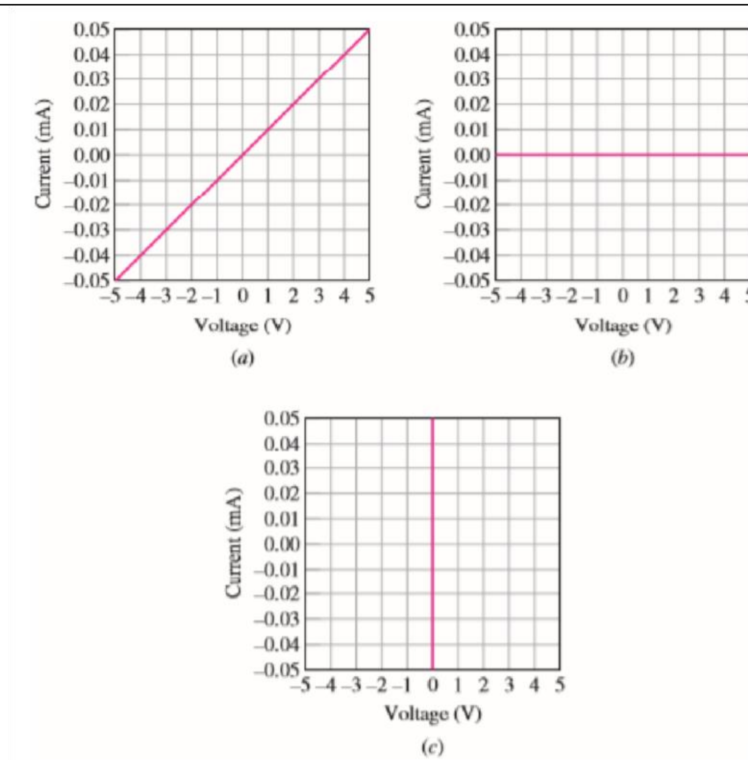
|---|---|---|---|
| | | Determine the power supplied by the leftmost element in the circuit of following figure   | PLO1 |
| | (c) | Following figure depicts the current-voltage characteristic of three different resistive elements. Determine the resistance of each, assuming the voltage and current are defined in accordance with the passive sign convention. | Marks 3<br>PLO1 |
| | |   | |
| Q2. | (a) | Refer to the circuits of following figures, and answer the following:<br>1. How many distinct nodes are contained in the circuit? | Marks 4 |

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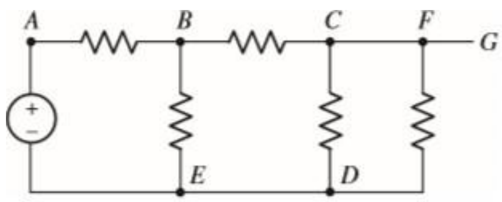
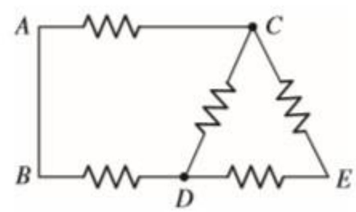
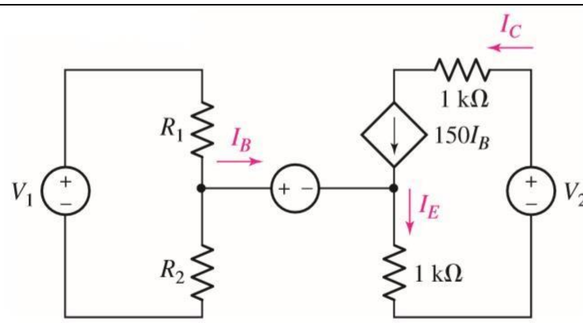
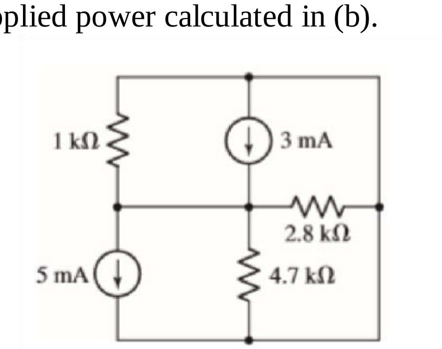
|---|---|---|---|
| | | 2. How many elements are contained in the circuit?<br>3. How many branches does the circuit have?<br>4. Determine if each of the following represents a path, a loop, both, or neither:<br>i. A to B<br>ii. B to D to C to E iii. C to E to D to B to A to C<br>iv. C to D to B to A to C to E<br>    | PLO2 |
| | (b) | For the circuit of following figure (which is a model for the dc operation of a bipolar junction transistor biased in forward active region), $I_B$ is measured to be 100 µA. Determine $I_C$ and $I_E$ | Marks 6<br>PLO2 |
| | |   | |
| Q3. | (a) | Although drawn so that it may not appear obvious at first glance, the circuit of following figure is in fact a single-node-pair circuit.<br>a. Determine the power absorbed by each resistor.<br>b. Determine the power supplied by each current source.<br>c. Show that the sum of the absorbed power calculated in (a) is equal to the sum of the supplied power calculated in (b).<br>  | Marks 5<br>PLO1 |
| | (b) | | Marks 5 |

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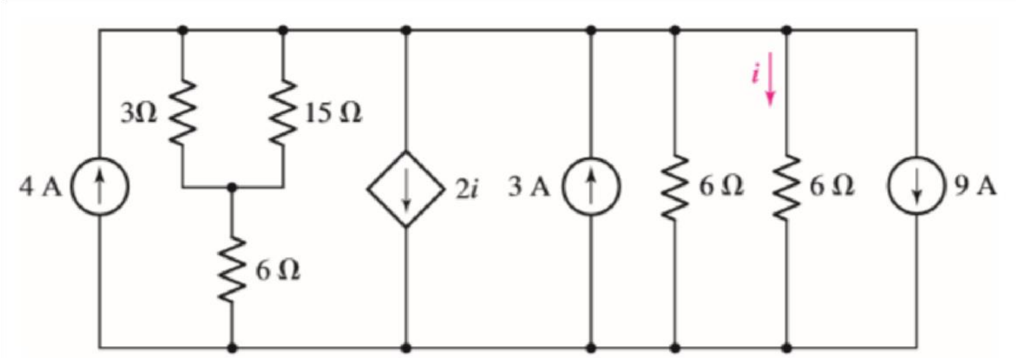
|---|---|---|---|
| | | Determine the power absorbed by the 15□ resistor in the circuit of following figure  | PLO1 |



## Ans 1(a):-

First we have to use Ohm's Law

$$V = IR$$

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

First find Power :

$$P = VI$$

To find first circuit. So we have to take the current in opposite side means with negative sign

$$V = IR$$

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

$$I = \frac{5v}{10000\Omega}$$

$$I = 0.0005A$$

$$I = 0.5mA$$

Now for Power

$$P = VI$$
$$P = 5 \times 0.5 \times 10^{-3}$$
$$P = 2.5 \times 10^{-3}$$
$$P = 0.25mW$$

Now for 2^ND circuit:

$$V = IR$$
$$I = \frac{V}{R}$$
$$I = \frac{-5v}{10000\Omega}$$
$$I = -0.0005A$$
$$I = -0.5mA$$

For power

$$P = VI$$
$$P = 5(-0.5 \times 10^{-3})$$
$$P = -2.5 \times 10^{-3}$$
$$P = -0.0025W$$
$$P = -0.25mW$$

For 3^rd circuit:

$$V = IR$$
$$I = \frac{V}{R}$$
$$I = \frac{-5v}{10000\Omega}$$
$$I = -0.0005A$$
$$I = -0.5mA$$

Then Power

$$P = VI$$
$$P = 5(-0.5 \times 10^{-3})$$
$$P = -2.5 \times 10^{-3}$$
$$P = -0.25mW$$

Now Circuit 4th:

$$V = IR$$
$$I = \frac{V}{R}$$
$$I = \frac{5v}{10000\Omega}$$
$$I = 0.5mA$$

For Power

$$P = VI$$
$$P = 5(0.5 \times 10^{-3})$$
$$P = 2.5 \times 10^{-3}$$
$$P = 0.25mW$$

## Ans 1(b):

We know that

$$P = VI$$
$$P = 2v \times 2A$$
$$P = 4W$$

In this circuit voltage and current are given

We will multiply two factors to find power

$$2v \times 2A = 4w$$

This 4w is supplied. And we will take current with positive sign.

## Ans 1(c):

For this we have to use Ohm's Law

$$V = IR$$

$$OR \quad R = \frac{V}{I}$$

To find R take the value of I and V from the graph

## Solution (a)

## Given that

$$I = 0.01mA$$

$$V = 1V$$

$$R = ?$$

## Calculation:

Using Ohm's Law

$$V = IR$$

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

$$R = \frac{0.5A}{5V}$$

$$R = 10\mu S$$

$$R = \frac{1v}{0.01 \times 10^{-3}}$$

$$R = 100 \times 10^{3}$$

$$R = 100k\Omega$$

## Solution (b)

## Given that:

From graph we know that current is zero

$$V = 1v$$

$$I = 0$$

$$R = ?$$

## Calculation:

We know that

$$V = IR$$

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

$$R = \frac{1v}{0}$$

$$R = \infty$$

## Solution (c)

## Given that:

From this graph we come to know that the current is infinite

$$V = 1v$$

$$I = \infty$$

$$R = ?$$

## Calculation:

We know that

$$V = IR$$

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

$$R = \frac{1}{\infty}$$

$R = 0$ So, we have zero resistance

## Ans 2(a):

1) Number of nodes = 4
2) Number of elements = 5
3) Number of branches = 5

4)

i. Neither
ii. Only path
iii. Path and loop
iv. neither

## Ans 2(b):

We know that KCL tells us that

Total current entering a node = total current leaving a node

So by this equation;

$$I_B + I_C = I_E$$

*Or*

$$I_E = I_B + I_C \quad \Rightarrow \quad I_C = 150.I_B$$

$$I_C = 15mA$$

Now,

$$I_E = 150\times10^{-3} + 100\times10^{-6}$$

$$I_E = 15.1\text{mA}$$

## Ans 3(a):

We know that

V=IR

So

$V=2\times 637\times 10^{-3} \Rightarrow$ 1.274V

Now find current I of each

V=IR

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

Let

$I_X=\frac{1.274v}{1000\Omega}$

$I_X = 0.001274A$

$I_X$ =1.274mA

Now

$I_Y=\frac{1.274v}{2800\Omega}$

$I_Y$ = 0.000455A

$I_Y$ =0.455mA

Then

$I_Z=\frac{1.274v}{4700\Omega}$

$I_Z$ =0.000271A

$I_Z$ =0.271mA

Now to find Power,

We know the equation

$P=VI$

$\Rightarrow$ P(2.8k)=(1.274v)(0.455)

=0.5797mW

$\Rightarrow$ P(4.7k)=(1.274)(0.271)

=0.3452mW

$\Rightarrow$ P(1k)=(1.274)(1.274)

=1.6230mW

$\Rightarrow$ P(5mA)=(1.274)(-5)

=-6.37mW

$\Rightarrow$ P(3mA)=(1.274)(3)

## Ans 3(b):

In this circuit first we will calculate the source and equivalences:

$$i_{eq} = 4 - 2i + 3 - 9$$
$$= 4 - 2i - 6$$
$$i_{eq} = -2 - 2i$$
$$R_{eq} = (6 + 3 \| 5) \| 6 \| 6$$
$$R_{eq} = 8.5 \| 3 \quad = 2.217\Omega$$

Now find voltage V:

$$V = i_{eq} \,.\, R_{eq}$$
$$V = (-2 - 2i)(2.217\Omega)$$

From diagram;

$$V = 6i$$
$$6i = (-2 - 2i)(2.217)$$
$$6i = -4.434 - 4.434i$$
$$6i + 4.434i = -4.434$$
$$10.434i = -4.434$$
$$i = \frac{-4.434}{10.434}$$
$$i = -0.424A$$
$$v = -2.55v$$

*So,*

$$P = \frac{V^2}{R}$$
$$P_{15\Omega} = \frac{(-2.55)^2}{15}$$
$$V_{15\Omega} = \frac{6}{6.25}$$
$$V_{15\Omega} = 1.8v$$

*Now Power,*

$$P_{15\Omega} = \frac{V^2}{R}$$

$$= \frac{(1.8)^2}{15\Omega}$$

$$= \frac{3.24}{15}$$

$$P_{15\Omega} = 0.216W$$

**Finished !**