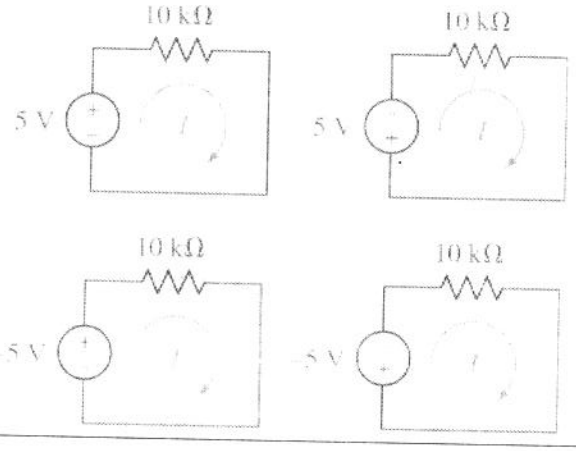
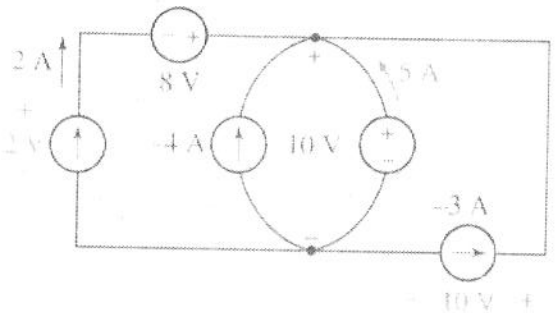
Department of Electrical Engineering
Assignment
Date:
13/04/2020

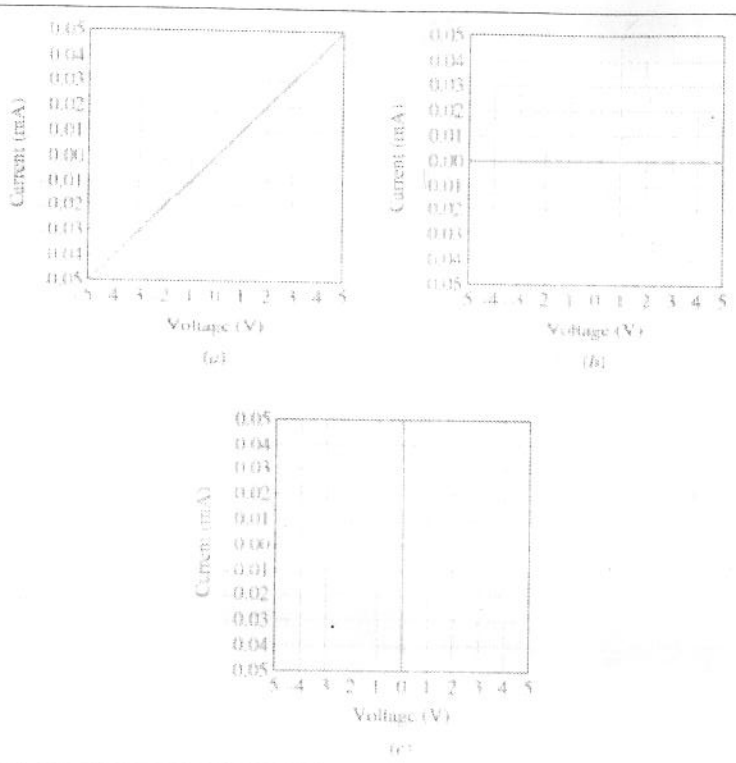
Course Details

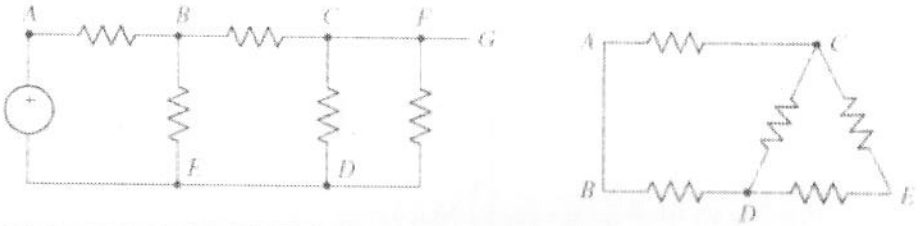
Course Title: Linear Circuit Analysis **Module:** 2
Instructor: Dr. Sohailimaran **Total Marks:** 30

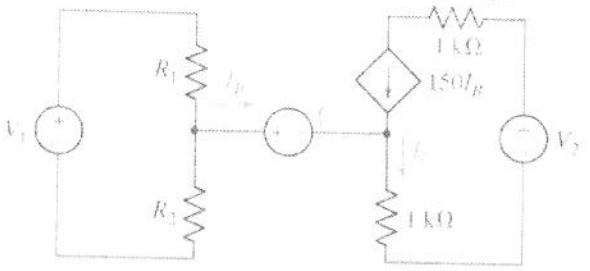
Student Details

Name: M.salman Nasir **Student ID:** 16664

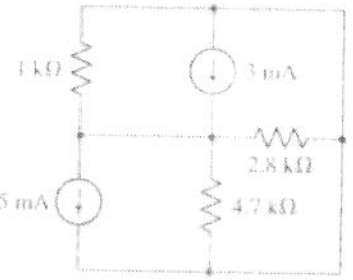
Q1.	(a)	For each of the circuits in figure, find the current I and compute the power absorbed by the resistor 	Marks 3 PLO1
	(b)	Determine the power supplied by the leftmost element in the circuit of following figure 	Marks 4 PLO1
	(c)	Following figure depicts the current-voltage characteristic of three different resistive elements. Determine the resistance of each, assuming the voltage and current are defined in accordance with the passive sign convention.	Marks 3 PLO1

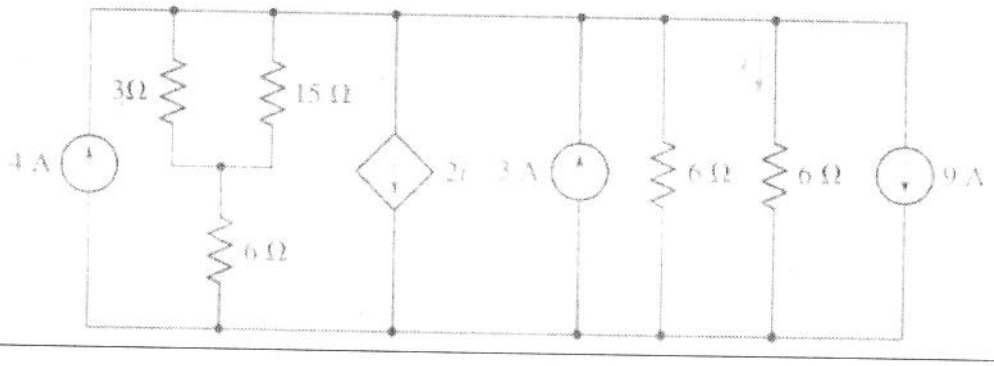


Q2.	(a)	Refer to the circuits of following figures, and answer the following: 1. How many distinct nodes are contained in the circuit? 2. How many elements are contained in the circuit? 3. How many branches does the circuit have? 4. Determine if each of the following represents a path, a loop, both, or neither: i. A to B ii. B to D to C to E iii. C to E to D to B to A to C iv. C to D to B to A to C to E 	Marks 4 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 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. a. Determine the power absorbed by each resistor. b. Determine the power supplied by each current source. c. Show that the sum of the absorbed power calculated in (a) is equal to the sum of the supplied power calculated in (b).	Marks 5 PLO1
	(b)	Determine the power absorbed by the 15 Ω resistor in the circuit of following figure	Marks 5 PLO1





Date:_____ (1)

Question No 1:-

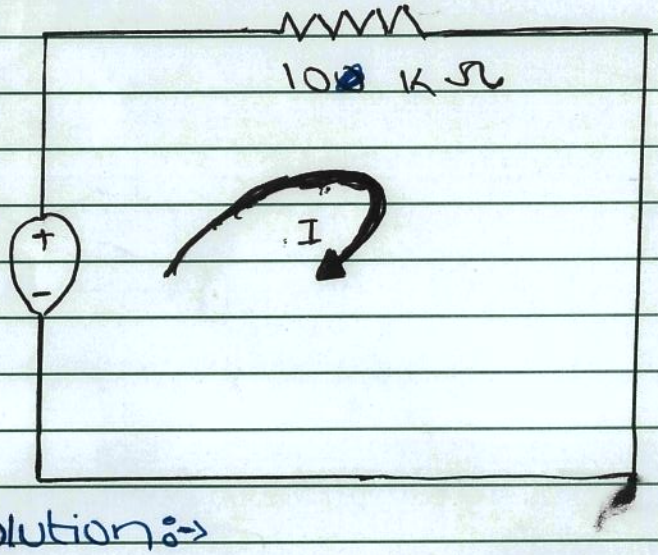
Part (a)

For each of the ~~circuit~~ following circuit.

Find Current (I)

and Power (P) ~~observe~~ absorbed by the resistor (R).

(1)



Solution:->

In order to Find Power we ~~have~~ need voltage and current.

$P = I \cdot V \longrightarrow (1)$

In Given Fig:-

voltage $v = 5V$

but current is not given.

So Frist we have to calculate ~~+~~ Curren (I) through circuit.

Date:_____

(a)

From Ohm Law:-

$V = IR$

$\Rightarrow I = V/R \quad -(ii)$

We have

$V = 5$ volt

$R = 10$ KΩ

$R = 10 \times 10^3$ ohm

$I = 5/10 \times 10^3$

$I = 0.0005\ A$

OR

$I = 0.5\ mA$

Put value of (2) I & V in (1)

(1) $\Rightarrow P = I \cdot V$

$P = 0.0005\ A \times 5$ volt

$P = 0.0025$ watt

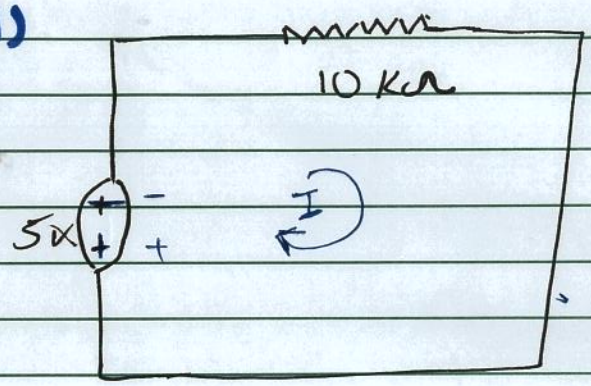
$p = 0.0025$ watt → ANS

OR

$P = 2.5$ mwatt

Date:_____ (3)

(11)



Solution:

In this circuit the polarity of voltage source is changed hence we take V as (-V)

$\Rightarrow$ V = 5 volt $\Rightarrow$ -5 volt.

From ohm law

$V = IR$

$I = V/R$

$= -5/10 \times 10^3$

$I = -0.0005A$

OR

$I = -0.5mA$

Hence power consumed by Resistor

$P = I \cdot V \Rightarrow -0.0005 \times -5$

$P = 0.0025W$

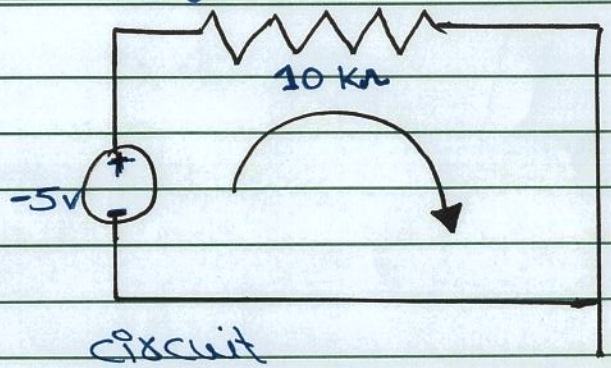
OR

$P = 2.5W$

Date:_____

(4)

(iii)



In above circuit

V = -5 volt

I = ?

P = ?

R = 10K ohm ⇒ 10×10^3 ohm

Solution:-

From ohm law

V = IR

I = V/R

$I = -5/10 \times 10^3$

I = -0.0005A

OR

I = -0.5mA

Power consumed

P = V·I

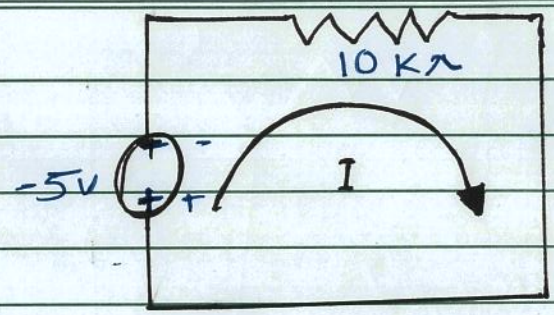
P = -5 x -0.0005

P = 0.0025 W

P = 2.5mW

Date:_____ (5)

(iv)



In above The direction / ~~polarity~~ polarity of voltage sorce changed hence we take

$\because V = -5 \Rightarrow -5V = -(-5)$

$\boxed{V = 5\ V}$

From ohm law

$V = IR$

$I = V/R$

$= -(-5) / 10 \times 10 \times 10^3$ ohm

$\Rightarrow I = 5/10 \times 10^3$

$\boxed{I = 0.0005A}$

OR $\boxed{I = 0.5mA}$

Hence power

$P = IV$

$P = 0.0005 \times 5$

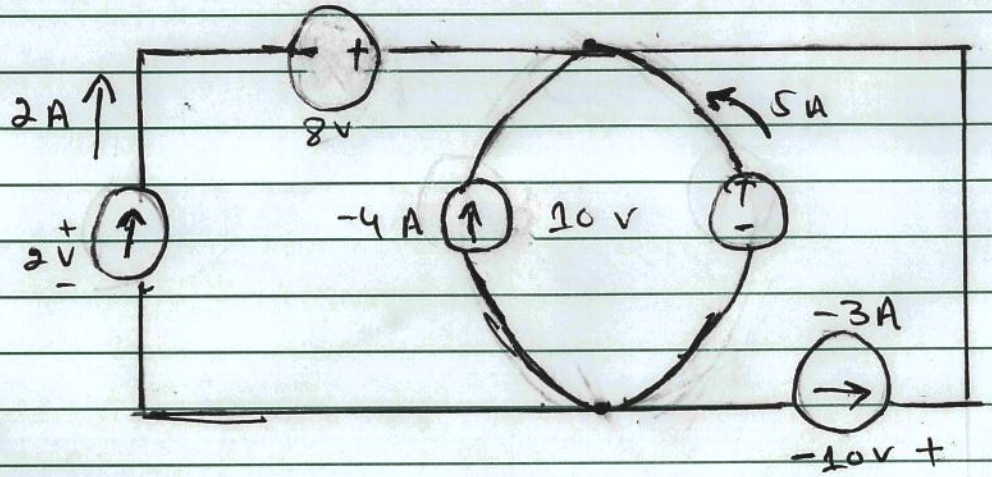
$\boxed{P = 0.0025\ w}$

$\boxed{P = 2.5\ mw}$

Q#1

Date: B (6)

B) Determine the Power supplied by the left most element in the circuit of fallwing figure.



Solution:-

The left most element of the circuit is the 2V voltage source. Here we have to calculate Power supplied by left most element i-e 2V source.

we know that:-

$$P = I \cdot V$$

Given $V = 2V$

$I = 2A$

$$\Rightarrow P = 2V \times 2A$$

$$P = 4W$$

P = 4W

This 4 watt power is supplied Power.

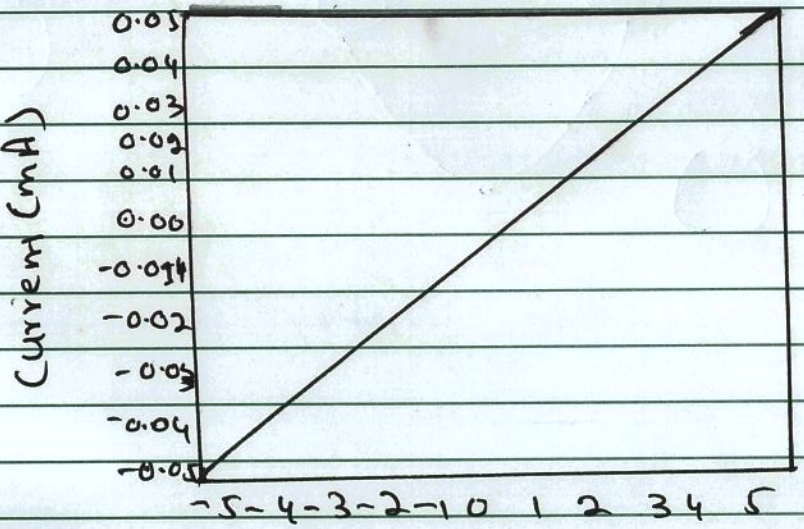
Q# 1

Date: C

(07)

C :- following figure depicts the current - voltage characteristic of three diffrent resistive element. Determine the resistance of each. assuming the voltage and current are difined in accordance with the passive sign convention.

(a)



SOLution:

We can Find Resistance From ohm Law

$V = IR$

$\Rightarrow R = V/I$ —(1)

above graph is ~~ten~~ Linear/constant we can take any point from The graph.

Date:_____

(08)

• Let

$I = 0.04mA = 0.04 \times 10^{-3}$

$V = 40\ V$

Put in (1)

(1) $\Rightarrow$ $R = V/I$

$= 40/0.04 \times 10^{-3}$

$= \frac{40}{0.00004}$

$R = 100000$

$R = 100 \times 10^3$ ohm

$\boxed{R = 100\ K\ ohm}$

~~in Fig (i)~~

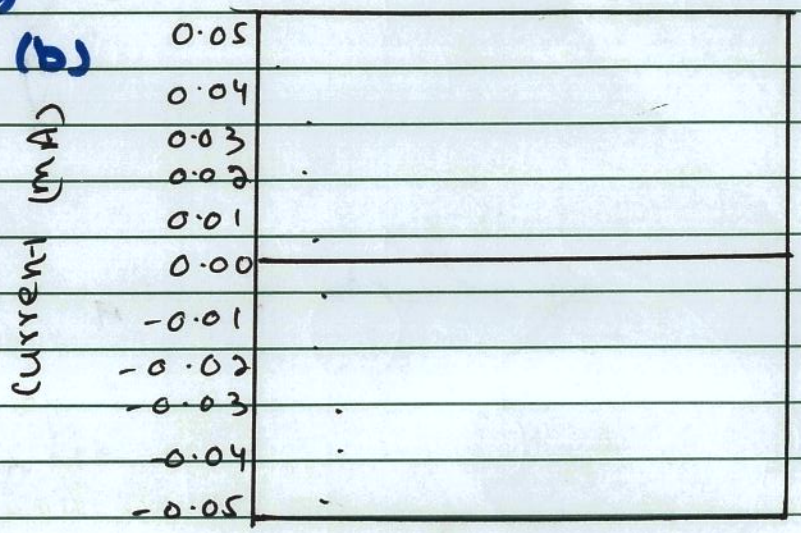
In Fig(i)

The resistor is 100 K ohm.

Date:_____

(09)

(b)



(b)

In above graph current(I) is zero.

We can take voltage from any point of Graph

Let

$V = 5$ volt

$I = 0$ mA $\Rightarrow 0$ A

From ohm law

$$R = V/I$$

$$R = 5/0$$

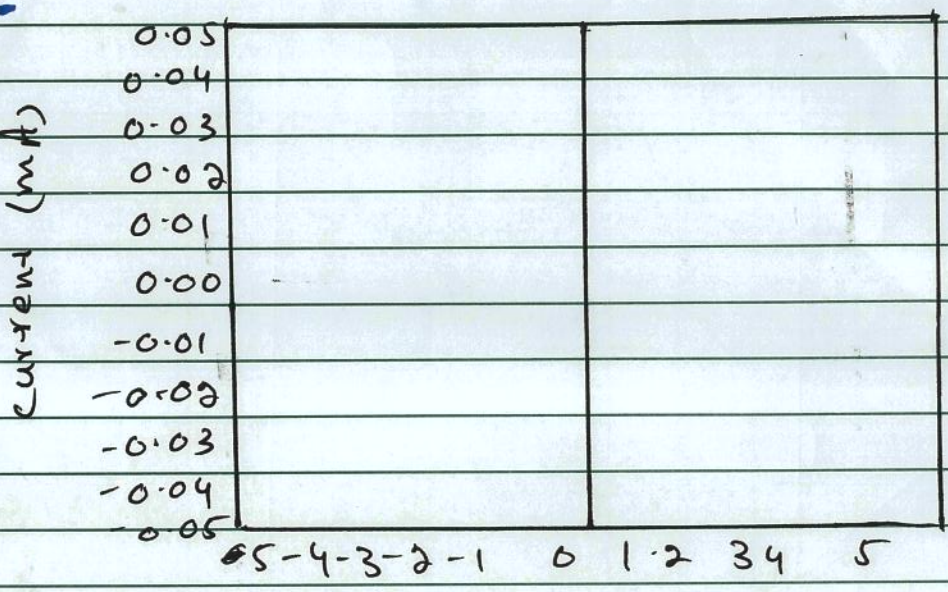
$$R = \infty$$ ohm

In above graph The current is zero and show infinite Resistance.

Date:_____

(10)

(c)-



(c)

In above graph voltage is zero V=0 we can take current from any point.

$V = IR$

$R = V/I$

$R = 0/0.05\,mA$

$\boxed{R = 0}$

above graph show zero resistor.

Date: **Question #2** **Part (A)**

(A)

2) a:- Refer to the circuits of following figure. and answer the following.

1) How many distinct nodes are containd in the circuits?

2) How many element are containd in the circuits?

3) How many branched does the circuit have?

4) Determine if each of the following represents a path, a loop, both, or neither!

(i) A to B

(ii) B to P to C to E

(iii) C to E to D to B to A to C

(iv) C to D to B to A to C to E

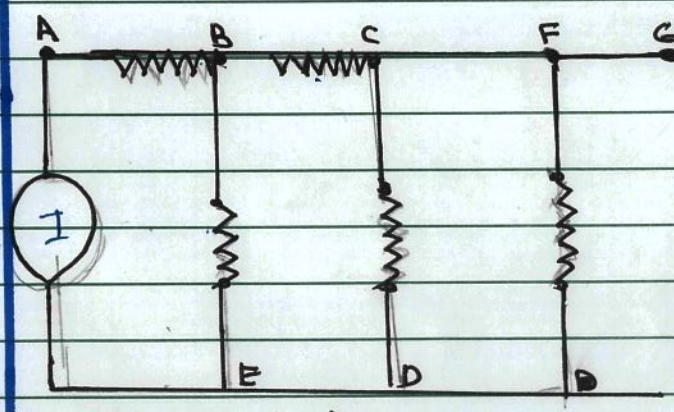


figure (a)

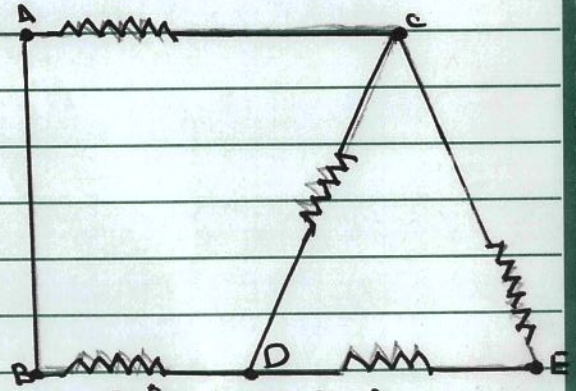


figure (b)

Date:_____

(1) By counting, we get that the number of nodes in the circuit is 4.

(2) Number of elements = 5 (5 resistor.)

(3) Number of branches in circuit is 5.

(4)

(i) Nither, we are on same node.

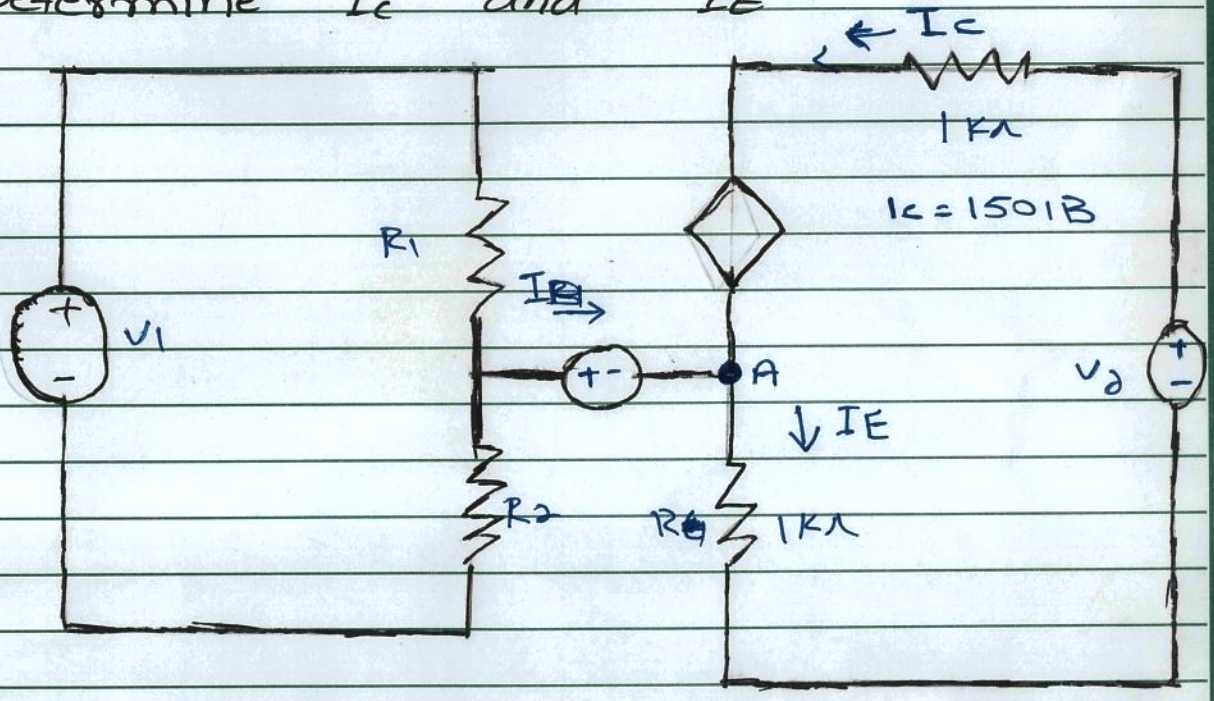
(ii) only path:
we are moved by 3 nodes & visit each once.

(iii) path & loop:
we moved by 4 nodes & the loop closed on "c".

(iv) Nither:
we visit node c twice but not finish in it.

Date: Q 2 B

Part :B: for the curcuit of the following (which is the model of the (DC) operation of a bipolar junction transister biased in the forward action regeion). I_B is measured to be 100μA. Determine I_c and I_E.



Solution:

We have to Find I_c & I_E

In order to Find These current we use Kirchhoff current low (KCL).

Date:_____

From KCL we know that

(1) Sum of all current in a node is equal to zero.

$$\sum_{i=1}^{n} I_n = 0$$

(2) OR

current intering node equal to current leaving node.

Now

From above Fig:-

Q Node A:-

I_B and I_C intering node but I_E leaving node.

$$I_B + I_C = I_E$$

OR

$$I_B + I_C - I_E = 0 \longrightarrow (i)$$

Given That

$$I_B = 100\,nA = 100 \times 10^{-9}\,A$$

$$I_C = 150 I_B$$

$$= 150 \times 100 \times 10^{-6} A$$

$$I_C = 0.015 A$$

Date:_____

To Find IE put value IB & IC on eq ①

① ⇒ $I_B + I_C - I_E = 0$

$I_E = I_B + I_C$

$I_E = 0.0001A + 0.015A$

$I_E = 0.0151\,A$

Result

$I_C = 0.015A$

OR $I_C = 15\,mA$

&

$I_E = 0.015A$

OR $I_E = 15.1\,mA$

→ ANS.

Date:_____

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Q3:-

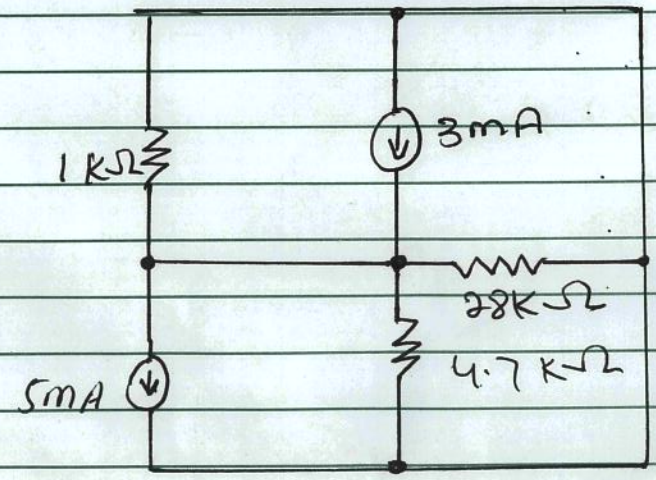
Part (a) :-

Although drawn so that it may not appear obvious at first glance, the circuit of following figure is in fact a Singel-node-Pair Cricuit.

a:- determine the Power absorved by each rasister.

b:- determine the Power supplied by each current Source.

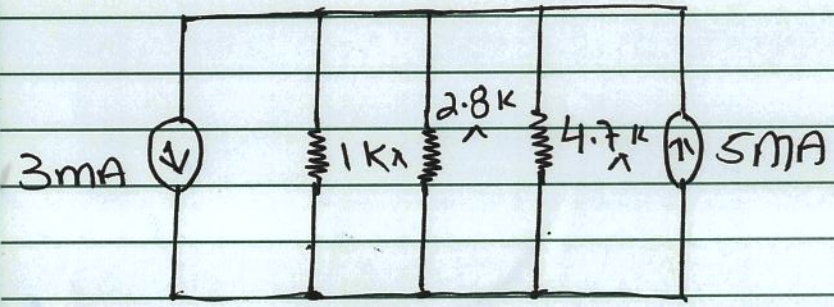
c:- Show that the Sum of the absorbed Power Calculated in (a) is equal to the Sum of the supplied Power Calculated in (b).



Date:_____

Solution!

by Re-constract Fig



The current sources & resistor are parallel to each other.

$I = -3 + 5$

$I = 2\,mA$

$$I = 2 \times 10^{-3} = 0.002\,A$$

NOW

$$\frac{1}{R_{eq}} = \frac{1}{1} + \frac{1}{2.8} + 4.7$$

$$= \frac{658 + 235 + 140}{658}$$

$$1/R_{eq} = \frac{1033}{658}$$

$$R = 658/1033$$

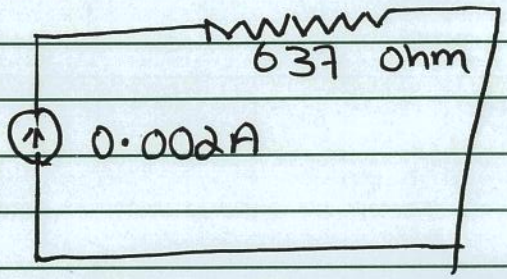
$$R = 0.637\ K\,ohm$$

$$R = 0.637 \times 10^{3}\ ohm$$

$$R = 637\ ohm$$

Date:_____

The Circuit be came



by Ohm law

$V = IR$

$= 0.002 \times 637$

$V = 1.27$ Volt

NOW

Power observed by 1K resistor

$P_{1K} = I_{1K} \times V$ —①

NOW $I_{1K} = V/R_{1K} = \frac{1.27}{1000}$

$I_{1K} = 0.0012A$

$P_{1K} = 0.0012A \times 1.27V$

$P_{1K} = 0.0016W$

OR → $P_{1K} = 1.6mW$

Date:_____

Power observed by 2.8 K resistor

$$I(2.8K) = V/R$$

$$= \frac{1.27}{2.8}$$

$$I(2.8K) = 0.45\ mA$$

$$\Rightarrow I(2.8K) = 0.00045A$$

NOW

$$P(2.8K) = 0.00045 \times 1.27$$

$$P(2.8K) = 0.00057\ W$$

OR

$$P(2.8K) = 0.57\ mW$$

Power by 4.7 K resistor

$$I(4.7K) = V/R = \frac{1.27}{4.7}$$

$$I(4.7K) = 0.27\ mA$$

$$I(4.7K) = 0.00027\ A$$

NOW

$$P(4.7K) = 0.00027 \times 1.27$$

$$P(4.7K) = 0.000343W$$

OR

$$P(4.7K) = 0.343\ mW$$

Date:_____

NOW

Power ~~outlet~~ supplied by 5mA source

$P(5mA) = I.V$

$= 5 \times 10^{-3} \times 1.27$

$= 0.005 \times 1.27$

$P(5mA) = 0.0063W$

OR $P(5mA) = 6.3mW$

~~$P(5mA)$~~

Power supplied by 3mA source.

$P(3mA) = -3 \times 10^{-3} \times 1.27$

0.003×1.27

$P(3mA) = -0.0038W$

OR $P(3mA) = -3.8mW$

NOW

Power observed by 'R' = power supplied.

$1.6mW + 0.57mW + 0.343mW = 3.8mW + 6.3$

$= 6.3mW - 3.8mW$

$2.5 = 2.5$ → Proved

Power observed = power supplied.

Q 3 (B) (21) Part (B)

Date:

(B) Determine the Power absorved by the 15Ω resister in the circuit of the following figure.

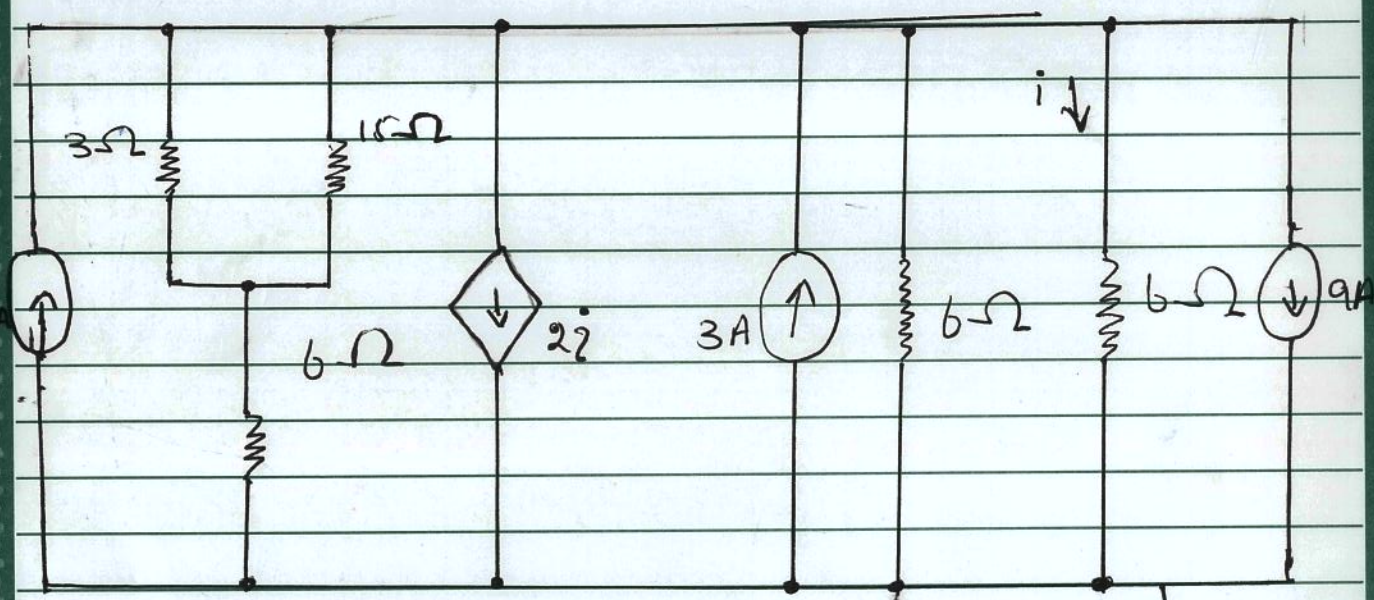


Fig (i)

Solution:-

In order to Find Power obsevred by 15 ohm resistor we need voltage & current

As

$$P = I.V$$

or

$$P = V^2/R$$

Date:_____

In above Fig all current source are parallel to each other, so we can add them

$$I_{(total)} = 4 - 2i + 3 - 9$$
$$7 - 9 - 2i$$
$$I_{(total)} = (-2 - 2i)$$

and also,

3Ω & 15Ω Resistors are parallel to each other but in series to 6Ω

Now

The equivalent resistor of these three resistor given by

$$R = \left(\frac{3 \times 15}{3+15}\right) + 6$$

$$R = \frac{45}{18} + 6$$

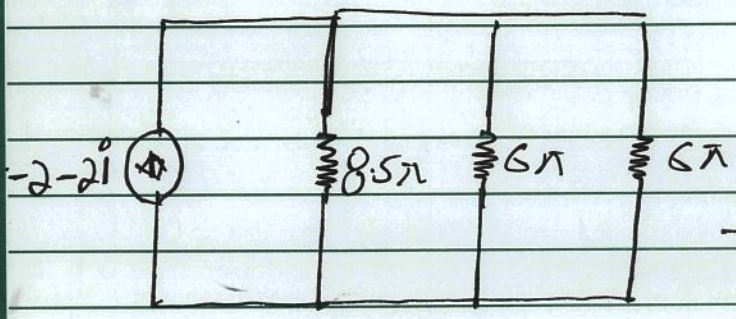
$$2.5 + 6$$

$$\boxed{R = 8.5 \text{ ohm}}$$

(23)

Date:_____

Now The Fig became



→ Fig (ii)

In Fig (ii) all resistor are parallel to each other.

$$\text{Now } \frac{1}{R_{(eq)}} = \frac{1}{8.5} + \frac{1}{6} + \frac{1}{6}$$

$$= \frac{12+17+17}{102}$$

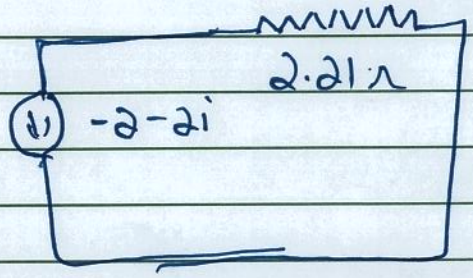
$$\frac{1}{R_{(eq)}} = 46/102$$

$$R_{(eq)} = 102/46$$

$$R_{(eq)} = 2.21 \text{ ohm}$$

Date:_____

Now we can draw Fig (ii) as:



From ohm law

$$V = IR$$

$$V = (-2-2i) \times (2.21\Omega) \longrightarrow *$$

Now the voltage across 6Ω resistor,

$$V = IR \Rightarrow V = i \times 6$$

$$V = 6i \longrightarrow (1)$$

The voltage across 6Ω resistor & across circuit will be same because it's parallel circuit. so its mean that

$$-2-2i \times (2.21) = 6i$$

$$-4.42 - 4.42i = 6i$$

$$-4.42 = 6i + 4.42i$$

$$10.42i = -4.42$$

$$I = \frac{-4.42}{10.42}$$

(25)

Date:_____

$$I = 0.42A$$

This (0.42A) current through 6 ohm resistor

$$\Rightarrow \quad V = 6I$$

$$V = 6 \times (0.42)$$

$$\boxed{V = -2.5V}$$

NOW

To calculate power observed by 15 ohm resistor we have to find votage across it. This (-2.5V) is not used for this resistor b/c there is 6 ohm resistor in series with 15 ohm resitor.

$$V_{(15\Omega)} = \frac{15}{6+15} \times V$$

$$= 0.714 \times 2.5$$

$$V_{(15\Omega)} = 1.78\ V$$

$$P_{(15\Omega)} = (1.78)^2 / 15$$

$$= 3.18 / 15$$

$$\boxed{P_{(15\Omega)} = 0.212\ W} \rightarrow \text{ANS.}$$

THE END