

Unit - 4

Electricity

1) With the help of a circuit diagram derive the formula for the resultant resistance of three resistance connected.

a) Resistor in series:-

E-

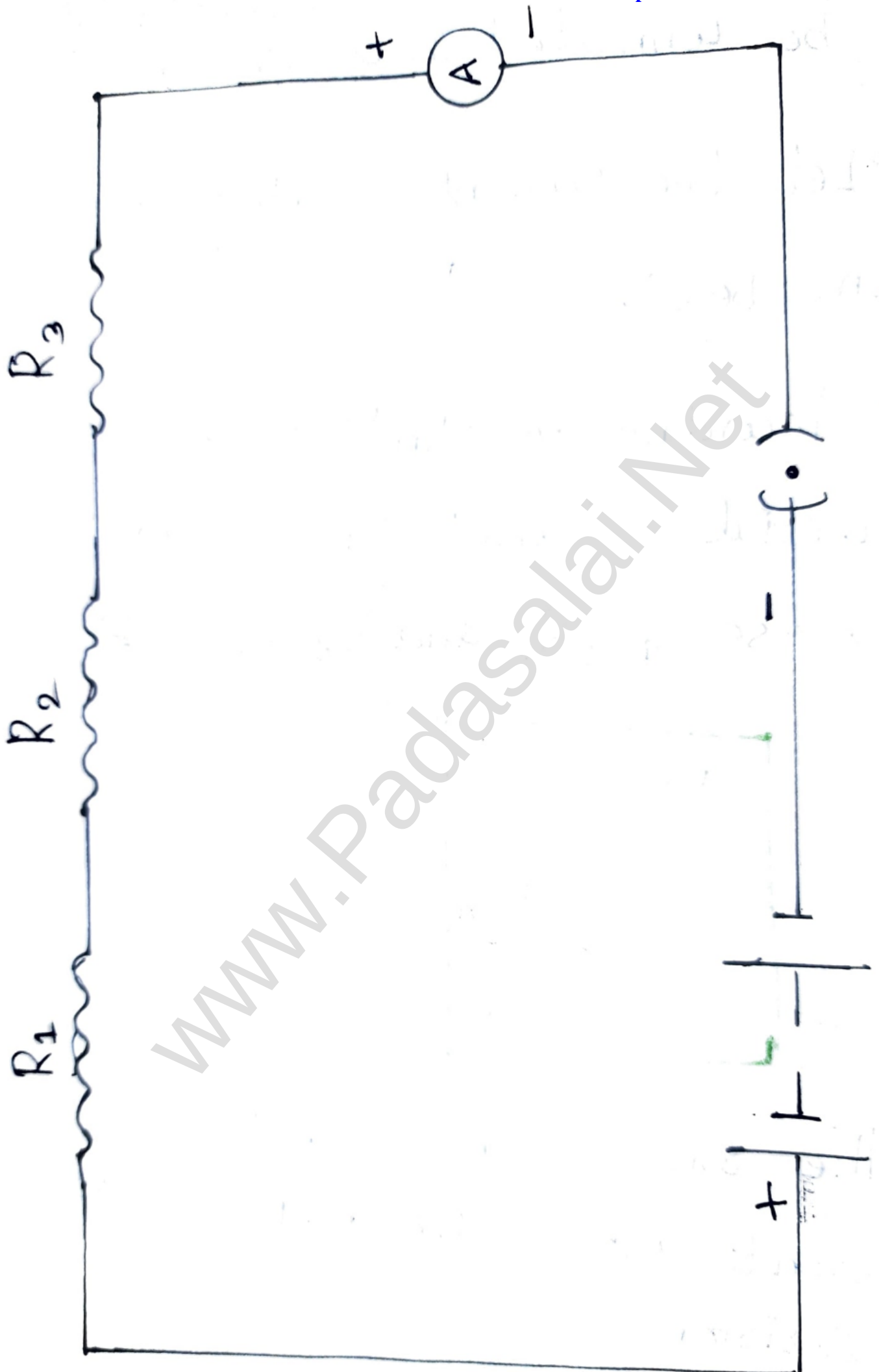
* Let three resistances R_1 , R_2 and R_3 be connected in series.

* Let the current flowing through them be I .

* According to Ohm's Law, the Potential different V_1 , V_2 , and V_3 across R_1 , R_2 and R_3 respectively

$V_1 = I R_1$	- - - ①
$V_2 = I R_2$	- - - ②
$V_3 = I R_3$	- - - ③

The sum of the Potential different across the end of each resistor



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$$V = IR_1 + IR_2 + IR_3 \quad \dots \quad (4)$$

The effective resistor is a single resistor which can replace the resistors effectively.

Let the effective resistance of the series - combination of the resistors be R_s .

$$V = IR_s \quad \dots \quad (5)$$

Combining equation (4) and (5) we get.

$$IR_s = IR_1 + IR_2 + IR_3$$

$$R_s = R_1 + R_2 + R_3 \quad \dots \quad (6)$$

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Thus, when Number of resistors are connected in series their equivalent resistance or effective resistance is equal to the sum of the Individual resistances.

When 'n' resistors of equal resistance R are connected in series the equivalent resistance is 'n R'

$$\text{i.e., } R_s = nR$$

The equivalent resistance in a series combination is greater than the highest of the Individual resistances.

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Resistor in Parallel:-

* Consider that three resistors R_1 , R_2 , and R_3 are connected across two common points A and B

* The potential difference across each resistance is the same and equal to the Potential difference between

A and B

* The current I arriving at A divides into three branches I_1 , I_2 , and I_3 passing through R_1 , R_2 and R_3 respectively.

According to the ohm's law we have.

$$I_1 = \frac{V}{R_1}$$

--- (1)

$$I_2 = \frac{V}{R_2}$$

--- (2)

$$I_3 = \frac{V}{R_3}$$

--- (3)

(38)

The total current through the circuit is given by

$$I = I_1 + I_2 + I_3$$

using equation (1) (2) and (3) we get

$$I = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \quad \text{--- (4)}$$

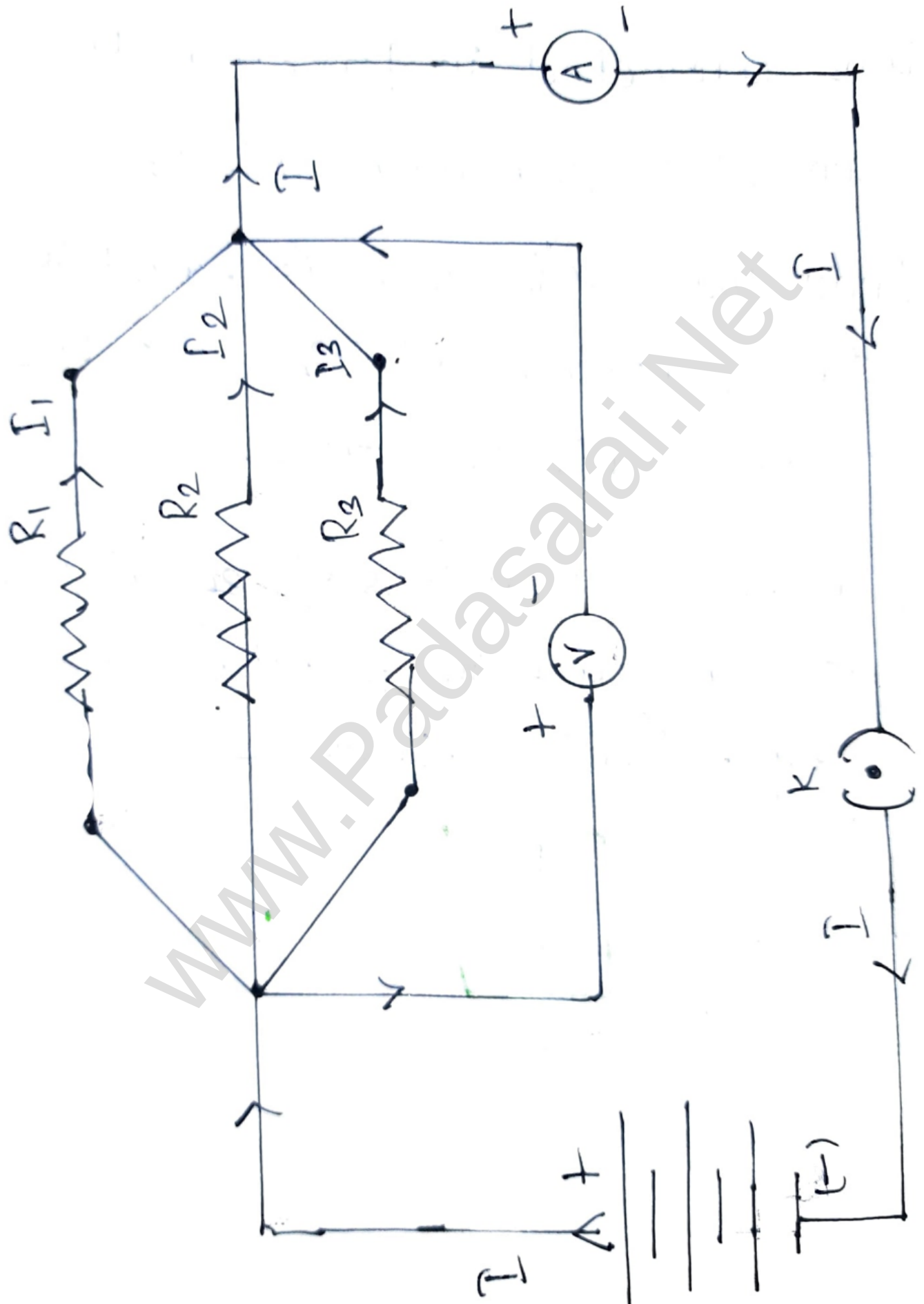
Let the effective resistance of the Parallel combination of resistors be R_p . Then

$$I = \frac{V}{R_p} \quad \text{--- (5)}$$

Combining equation (4) and (5) we get have.

$$\begin{aligned} \frac{V}{R_p} &= \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \\ \frac{1}{R_p} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \quad \text{--- (6)} \end{aligned}$$

Parallel connection of resistors.



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* Thus when a Number of resistors are connected in Parallel the sum of the reciprocals of the Individual resistances is equal to the reciprocal of the effective or equivalent resistance.

* When 'n' resistors of equal resistances R are connected in Parallel the equivalent resistance is

$$\frac{R}{n}$$

$$\text{A1) } \frac{1}{R_p} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} \dots + \frac{1}{R} = \frac{n}{R}$$

$$\text{Hence, } R_p = \frac{R}{n}$$

* The equivalent resistance in a parallel combination is less than the lowest of the individual resistances.

2) a) What is meant by electric current?

Electric current is defined as the rate of flow of charges in a conductor.

$$I = \frac{Q}{t}$$

(12)

b) name and define its unit

* The SI unit of electric current is ampere

* When a charge of one coulomb flows across any cross section of a conductor in one second.

$$1 \text{ ampere} = \frac{1 \text{ Coulomb}}{1 \text{ second}}$$

c) which instrument is used to measure the electric current?

How should it be connected in a circuit?

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Instrument : Ammeter

- * The Ammeter is used to measure the current
- * An Ammeter is connected in series with the circuit.
- * The Ammeter is a low impedance device connecting it in parallel.
- * The circuit would cause a
 - * Short circuit
 - * damaging
- * The Ammeter or the circuit.

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3) a) state Joule's law of heating.

Joule's law of heating states that the heat produced in any resistor is :

- * Directly Proportional to the square of the current passing through the resistor.
- * Directly Proportional to the resistance of the resistor.
- * Directly Proportional to the time for which the current is passing through the resistor

$$H = I^2 R t$$

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b) An alloy of Nickel Chromium is used as the heating element. Why?

- * It has high resistivity
- * It has a high melting point
- * It is not easily oxidized.

c) How does a fuse wire protect electrical appliances?

- * When a large current passes through the circuit, the fuse wire melts due to Joule's heating effect and hence the circuit gets disconnected.

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* Therefore the circuit and the electric appliances are saved from any damage.

4) Explain about domestic electric circuits (circuit diagram not required)

The first stage of the domestic circuit is to bring the power supply to the main-box from a distribution panel such as a transformer main box !.

* Fuse box

* Meter

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Fuse box! -

* It contains either a fuse wire or a miniature circuit breaker

(MCB)

* It is used to protect the house hold electrical appliances from overloading due to excess current.

* An MCB has a spring attached to the switch, which is attracted by an electromagnet when an excess current passes through the circuit.

* It is activated automatically as well as manually.

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Meter:-

It is used to record the consumption of electrical energy.

Insulated wire

* The electricity is brought to houses by two Insulated wire

* One wire has a red insulation and is called is live wire.

* The other wire has a black insulation and is called the
'Neutral wire'

A9

* Both the live wire and the Neutral wire enter into a box where the main fuse is connected with the live wire.

* After the electricity meter these wires enter into the main switch, which is used to discontinue the electricity supply when required.

* Then, these wires are connected to live wires of two separate circuits.

5A rating circuit

* It is used to run the electric appliances with a lower power rating such as

(50)

* tube light

* bulbs

* fans

15 A rating circuit

* It is used to run electric appliances with a high power rating such as ~~air~~

* air conditioners

* refrigerators etc...

* The electricity supplied to our house is actually an alternating current having an electric potential of

220 V.

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5) a) what are the advantages of LED TV over the Normal TV?

- * It has brighter picture quality
- * It is thinner in size
- * It uses less power and consumes very less energy
- * Its life span is more
- * It is more reliable

b) List the merits of LED bulb :-

- * A there is no filament, there is no loss of energy in the form of heat. It is cooler than the Incandescent bulb.

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- * In ^{Comparison} comparison with the fluorescent light, it has significantly low power requirement
- * It is Not harmful to the environment
- * A wide range of colours is possible here
- * It is cost-efficient and energy efficient
- * mercury and other toxic materials are not required.